

doi:10.25143/prom-rsu_2016-12_dts



RĪGAS STRADIŅA
UNIVERSITĀTE

Andrejs Ivanovs

**ANALYSIS OF RISK FACTORS
FOR THE PREVALENCE
OF TUBERCULOSIS IN LATVIA**

Summary of Doctoral Thesis
for obtaining the degree of a Doctor of Sociology
Speciality – Sociology

Riga, 2016



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Defence of the Doctoral Thesis will take place at the public session of the Doctoral Council of Sociology on 30 November 2016 at 15.00 in 26a Anniņmuižas Boulevard, Riga, in the Conference hall.

The Doctoral Thesis is available at the library of Rīga Stradiņš University and on the website of RSU: www.rsu.lv



IEGULDĪJUMS TAVĀ NĀKOTNĒ



The elaboration of the Doctoral Thesis is financially supported by the European Social Fund within the limits of the grant “Support for the doctoral students for the study program and acquisition of the doctoral degree.”

Secretary of Promotion Council:

Dr. sc. soc., Assistant Professor **Agita Lūse**

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USED ABBREVIATIONS

ASA – American Sociological Association

B – B coefficient of regression

BCG – Bacillus Calmette–Guérin

BMI – Body Mass Index

CDPC – The Centre for Disease Prevention and Control

CTLD – Centre of tuberculosis and lung diseases

CSB – Central Statistical Bureau

DOTS – Directly Observed Treatment, Short-Course

EU-Silc – European Union Statistics on Income and Living Conditions

Fig. – Figure

HIV – Human Immunodeficiency Virus

LVL – Latvian Lats

LU – University of Latvia

n – Number of respondents

OR – Odds Ratio

p – Propability

PAF – Population attributable fraction

RSU – Rīga Stradins University

SE – Standart Error

TB – tuberculosis

USSR – The Union of Soviet Socialist Republics

WHO – World Health Organization

95% CI – 95% Confidence Interval

INTRODUCTION

TB is a bacterial disease that most commonly affects lungs. *Bacillus Mycobacterium tuberculosis* causes TB in humans. Infection mostly gets into human bodies with droplets as the result of the direct contact (Vīksna, 2011; Millet, et al., 2012). A person having TB annually infects 10 people; two out of them can develop active form of TB (Narasimhan, et al., 2013).

Despite the medical progress and social policies, Tuberculosis (TB) is an outstanding problem and remains a widespread disease of the World. According to the WHO, 8.6 million people in the World fell ill with TB in 2012 (1.4 mill. died) (WHO, 2013), 9.0 million people – in 2013 (1.5 mill. died) (WHO, 2014), but 9.6 million people - in 2014 (1.5 mill. died) (WHO, 2015).

TB is the second most important cause of death following HIV/AIDS. 95% of TB's deaths occur in countries of low or moderate income level. During the period from 1990 to 2012, the world mortality from TB has declined by 45% (WHO, 2014). The WHO Assembly resolution declared TB as a worldwide public health problem in 1991 (WHO, 1991).

Since 2001 epidemiological situation of TB in Latvia has generally improved – morbidity has declined; however, in 2012 morbidity increase in Latvia was registered – 43.0 cases per 100,000 inhabitants. In 2013 morbidity decreased again, amounting to 38.3 cases per 100,000 inhabitants, but in 2014 and in 2015 the morbidity rate continued to decrease to 31.3 cases per 100 000 (SPKC, 2016). Quality treatment (DOTS) and diagnostics options, reimbursed by the State, are available for the population in Latvia. Despite that, TB morbidity rates in Latvia are still among the highest in Europe, leaving behind only Lithuania and Romania.

The high prevalence of TB in Latvia causes economic and social consequences. Healthcare specialists attribute these negative effects to the

lengthy treatment of TB that results in direct and indirect losses to both the individual and state.

In most cases the consequences of TB are measured by the direct expenses for the treatment of patients, including drugs and personnel (Tanimura, et al., 2014). Due to the long duration of TB treatment, it tends to be more expensive on average than treatment of other illnesses, nevertheless according to the Regulation of Cabinet of Ministers No. 413, adopted on 14 June, 2005, it has been included in the list of (Latvijas Vēstnesis, 2005) diseases for which the treatment is fully covered by the state. Therefore TB patients in Latvia do not suffer from direct losses due to the costs of treatment in comparison to other countries (Wilkinson, et al., 1997).

According to the data of the National Health Service, in 2015 treatment of TB inpatients costed 5.5 m euros to the state budget – 4.8 m euros were allotted to the hospitals, but 0.685 m euros in compensations. When dividing the total amount of 1724 hospitalizations in 2015, we can see that hospital treatment of every patient costed 3191 euros for the state, whereas the costs of the treatment of patients with multi-drug resistant TB amounted to 10288.8 euro.

Direct losses of TB treatment also include travelling expenses to the hospital or outpatients clinic. Some municipalities in Latvia cover the travelling expenses, for example, Riga municipality (Brice, 2012) and Daugavpils municipality (Latvijas Vēstnesis, 2005), but the majority of municipalities do not offer this additional support.

There are also indirect economic losses to the individual or his family members in regards to disability during the treatment period (Tanimura, et al., 2014) or a lower productivity during outpatient care (Rajeswari, et al., 2010). These type of losses mostly concern the able-bodied population, as TB most often affects the economically active (aged 15 – 54) (Kim, et al., 2007), and in Latvia these are mostly 35 – 55-year-olds (SPKC, 2016).

The size of the indirect losses for an individual depend on the state's social policy. Disability allowance reduces the indirect economic losses caused by TB. The Latvian state partly compensates (75 – 80%) the individual's income during the period of sickness (Latvijas Vēstniešis, 1997). During the treatment, patients are given a sick leave certificate B and receive a disability allowance. Although it decreases the indirect losses of the patient, it also results in a burden for the social budget, especially if the treatment lasts for more than 6 months or the person is declared as disabled, therefore creating an even greater financial burden on the social budget and reducing the budget tax revenue from individual's income.

In addition to the financial losses TB also causes psychological and social issues. During the lengthy treatment, TB patients are separated from their families and relatives or they can lose their job. TB is seen as a disease of the poor and homeless by the general public. This type of discrimination may lead to depression and decreased quality of life.

A distinction between two concepts should be made – latent TB where someone is infected with *M. tuberculosis*, but does not have TB disease (no losses are caused), and active TB when bacteria overcome the defences of the immune system, resulting in the progression from latent TB infection to TB disease. Around 1/3 of the world's population has latent TB (WHO, 2013), but the ratio of the infected people varies between countries. In African countries this ratio may even be 95%, whereas in Europe it is up to 5%. About 5 to 10% of infected persons will develop TB disease at some time in their lives due to the TB risk factors. If the impact of the risk factors is decreased, so is the risk of morbidity. Therefore in order to decrease the direct and indirect losses caused by a high prevalence of TB both for the individual and the state, it is necessary do develop and implement a comprehensive program for combating TB, taking into consideration both the micro and macro TB risk factors and their influencing risk conditions.

The importance of TB risk factors and risk conditions is confirmed by historical examples. In the second half of the 19th century and the first half of the 20th century, even before the discovery of TB medications, morbidity and mortality rates of TB in Europe were constantly decreasing due to not only the isolation of TB patients in sanatoriums and hospitals (Wilson, 2005), but also because of housing, hygiene and sanitation improvements, better diet and access to clean water (Lienhardt, 2001).

Big hopes of combatting TB were pinned to BCG vaccine discovered in 1921, nevertheless the protective effect was proven to be limited. In 1943 the first anti-TB drug *streptomycin* was discovered, in 1950's chemotherapy was introduced, and as a result TB become a curable disease, raising hopes of its complete eradication (Lönnroth, et al., 2009).

Anti-TB drugs undoubtedly helped to decrease TB morbidity at a faster rate in the 1950's and 1960's, nevertheless we should take into consideration that during this period people's well-being considerably increased, as well as economy improved, resulting in better housing, better nutrition and work conditions. Therefore the progress in combatting TB can be attributed to medical breakthroughs, as well as improvements in public health, economy and social sphere (Navarro, et al., 2006).

Nowadays risk factors of TB mortality are being widely studied around the world, and we are aware of the range of possible risk factors, however in each country there are different risk factors or their impact may be varied due to economic, social and cultural peculiarities. TB mortality risk factors are being researched in epidemiology and medical sociology. Some scientists believe that both of these scientific branches deal with determinants of health, and that the boundaries between the social epidemiology and medical sociology are relative (Faresjö, 1992; Zielbertus & Kiemeny, 2001). However, Christian Lienhardt draws a line between the two:

- The aim of the *epidemiological approach* is to identify the genetic, biological and social risk factors in order to reduce the morbidity risk at an **individual level**.
- The sociological approach attempts to understand the complex connection between socioeconomic factors and causes of morbidity in order to decrease the morbidity risk at the **level of society**.

The thesis has been developed in the field of medical sociology, which is a separate sub-branch of sociology and provides analytical basis for the understanding of health, disease and healthcare contexts. The main fields of research of medical sociology are (ASA, 2012):

- The subjective experience of health and sickness of an individual, as well as individual's general attitude towards disease and health
- Medicine and healthcare as a social institution
- Social, political, economic and ecological conditions that contribute to the deterioration of individual's health or increase of disease risk

In the framework of the latter research field, medical sociology aims to analyse disease risk factors by searching for connections between health or disease and the social, economic and environmental processes in the society by implying methods of sociological theory and research. Typical research includes the impact of ethnicity, age, gender, socioeconomic status, behavioural and other factors on disease risk (U.S. National Library of Medicine, 2012). The thesis is developed in the framework of the latter research field and may be formulated as follows:

The aim of the study:

To reveal the impact of risk factors of TB in Latvia.

The tasks:

1. To gather and analyse theoretical materials on models of health influencing factors and to choose the most appropriate for the thesis.
2. To gather and analyse data of scientific research on TB risk factors in the framework of the Four layers of health determinants model.
3. To find out the socio-economic profile of TB patients in Latvia and compare it to the data of Latvian population.
4. To find out which are the risk factors that affect TB morbidity in Latvia the most.
5. To develop recommendations for TB prevention regarding risk conditions and risk factors.

Hypothesis:

The most significant risk factors of TB morbidity in Latvia are the bad habits of the individual, whereas biological and psychosocial risk factors are of secondary importance.

Novelty and practical importance of the study:

Although TB risk factors have been widely studied in the world, **no scientific research has been done** in Latvia. Such research would allow to determine risk factors for TB that are especially relevant in Latvia, to forecast the spread of the disease, as well as to plan preventative measures. The only institution that gathers information on TB risk factors is CDPC which has created the National Tuberculosis Registry. Since 1997 it has gathered information on patients' risk factors without further data analysis.

This research in the framework of the **Four layers of health determinants model** (Dahlgren & Whitehead, 1991) is the first attempt to not only gather and analyse the most important risk factors that directly increase the disease risk at an individual level, but to also include risk conditions with

have mediated effects on the disease risk via risk factors in the analysis. This type of separation of risk conditions and risk factors has been done for the first time and was not practised in the analysis of TB determinants in Latvia.

Within the framework of the chosen health determinant model, information was gathered on **risk conditions** affecting each of the risk factors. This allows to better understand the causes of risk factors, thus helping to reduce their impact. The scheme of TB risk factors and risk conditions is also a novelty for the analysis of TB risk factors in Latvia, as until now the National Tuberculosis Registry gathered data on a one dimensional level – “risk factor – disease”, but the scheme, based on the research results of the thesis, explains the importance of the each risk factor in more detail, as well as which risk conditions affect the particular risk factor the most.

Information on the **psychological health** of TB patients during the treatment, as well psychosocial risk factors has been gathered and analysed in this thesis for the first time. In Latvia no researches on the psychological state of TB patients before or after getting ill has been conducted. The thesis is also the first attempt to estimate the importance of psychosocial factors in developing TB.

Based on the results of this research on most significant risk factors and the risk conditions influencing them, **practical recommendations** on how to combat TB more effectively were developed.

1. ANALYSIS PRINCIPLES OF FACTORS AFFECTING DISEASES

1.1. Health and Disease in Sociological Perspective

Nowadays health is one of the fundamental values for the individual and society. It not only affects person's material status, but also social status and well-being. Deterioration of public health may be a threat to social stability and social development.

To define health and analyse health related processes two models are mostly used. **The biomedical model** is the currently most used model by doctors for disease diagnostics. According to this model, "health constitutes the freedom from disease, pain, or defect" (Annandale, 1998). This model prescribes direct treatment of a disease – clinical diagnostics and medical intervention to treat symptoms, whereas disease prevention and health promotion are of secondary importance (Shi & Singh, 2013).

The **biopsychosocial model** studies three aspects of health – physical, psychological and social factors that determine health and disease treatments. In 1948 Constitution of the WHO adopted a definition for the concept of health that may be attributed to this model. Health is defined "as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1948, p. 1).

In 1968, Ottawa Charter for Health Promotion elaborated on the definition adopted in 1948, emphasizing that health means "to reach a state of complete physical mental and social well-being, an individual or group must be able to identify and to realize aspirations, to satisfy needs, and to change or cope with the environment. Good health is a major resource for social, economic and personal development and an important dimension of quality of life." (WHO, November 17–21, 1986, p. 1).

É. Durkheim, T. Parsons and E. Goffman were pioneers of sociological research. One of the first theoretical conceptions that included concepts of health and disease, is **Émile David Durkheim's deviance theory** according to which any society with existing social norms has to face violations of these social norms – deviances. According to the deviance theory, all diseases are **deviances** (Дюркгейм, 1995).

Sociologist **Talcott Parsons**, a representative of USA's structural functionalism, author of *role theory*, treats health as “the optimum capacity of an individual for the effective performance of the roles and tasks he has been socialised”. Whereas disease is application of the sick role (Parsons, 1975). In the case of not performing one's duties, individual's behaviour is seen as being deviant, but in contradiction to Durkheim, Parsons does not consider disease itself as a deviance, but the individual's behaviour that does not correspond to the sick role.

Robert King Merton also believes that not all individuals with health problems should be considered as deviant, but only the ones who do not engage in 5 ways of adaptation which help to achieve the goal set by the society – good health – conformity, innovation, ritualism, retreatism and rebellion (Мертон, 1966). Retreatism and rebellion are often regarded as deviations.

Another group of sociologists view disease as a **risk**. The term risk was introduced in sociology from the **social risk theory**. Risks were closely studied by sociologists **Anthony Giddens** and **Ulrich Beck**.

By gathering criteria of risks determined by both of the aforementioned authors, we can outline four basic criteria that can attribute an event or occurrence to social risks:

1. *Probability of the occurrence of an event* – the negative event may take place or might not happen.

2. *The potential losses* for the individual, social group or society as a result of risk realization – deterioration of health, losing a job, family disintegration, etc.
3. *Actions needed to neutralize the risk* – the risk must be mitigated or neutralized by the society, a social group or individual behaviour.
4. *Influencing factors* – individual, group, or environmental factors which can change the probability of the occurrence of an event.

Getting ill, including development of TB, may be regarded as a **social risk**, as it characterised by all the four aforementioned basic criteria – the probability of the occurrence of an event – a person may or may not become ill in his lifetime; negative consequences for the individual or society – physical deterioration, pain, physical function limitations, etc.; necessary actions to reduce the social risk – strengthening immunity, compliance with doctor’s recommendations, etc., but at the macro level it is maintenance of health institutes, implementation of health promotion programs etc.; the presence of influencing factors – health influencing factors can increase an individual’s risk of a disease, therefore there is a need for disease risk control programs.

1.2. Health Determinants

Evaluation of morbidity risk and disease risk factors have nowadays become one of the main topics in medical sociology and public health (Gabe, et al., 2004). Nowadays the most prevalent diseases may more or less be linked to the individual’s lifestyle – bad habits and unhealthy diet increase the risk of chronic diseases (Решетников, 2010). WHO recognizes that the person’s health is affected by genetic, environmental, social and economic factors which are related to the person’s well-being, living conditions, income, family life, education, quality of life, and to a lesser extent – medical help (WHO, 2005). The importance of social and economic factors in regards to health has been

stated in the Ottawa Charter for Health Promotion “Prerequisites for health are peace, shelter, education, food, income, a stable eco-system, sustainable resources, social justice, and equity” (WHO, November 17–21, 1986).

Medical sociologists also study the impact of various social factors on the health of the individual and disease risk. The British medical sociologist **William Cockerham** is convinced that social class or socioeconomic status of the individual “is one of the strongest predictors of health, disease causation, and longevity”, also in interaction with other factors. (Cockerham, 2007). According to Giddens (2009), individuals belonging to a higher social status are healthier, stronger and live longer.

Sociologists attribute the differences in disease risk between different social strata to the existing **inequality**. According to the theory of unequal distribution of resources, two individuals with the same health indicators may have a different disease risk (Решетников, 2010).

The aforementioned theory is closely connected to *the Theory of Class Distinction* and allows to study health depending on the individual’s or group’s social position. The French sociologist **Pierre Bourdieu** claims that the social structure, by determining individual’s social position, is largely connected to health and well-being (Bourdieu, 1986).

In the context of risk, TB may be characterised as a consequence of **social inequality** or structural violence against individual’s rights and health (De Maio, 2010). This connection may be explained by individual’s behaviour models, stating that individuals who belong to lower social class, are more likely to exhibit health damaging behaviour (Giddens, 2009). At the same time individual’s choice is affected by structural and social conditions and factors influencing individual’s behaviour (Nettleton, 2006).

It needs to be emphasized that both individuals characterizing influencing factors – lifestyle, behaviour, diet and culture, as well as the

structural influencing factors – income levels and poverty have an important role in explaining the social origins of health and disease.

In the case of health influencing risk factors, it is more accurate to use the more narrow term **health determinant** instead of **influencing factor**. Health determinant is a range of factors and conditions, which directly affects individual's health by strengthening or deteriorating it (Shi & Singh, 2013).

Health determinants can leave both negative and positive impact on health. **Protective factors** have a positive impact – they strengthen human health, increase the body's defences. **Risk factors** impact health in a negative way – they worsen human health, thereby increasing the risk of disease or even provoking premature death (Барг & Лебедева-Несебря, 2012).

Risk factor is one of the most important terms in both medical sociology and epidemiology. “A risk factor is any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury”. (WHO, 2009). A risk factor does not necessarily cause the disease, but only increases the **probability** or **risk** of developing a disease.

1.3. Major approaches in the analysis of health determinants

Nowadays there are three main health promoting approaches that analyse health determinants from three different viewpoints:

- **Medical (traditional) approach** analysis health as a non-existence of a disease.
- **Behavioural (Lifestyle) approach** analysis health as the result of individual's chosen lifestyle.
- **Socio-Environmental (Structural) approach** analyse health as the result of interactions and impact between social, economic and environmental factors.

Each of the approaches has its advantages and disadvantages, they all indicate different health determinants, and each has its own explanation for the cause of a disease, nevertheless these three approaches have a significant role in health promotion.

According to the **medical approach**, health is defined as a non-existence of a disease or disability and health determinants are connected to the potential cause of the disease – infection, low BMI, weak immune system, high blood pressure or cholesterol level etc. Healthcare related activities are mostly carried out in a doctor's practice, out-patient clinics or hospitals and the main actors are doctors, nurses and other healthcare workers who mostly dedicate their efforts to the treatment of a disease instead of preventative care (Labonte, 1993). In the medical approach preventative healthcare means fighting causes of a specific disease – trying to prevent, foresee and timely diagnose it instead of improving one's general health. This is the biggest drawback of the medical approach – the fact that it concentrates on particular diseases and does not analyse the human body as a single system.

Nevertheless the preventative measures prescribed by the medical approach are beneficial to the individual. For example, regular blood pressure and cholesterol tests help to timely diagnose cardiovascular and other disease risks. Early cancer diagnostics help to avoid the last stages of the disease.

In the framework of **behavioural approach** individual's lifestyle is viewed as conscious choice, therefore mass campaigns were launched to promote healthy lifestyle (Birse, 1998). Health determinants became synonymous with healthy lifestyle. The fact that individual's health depends not only on healthcare but also on the behaviour of the person was emphasized. (Labonte, 1993). The most common lifestyle factors include diet, physical activity, smoking, alcohol abuse, drug abuse, unjustified use of medication and others (Birse, 1998).

The first attempt to include lifestyle factors in health promotion at a state level was in 1974 when Marc Lalonde published his vision in **the Health Field Concept** on the necessary reform in healthcare system and concluded that the previously used healthcare approach was erroneous and health needed to be viewed from a broader perspective. In addition to medical care Lalonde also mentions individual responsibility for one's health, stating that all health determinants should be classified into four large fields – healthcare system, human biology, environment and lifestyle (Lalonde, 1974).

In the 1970s health promotion transitioned into **Socio-Environmental approach** by adding environmental and structural factors to the health determinants due to the fact that promotion of healthy lifestyle mostly affected the educated part of the society and was less likely to leave an impact on those who were less educated and poor. (Labonte, 1993). This confirmed that the lifestyle of an individual does not depend only on the individual itself, but also on socio-environmental conditions that indirectly affect individual's health (VanLeeuwen, et al., 1999).

In the framework of the Socio-Environmental approach various health determinant models were developed. Henrik L. Blum's model **Environment of Health** (later renamed *Paradigms*) is considered as one of the most important ones. The *Force Field and Well-Being Paradigms of Health* characterises health as physical, psychological and social well-being. In his model Blum showed that the impact of health determinants should be viewed by both the direct impact when a risk factor increases risk of morbidity, and through indirect or immediate impact.

Proximate risk factors are the physical, social and mental risk factors that directly increase the impact of a disease and the risk of getting ill (Lönnroth, et al., 2009). The intensity of proximate risk factors is affected by risk events. **Risk conditions** do not affect human health directly, but indirectly

cause an emergence of risk factors, therefore influencing the risk of getting ill (Лебедева-Несевря & Гордеева, 2011).

The importance of **psychosocial risk factors** was emphasized by Ronald Labonte. According to the Socioenvironmental model, individuals who experience the impact of negative risk conditions, feel less social support from their loved ones or the society, exhibit self-isolating behaviour, are unhappy, tend to blame themselves and more often experience helplessness. These individuals are also characterised by health damaging behaviour which they use to cope with the stress (Labonte, 1993).

Göran Dahlgren and Margaret Whitehead classified health determinants in four layers of influence in **Four layers of health determinants model**, stating that individual's health depends on both the individual itself and the society – starting with the macro level of society to individual micro level (see Figure 1.1.). At the centre of the model is the core with non-adjustable human biological risk factors (Dahlgren & Whitehead, 1991).

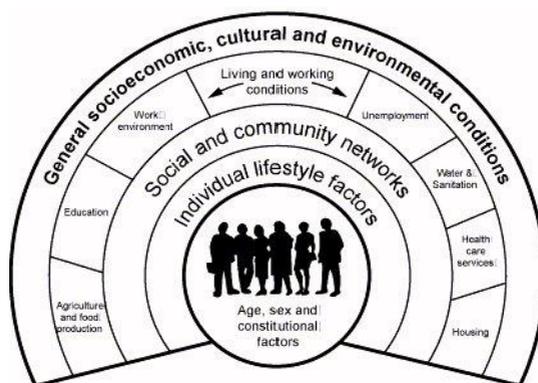


Figure 1.1. **Four layers of health determinants model**
Source: (Dahlgren & Whitehead, 1991)

First layer – socioeconomic, cultural and environmental conditions – functions only at the macro level of society – development of the society, functioning of social institutions, political, cultural and economic characteristics, ecology.

Second layer – living and working conditions – is extensive and include additional groups of risk conditions – housing, health care, water and sanitation norms, unemployment, working conditions, educational opportunities and food quality.

Third layer – social and community networks – relations between people – family, friends and relatives.

Fourth layer – individual lifestyle factors – bad habits, eating habits.

Core – non-adjustable human biological risk factors – gender, age and constitutional factors that cannot be changed neither by individual himself, nor by factors from other levels (Dahlgren & Whitehead, 1991).

The Four layers of health determinants model most comprehensively shows individual's health determinants, their classification and interactions between them, therefore this model was used for the analysis of TB risk conditions and risk factors. Two adjustments were made to the model – social relations risk factors of the third layer were extended according to the Labonte's definition of psychosocial risk factors and, as well as adjustable biological risk factors were added to the non-adjustable human biological risk factors to the core of the model.

2. DETERMINANTS OF TUBERCULOSIS

In the current study most important determinants of TB were identified and classified by summarizing information about most important disease risk factors and risk conditions, as well by exploiting the Four-layer model of health determinants:

First level – general socioeconomic conditions of the society, culture and environment:

1. **Gross domestic product** – TB morbidity rates are higher in countries with a lower GDP per capita (Millet, et al., 2012). It was found that there is a very close linear relationship between the GDP per capita and TB morbidity and mortality rates (Arinaminpathy & Dye, 2010).
2. **Immigration process** – in developed countries where there are a lot immigrants, TB morbidity rates are not decreasing due to immigrants from Asian, African and Latin American countries. In Europe 25% – 50% of all TB cases are attributable to immigrants (Millet, et al., 2012).
3. **Urbanisation** – if urban planning principles, social reforms and environment protection are not taken into consideration and there is lack of a well organised healthcare system, it constitutes ideal conditions to the spread of TB (Lönnroth, et al., 2009).
4. **Incidence of TB in the country** determines the risks involved for a healthy person to meet someone who has TB and get infected from that person.

Second level – living and working conditions:

5. **Poverty (socioeconomic status)** – TB is more characteristic to people with lower incomes (Lienhardt, 2001), because they more often live in narrow dwellings with inadequate ventilation, are more

likely to smoke and consume alcohol, more often have contact with TB patients, are more likely to work in worse conditions, are not able to provide quality nutrition, have a limited access to healthcare, and are less likely to have a healthy lifestyle (Lönnroth, et al., 2009).

6. **Employment (unemployment)** – the unemployed are more likely to suffer from TB, as person's income, acquaintances, job prestige and social status depend on employment (Coker, et al., 2006).
7. **Housing conditions (overcrowding)** – low quality of housing, overcrowding related to poverty, non-existence of ventilation, and mold aggravate respiratory health and increases risk of TB morbidity (Canadian TB Committee, 2007).
8. **Homelessness** – very bad living conditions contribute to the spread of TB – poverty, contact with other TB patients, experience of imprisonment. The characteristics of homeless people do not accelerate TB recovery – they tend to have a weak character, low intelligence and poor physical development and exhibit asocial behaviour (Ковалева, et al., 1997).
9. **Imprisonment** – high density of prisoners, suppressed psyche, bad sanitary conditions, poor diet, the length of isolation, belated discovery of source of infection (Санников, 1998). The situation is also aggravated by subjective factors – smoking, alcoholism and low level of education (Narasimhan, et al., 2013).

Third level – psychosocial risk factors – psychosocial risk factors are of a dual effect – they may weaken immunity or they can occur as a consequence of long-term treatment of TB and being in an out-patient clinic, which contributes to the deterioration of psychological health.

10. **Social exclusion** – condition of social isolation leaves a negative impact on the immune system, therefore increasing the morbidity risk.

11. **Depression** – depression and stress negatively affect the immune system, therefore also increasing morbidity risk (Pachi, et al., 2013).

Fourth level – individual lifestyle risk factors:

12. **Smoking** – the proportion of smokers among the TB patients differs in various studies varying from 45% to 85% (Yach, 2000). Smoking increases TB morbidity risk and mortality rates (Slama, et al., 2007), as it leaves a negative impact on lungs and immunity.
13. **Alcohol abuse** – may cause changes in the immune system and lead to immunodeficiency, resulting in susceptibility to pneumonia, TB and other infectious diseases. (Narasimhan, et al., 2013). The proportion of alcoholics among the TB patients is 10% to 50% (Lönnroth, et al., 2008).
14. **Drug use** – the negative effects are associated with the detrimental impact on the immune system. Drug use or even trying them once (both injectable and not) has been recognized as a serious disease risk factor in several studies (Coker, et al., 2006).
15. **Malnutrition** – has an adverse impact on immunity as well. TB patients are more likely to have lower contents of protein and fat in their diets (Подгаева, et al., 2011), moreover TB causes loss of weight and appetite, accelerates protein metabolism, as well as causes immune dysfunction (Narasimhan, et al., 2013).

BMI – individuals with low BMI have a higher TB morbidity (Lönnroth, et al., 2010), because one's body constitution may affect susceptibility to TB due to differences in lung mechanics. BMI is more often linked to genetics than diet.

Core – human's biological risk factors:

16. **Gender** – TB patients are mostly men (Millet, et al., 2012). The difference between genders is thought to lie in different immune system reactions due to different sex hormones (Kolappan, et al.,

2007), as well as differences in social roles and economic activity (Lienhardt, 2001).

17. **Age** – the immune system weakens with age (Lienhardt, 2001), nevertheless the effect of age on a disease is not linear, but U-shaped, and as the most affected are those aged 35 to 55.
18. **HIV** is the most influential TB risk factor (more significant than drug use) Millet, et al., 2012) due to its devastating effect on the human immune system. According to the estimations of WHO, people with HIV have 21 – 34 times higher TB morbidity risk (WHO, 2011).
19. **Diabetes** – diabetes impairs innate and adaptive immunity, therefore accelerating the spread of TB.

Interaction and impact of TB risk factors and risk conditions within the framework of Four-layer health determinant model are illustrated in Fig. 2.1. Morbidity of TB is mostly developed by individual immunity disorders – due to low immunity level „sleeping” mycobacteria reactivates, or after contact with TB patient in active phase reinfection occurs, resulting in mycobacterial stress in body that cannot be tackled by the organism’s immune system. Immune system disorders are caused by a number of risk factors of the third, the forth and the core level of the Determinant model – psychosocial risk factors (social exclusion and state of depression), individual lifestyle risk factors (addictions, malnutrition and BMI), as well as biological risk factors (gender, age, HIV and diabetes).

Biological risk factors could not be impacted by any risk conditions, but psychosocial and individual lifestyle risk factors are impacted by risk conditions of the first and second level – living and working conditions (socio economic status, imprisonment, housing, employment, homelessness) and general risk conditions (incidence of TB, immigration, urbanization, GPD).

Prevalence of TB risk factors is affected by individual's living and working conditions (the second level) – low socioeconomic status, poverty, low-skilled job or lack of employment, poor housing conditions and imprisonment or homelessness. Risk conditions on the first level impact factors of the societal level – gross domestic product, immigration processes, urbanization rate and TB incidence in the society.

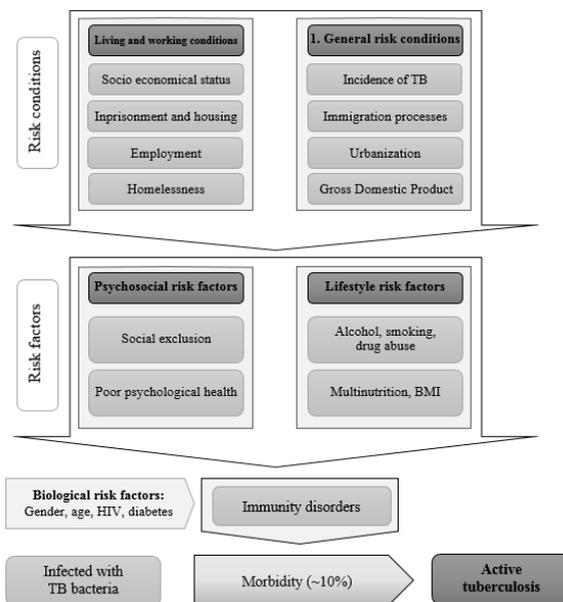


Figure 2.1. **Scheme of TB risk factors and risk conditions**
Scheme developed by author

Prevalence of active TB impacts incidence of TB in the country, creating a vicious cycle – alongside with increase of morbidity, significance of this risk condition increases, influencing individual risk of infection and reinfection. Individual level consequences of TB negatively affect individual's socioeconomic and psychological status.

3. METHODOLOGY OF EMPIRICAL RESEARCH

The **research instrument** is a questionnaire for TB patients, which included 196 questions. The 4 risk conditions of the first level were not included in the questionnaire due to of local scale of the research, with the exception of immigration processes, which have been re-defined as 2 level factor “Born outside” Other 15 risk conditions and risk factors were included in the analysis. 14 out of 16 risk factors and risk conditions were included in the questionnaire. Information about the significance of the remaining two risk factors was obtained from the National TB Registry.

TB risk condition and risk factors included in the questionnaire:

Second level – living and working conditions

1. Born outside Latvia;
2. Poverty;
3. Employment;
4. Housing conditions;
5. Homelessness;
6. Imprisonment;

Third level – psychosocial risk factors:

7. The social relations of the TB patients and society’s attitude towards them
8. Psychological health of the respondents

Fourth level – individual lifestyle risk factors

9. Smoking;
10. Alcohol abuse;
11. Drug use;
12. Malnutrition, weigh, height, and physical activities;

Core – human’s biological risk factors

13. Gender;

14. Age;

TB risk factors that were not included in the questionnaire:

15. HIV – data on HIV status was obtained from the TB Registry

16. Diabetes – data on diabetes was obtained from the TB Registry

Additional sections of the questionnaire:

17. Education

18. Health and healthcare of the respondents

19. Quality of life related to health

Survey method. In the framework of the study, a survey of TB patients was carried out. This method was chosen because the questionnaire contains sensitive questions about the use of drugs, the respondent's socio-economic status and relationship with relatives, nevertheless a questionnaire allows to obtain accurate information on the issues on which people do not want to answer (Sniķere, et al., 2012).

The survey was carried out from August 2011 to December 2012 in four Latvian out-patient clinics where TB patients are treated:

- at the Tuberculosis and Lung Diseases Centre (TLDC) of the Latvian Centre of Infectious Diseases
- TLDC's branch "Ceplīši"
- the Centre of Tuberculosis and Lung Diseases of Daugavpils Regional Hospital
- the Department of Pulmonary and Infectious Diseases of Liepāja Regional Hospital

Sample. Patients from all of the above mentioned out-patient clinics who were at least 18 years old and who had been clinically diagnosed pulmonary or extra pulmonary TB from August 2011 to December 2012.

Sample characterisation. From August 2011 to December 2012 **304** questionnaires were filled and used for analysis. According to the data of

CDPC, from 1 August to 31 December **2647** patients from the age of 18 with TB diagnosis were discharged from the 4 aforementioned out-patient clinics. The sample error is $\pm 5.29\%$, calculated with 95% confidence levels. In order to obtain more precise results, data were adjusted by gender and age groups (after 10 years).

The results obtained were compared to **5 control group studies**.

Research on Health Behaviour among Latvian Adult Population (2012, FinBalt). The questionnaire consists of 110 questions on respondents' health, healthcare and access to healthcare; health habits (diet and physical activity); bad habits, as well as the respondent's socio-demographic characteristics (Pudule, et al., 2013).

2012 study **EU-SILC** (The European Union Statistics on Income and Living Conditions) is a Latvian annual study on the housing conditions of the population, housing maintenance, economic situation of the household, employment, monthly income, income structure, education and subjective health status (Central Statistical Bureau, 2013).

*The study **Addictive Substance use among the General Population** was conducted in 2011 with an aim of obtaining data on the prevalence of addictive substance use in Latvia. The questionnaire contained questions about the use of licit addictive substances (alcohol, tobacco), as well as use of illegal substances (drugs, psychoactive drugs) (Sniķere, et al., 2012).*

In the 2007 study **Causes and Duration of Unemployment and Social Exclusion** factors influencing the duration of unemployment were determined, labour flows from unemployment to employment and vice versa were analysed, the effectiveness of active employment measures was found out, the main manifestations of social exclusion were established, as well as risk groups of social exclusion and their characteristics were determined (LU FSI, BICEPS, SPI, 2007).

RSU study „**Population norms of health-related quality of life instrument, 2009**”, using standardized research SF-36v2, made it possible to assess the respondent’s state of health and subjective health assessment from 8 viewpoints (Ivanov et al., 2011).

Statistical methods. Patient characterization using descriptive statistical methods – the central tendency indicators (the mean) and dispersion indicators – the standard deviation (SD), but if the data did not meet the normal distribution – the median (Me) with interquartile range (IQR).

The results were evaluated with 5% α -error, therefore, if the test p-value was less than 0.05, the result was found to be statistically significant.

The difference was evaluated using several statistical tests – if the quantitative data were subjected to the normal distribution, in order to analyse differences between two or more groups *analysis of variance (ANOVA)* was used, between two groups – *Student’s t-test*, in addition to evaluating the group variance with *Levene test*. If the data were not subjected to the normal distribution, nonparametric *Mann-Whitney U-test* was used to compare two samples or *Kruskal-Wallis H-test* to compare three or more samples. Data compliance with the normal distribution was determined by using *Kolmogorov-Smirnov test* and *Shapiro-Wilk test*.

In order to find a connection between two variables, correlation analysis was used. If the variables were measured in on a ratio scale and corresponded to the normal distribution, *Pearson correlation coefficient* was used. If one of the variables was measured on an ordinal scale or did not meet the normal distribution, nonparametric *Spearman rank correlation coefficient* was used.

In order to determine the strength of impact of independent factors, regression analysis was used. If the dependent variable was measured on a ratio scale, *linear regression was applied*. If the dependent variable was measured on an ordinal scale *categorical regression* was used. If the dependent variable was binary, *binary logistic regression* was applied.

4. SIGNIFICANCE OF TUBERCULOSIS RISK CONDITIONS AND RISK FACTORS IN LATVIA

4.1. Living and working risk conditions

12% of TB patients were born outside Latvian, which is similar to the CSB immigration figures – 14.6% ($p = 0.257$) but higher than that of the National TB Registry – (5%). Only one patient was born outside the borders of the Soviet Union – in Ireland. The rest of the individuals born outside Latvia were born in former Soviet Republics. Risk calculation shows that being born in another country is not a statistically significant disease risk factor – OR = 0.80 (95% CI = 0.56 to 1.14), $p = 0.225$, therefore people born in other countries are not at a higher risk of developing TB.

Perhaps the statistical insignificance of this risk condition is due to the fact that the immigration trends of the world are not relevant to Latvia because of low immigration levels. Almost all study participants were born in the Soviet Union and the rest of them arrived in Latvia during the Soviet times. The former Soviet Republics had the same strategy to combat TB and treatment options, thus being born in another country is not an actual risk factor in Latvia's conditions. This condition is also not statistically significant in Estonia either – OR = 0.68 (Tekkel, et al., 2002).

Income of TB patients both per one member of the family and per household is lower than the national average ($p < 0.001$). 30.7% of the patients have no regular monthly income. For 61.1% of the patients' income per family member ranges between 0 to 100 lats per month (in Latvia – 19.2%, $p < 0.001$). TB patients own fewer household objects ($p < 0.001$), as well as more often have delays of credit, rent, and utilities payments ($p < 0.001$) than the average inhabitant of Latvia.

Calculation of risk suggests that people with a monthly income of up to 100 lats a month per family member are at 6.8 times higher risk of developing TB than people with higher incomes – OR = 6.82 (95% CI = 5.12 to 9.08), $p < 0.001$. These results confirm the findings of global studies (Lienhardt, 2001; Подгаева, et al., 2011; Lönnroth, et al., 2009) – in Latvia and elsewhere in the world TB is more likely to affect the poor.

There are more **unemployed** among the TB patients than on average in Latvia – 41.2% of TB patients do not have a job (in 2012, in Latvia – 13.1%, $p < 0.001$). Unemployed TB patients are characterized by long-term unemployment. 33.6% of TB patients are in gainful employment (in Latvia – 49.2%, $p < 0.001$), nevertheless they tend to be low-skilled workers. The average length of employment and the age of starting to work between the two groups are not statistically significantly different ($p = 0.395$ & $p = 0.768$).

Risk calculation shows that the unemployed are at a 6.6 times higher risk of developing TB than the employed – OR = 6.60 (95% CI = 4.98 to 8.74), $p < 0.001$. The results obtained generally concur with the results of foreign studies (Lienhardt, 2001; Подгаева, et al., 2011; Lönnroth, et al., 2009) reestablishing the fact that there are more TB patients among the unemployed. The unemployment individual risk estimate (OR = 6.6) is relatively close to the one of the Russian study (Coker, et al., 2006) (OR = 6.1) and that of the Estonian study (Tekkel, et al., 2002) data (OR = 5.1), which indicates similar trends in the employment situation of TB patients.

TB patients are characterized by a lower level of **education** ($p < 0.001$) than the general population – 35.4% of TB patients have only got primary education (in Latvia – 2.7%). There are more TB patients with secondary education – 32.5% (in Latvia – 21.0%, $p < 0.001$), but only 6.9% of TB patients can boast higher education (in Latvia – 22.95%). Foreign studies (Lienhardt, 2001; Narasimhan, et al., 2013) show similar results, indicating that the TB patients in foreign countries also have lower levels of education.

Housing conditions of the TB patients are generally worse. They live in older ($p < 0.001$) and smaller housings ($p = 0.005$), with a smaller number of rooms ($p < 0.001$) and the total housing area ($p = 0.015$). Their housing is less likely to be equipped with a central sewerage, hot and cold water supply, toilet with a waterpipe and bathroom or shower ($p < 0.001$) than on average in Latvia. TB patients' homes more often have wood heating than central heating ($p < 0.001$). TB patients have more often reported that their housing is dark ($p = 0.001$).

If a person lives in a dwelling, where one family member has $< 15 \text{ m}^2$, his risk of developing TB is 1.8 times higher than for a person living in a more spacious housing – OR = 1.84 (95% CI = 1.25 to 2.69, $p = 0.002$). The significance of housing conditions is lower in the Latvian study than foreign studies (Canadian TB Committee, 2007; Lienhardt, 2001; Clark et al., 2002), which could be due to the fact that in Latvia housing area is not an indicator of poverty, as there is no connection between person's monthly income per family member and a total living area, number of rooms and housing area per family ($r_s = 0.061$; $r_s = 0.023$; $r_s = 0.067$, respectively).

There is a higher prevalence of **homelessness** among TB patients in Latvia. According to calculations of the CSB (CSB, 2011), there are 4684 people in Latvian without a home or 0.226% of the total population, whereas among TB patients it is 8.5% ($p < 0.001$). If a person is homeless, his risk of developing TB is 28.6 times higher than for an individual who does have a dwelling – OR = 28.65 (95% CI = 22.35 to 36.72), $p < 0.001$, making it one of the strongest risk conditions. This is a much higher figure than that of the Polish study (Romaszko, et al., 2008) (OR = 7.8). The difference in the results may be explained by the fact that in Poland 4.3% among the patients of the study were homeless, while in Latvia – 8.5%.

The research results show that 18.8% of TB patients have been **imprisoned** in their lifetime, in Latvia the figure is 0.8% ($p < 0.001$) (LU FSI,

BICEPS, SPI, 2007). Risk calculation shows that a person who has been imprisoned only once, has a 27.6 times higher risk of developing TB compared to an individual with no such an experience – OR = 27.57 (95% CI = 18.82 to 40.38), $p < 0.001$. Compared with the Samara study (Coker, et al., 2006) results (OR = 12.5), the Latvian OR figure is much higher. Such a surprisingly high risk could be due to differences in imprisonment rates – in Latvia 0.8% of the population has been arrested at least once, whereas in Russia this number is much higher – 3.6% of the population (Радченко, 2008), which is much more than in Latvia. These differences could be attributed to different legal systems – the Latvian justice system is more liberal and people are sentenced to prison less often than in Russia.

4.2. Psychosocial risk factors

The results obtained indicate that the **psychological health** of TB patients is worse than that of the average Latvian population. TB patients feel anxiety and stress (16.2%, $p < 0.001$), are depressed (24.8%, $p < 0.001$) and even have suicidal thoughts (7.2%, $p < 0.001$), statistically significantly more frequently than the general population in Latvia (8.8%, 10.4% and 0.8% respectively).

To assess the potential impact of psychological health on TB morbidity risk, an additional variable was added that characterizes individual's psychological health, by combining all of the manifestations of psychological health mentioned in the questionnaire. Poor psychological health (which is characterized by frequent stress or anxiety, occasional depressive episodes, rare thoughts of suicide and very rare wishes to commit suicide) increase the risk of TB morbidity by 4.2 times – OR = 4.15 (95% CI = 2.81 to 6.12), $p < 0.001$.

However in relation to questions of the existence of social exclusion, the statistical analysis showed no statistically significant differences among the

responses of TB patients and the general public ($p > 0.05$). Intensity of contact for TB patients is different, but not trend-oriented ($r_s < 0.05$; $p < 0.05$). TB patients are just as satisfied with the frequency of contact with family and friends ($r_s < 0.05$; $p < 0.05$) as the general public. Also, there is no trend that TB patients would have less people who are able to assist in solving problems ($r_s < 0.05$; $p < 0.05$).

4.3. Lifestyle risk factors

There are more smokers among the TB patients (72.3%) than on average in Latvia (40.1%, $p < 0.001$). TB patients start smoking earlier on average ($M = 17.6 \pm 5.6$ years (SD)) than the average Latvian ($M = 25.3 \pm 10.3$ years (SD), $p < 0.001$), and smoke for a longer period of time – 46.4% of TB patients smoked for 20 years or more (25.3% in Latvia, $p < 0.001$). Nevertheless, TB patients are more concerned about the negative effects of smoking on health (51.7% vs. 38.9%, $p < 0.001$), in more cases and earlier have decided to quit smoking (43.4% vs. 26.1%, $p < 0.001$) and are more likely to have attempted to quit smoking (37.0% vs. 13.2%, $p < 0.001$).

Risk calculation shows that people who are currently smoking or had been smoking in the past, have 5.6 times higher morbidity risk than non-smokers – OR = 5.6 (95% CI = 4.0 to 7.9), $p < 0.001$.

The results of Latvian research generally confirm the global trends – TB patients more often are smokers, they start smoking earlier on average and smoke for a longer period of time. The estimated risk (OR = 5.6) is within the intervals calculated by the French scientist Slama (2.3 to 9.3) (Slama et al., 2007), but when compared with the results of other European countries, the Latvian figure is higher – in the Estonian study (Tekkel, et al., 2002) the risk for smokers is 4.6 times and in the Spanish study it is (Altet-Gómez et al.,

2005) 2.1 times higher, while in the Polish study (Romaszko, et al., 2008) smoking is not recognized as a statistically significant risk factor. Perhaps the outcome is due to the negative smoking trends in Latvia. In 2012, according to the data by the WHO, 35.5% of the Latvian population smoke regularly, which is more than in Estonia, Lithuania, Finland (Prättälä, et al., 2011) and almost all European countries (WHO, 2010).

Alcohol abuse has similar negative trends – TB patients consume more alcohol than the average Latvian. 46.9% of TB patients are estimated to drink at least once a week, the average figure in Latvia is much smaller – 30.3% ($p < 0.001$). TB patients consume beer ($p < 0.001$) and spirits ($p < 0.001$) more often and in larger quantities, whereas wine is consumed less frequently ($p < 0,001$).

Consumption of alcohol at least once a week increases TB morbidity risk by 2.0 times compared with people who drink less often – OR = 2.02 (95% CI = 1.54 to 2.66), $p < 0.001$.

The results of the Latvian TB patient study are similar to the overseas results – TB patients consume more alcohol and drink more often. Scientist K.Lonrota's studies concluded that the abuse of alcohol increases morbidity risk by three times (Lönnroth, et al., 2008), the Latvian figure is lower, and significantly lower than that of the Estonian study's (Tekkel, et al., 2002) results, where individuals consuming alcohol once a week or more often, had a 15.0 times higher disease risk. The Latvian study's result is more similar to the Indian study (Kolappan, et al., 2007) results, where the risk level is 2.1.

There are more **drug users** among the TB patients than on average in Latvia. 12.0% of the TB patients have tried drugs once (3.5% in Latvia, $p < 0.001$) and 13.0% have used drugs several times (Latvian 1.3%, $p < 0.001$). TB patients are characterized by the same drug trends as the rest of the Latvian society – most TB patients have used hashish, marijuana (23%), amphetamines (9.3%) and ecstasy (6.6%).

Calculation of risk suggests that for people who have tried drugs, the risk of developing TB is 7.6 times higher than for people who have never tried drugs – OR = 7.61 (95% CI = 5.77 to 10, 03), $p < 0.001$.

Latvia's research has demonstrated that there are more drug users among TB patients than on average in Latvia, nevertheless the risk is smaller compared with the Russian study (Coker, et al., 2006), where the estimated TB morbidity risk for drug users was 8.7 times higher. In the Estonian study (Tekkel, et al., 2002) drug use has not been recognized as a statistically significant risk factor.

When comparing TB patients' diet to the general Latvian public, it was found that TB patients tend to eat breakfast less frequently (32.6%) prior being admitted to hospital than the average Latvian (15.0%, $p < 0.001$). If we define skipping breakfast as a risk factor, the calculation shows that people who do not eat breakfast, have a 2.7 times higher risk of developing TB than those who eat breakfast – OR = 2.74 (95% CI = 2.03 to 3, 7), $p < 0.001$.

Comparing TB patients' BMI to the Latvian population, it was found that more patients are characterized by insufficient (20.9%) and normal weight (65.7%) than in the Latvia on average (2.2% and 46.6%, $p < 0.001$ respectively). The regression analysis indicated that BMI has a statistically significant impact on TB risk, as evidenced by a high Nagelkerk R^2 score – 0.165 and a high Wald coefficient = 169.829, $p < 0.001$.

By defining low BMI as a TB risk factor, we can calculate that a person who is underweight has a 12 times higher risk of developing TB than someone having normal weight or being overweight – OR = 12.0 (95% CI = 8.17 to 17.65), $p < 0.001$. In comparison with the results of the Estonian research (Tekkel, et al., 2002), in which insufficient weight increases TB morbidity risk by only 2 times, the Latvian figure is significantly higher.

4.4. Biological risk factors

There is a higher prevalence of **HIV** among the TB patients (11.4%) than in the general population (0.3%, $p < 0.001$). HIV-positive people are 40.1 times more likely to get infected with TB than people without this virus – OR = 40.11 (95% CI = 32.23 to 49.92), $p < 0,001$. This is the highest result out of all risk conditions and risk factors included in the analysis. It is also significantly higher than that of foreign studies, where risk varies from 6 – 26 (Lienhardt, 2001), and the WHO findings on the risk – 21– 34 (WHO, 2011).

In regards to the second biological risk factor – **diabetes** – there are no significant statistical differences between the TB patients (4.3%) and the Latvian society (3.1%, $p = 0.247$). Risk calculation also shows that diabetes is not an important TB risk factor – OR = 1.42 (95% CI = 0.78 to 2.57), $p = 0.249$, although foreign studies (Narasimhan et al., 2013; Jurcev-Savicevic, et al., 2013; Coker, et al., 2006; Lönnroth, et al., 2009) have determined the importance of this risk factor.

Demographic indicators show that men (69.4%) are more likely to suffer from TB than women (30.6%, $p < 0.001$) – they have a 2.8 times greater risk of developing TB than women – OR = 2.82 (95% CI = 2.20 to 2.62), $p < 0.001$. There is a very weak connection between the age and TB morbidity – $r_s = 0.060$, $p = 0.001$, as evidenced by the foreign studies that the connection between age and TB morbidity is not linear, as most patients are 35-55 years old.

4.5. Summary of risk conditions and risk factors

In the framework of the study, impact strength (OR) of the each risk condition and risk factor) at the individual level was determined, which shows

how many times an individual's disease risk is higher due to the impact of the particular risk condition or risk factor (see Table 4.1.).

The most significant TB morbidity predictor is one of the core risk factors – presence of HIV – an HIV-positive person has a 40.1 times greater risk of developing TB than a person without the virus. The second strongest predictor is the 2 level risk condition – homelessness – a person without a home is 28.7 times more likely to get infected with TB. A very close third place can be attributed to the 2 level risk condition – experience of imprisonment, which increases TB morbidity risk by 27.6 times.

Table 4.1.

Summary of TB disease risk conditions and risk factors

Conditions and factors	OR (95% CI)	P-value	Prevalence	PAF
2. level living and working risk conditions				
1. Homeless	28.6 (22.4 – 36.7)	< 0.001	0.33%	8.33%
2. Experience of imprisonment	27.6 (18.8 – 40.4)	< 0.001	0.83%	18.13%
3. Income LVL 0-100 per 1 family member	6.8 (5.1 – 9.1)	< 0.001	19.20%	53.13%
4. Unemployed	6.6 (5.0 – 8.7)	< 0.001	17.00%	40.42%
5. Housing area <15 m ² per 1 person	1.8 (1.3 – 2.7)	0.002	19.20%	13.60%
6. Born outside Latvia	0.8 (0.6 – 1.1)	0.225	14.60%	-3.05%
3. level psychosocial risk factors				
1. Bad psychological health	4.2 (2.8 – 6.1)	< 0.001	5.30%	14.37%
4. level lifestyle risk factors				
1. Underweight	12.0 (8.2 – 17.7)	< 0.001	2.20%	19.13%
2. Experience of drug using	7.6 (5.8 – 10.0)	< 0.001	4.70%	24.14%
3. Regular or occasional smoking	5.6 (4.0 – 7.9)	< 0.001	40.10%	59.34%
4. Skipping breakfast	2.7 (2.0 – 3.7)	< 0.001	15.00%	20.72%
5. Use of alcohol ≥1 per week	2.0 (1.5 – 2.7)	< 0.001	30.30%	33.79%
Core biological risk factors				
1. HIV positive	40.1 (32.2 – 49.9)	< 0.001	0.33%	11.35%
2. Male	2.82 (2.2 – 2.6)	< 0.001	44.60%	44.85%
3. Diabetes	1.42 (0.8 – 2.6)	0.249	3.10%	8.19%

The fourth strongest risk factor is the 4 level risk factor – **being underweight**. Persons with a low BMI (< 18.5) have a 12 times higher risk of developing TB than people who have normal weight or are overweight.

Thus, individuals with HIV, without housing, with the experience of imprisonment, and having insufficient weight should be extra cautious in regard to TB morbidity, since the four aforementioned risk factors and risk conditions contribute to an individual's illness the most.

The importance of risk conditions and risk factors on the level of society is shown by another indicator – **Population attributable fraction (PAF)**, which demonstrates the importance of a risk factor in the society. PAF indicator is calculated by taking into account the risk factor prevalence in the society and its significance (OR) at the individual level.

PAF indicator has reduced the importance of the following risk factors – HIV, homelessness and imprisonment due to their low prevalence, making **smoking** the most important risk factor for TB. It means that 59.3% of TB morbidity cases should be attributed to smoking. The second most important risk condition is the person's **income** per family member – 53.1% of the TB morbidity cases are related to insufficient income. The third most important risk factor is **gender** (male) – 44.9% of the TB morbidity cases.

Therefore when developing national TB prevention measures in order to maximise the results, primarily focus should be on male smokers with low incomes.

4.6. Multifactor analysis

The odds ratio (OR) and PAF separately analyse the impact of each risk factor on the morbidity risk, without taking into account interactions between the risk factors, therefore in order to develop a unified multifactorial model,

which takes into account interactions between the factors, *binary logistic regression* was used.

TB status – having TB (1) or not having TB (0) was chosen as the dependent variable in regression analysis. Whereas 8 psychosocial, lifestyle and biological risk factors – smoking habits, alcohol abuse, use of soft drugs, psychological health, breakfast eating, BMI, gender and age were chosen as risk influencing predictors. Risk conditions were not included in this regression model, as they do not have a direct impact on the disease risk.

In order to develop the regression model, enter method was been used. Nagelkerk $R^2 = 0.357$. The main results of regression analysis are presented in Table 4.2. Almost all of the risk factors are statistically significant, so in order to better assess their impact, Wald coefficient was used. The higher is the Wald coefficient, the more impact the particular predictor leaves on the disease risk.

Table 4.2.

Disease risk influencing factors

Factors	B	SE	Wald	P	Exp(B)
1. Gender	0.313	0.208	2.259	0.133	1.368
2. Age	0.054	0.007	60.076	< 0.001	1.056
3. BMI	-0.336	0.029	136.027	< 0.001	0.714
4. Experience of using soft drugs	1.294	0.143	82.202	< 0.001	3.649
5. Smoking	0.297	0.105	8.024	0.005	1.346
6. Use of alcohol	-0.023	0.067	0.122	0.727	0.977
7. Psychological health	-1.993	0.450	19.625	< 0.001	0.136
8. Breakfast eating	0.708	0.196	12.983	< 0.001	2.029
Constant	1.521	0.853	3.182	0.074	4.577

The regression model demonstrates that the strongest influencing predictor is **BMI**, moreover this risk factor has a very high Wald coefficient (Wald = 136.027), indicating the extremely strong impact of this predictor. The results are contrary to the society’s misconception that TB is a disease of drug addicts or alcoholics. TB can affect anyone, and a low BMI could be one of the

unifying indicators that is characteristic to both the individuals with bad habits or asocial behaviour and without them.

The second most important predictor is use of soft **drugs** (Wald = 82.202). Given the very close link to the use drugs in general ($r_s = 0.890$, $p < 0.001$), this risk factor could serve as an indicator for any experience of drug use. Considering the devastating effects of drugs on human immunity, this outcome is only logical.

The third most significant predictor is **age** (Wald = 60.076). This result is surprising, considering that age had one of the weakest effects on the disease risk, moreover the impact may be nonlinear and U-shaped. The results of regression analysis show that age does have a considerable impact, and not due to the model's risk factors, as the importance of age has not been weakened by any of the risk factors of each of the 8 blocks, plus the significance of age only grew with each successive block.

The impact strength of psychological health should be also noted (Wald = 19.625). The model demonstrates that psychological health is the fourth most important predictor, therefore scientists should pay attention to this risk factor.

Five living and working risk conditions of the model's second level were purposefully excluded, as they have only a mediated effect on disease risk through risk factors. Nevertheless it is not possible to include all of the possible risk factors through which risk conditions leave their impact in the regression model. In order to compare the results, it would be useful to also include the risk conditions (see Table 4.3.). Nagelkerk $R^2 = 0.443$. Method – *Enter*.

Table 4.3.

Health influencing risk conditions and risk factors

Risk factors	B	SE	Wald	P	Exp(B)
1. Gender	0.166	0.253	0.432	0.511	1.181
2. Age	0.037	0.010	13.460	< 0.001	1.038
3. BMI	-0.375	0.038	96.955	< 0.001	0.688
4. Experience of using soft drugs	1.162	0.177	43.314	< 0.001	3.197
5. Smoking	0.141	0.135	1.097	0.295	1.152
6. Use of alcohol	-0.088	0.083	1.118	0.290	0.916
7. Psychological health	-1.241	0.567	4.782	0.029	0.289
8. Eating breakfast	0.906	0.232	15.204	< 0.001	2.475
Risk conditions	B	SE	Wald	P	Exp(B)
9. Unemployment	1.019	0.244	17.450	< 0.001	2.770
10. Income	0.179	0.168	1.134	0.287	1.196
11. Education	0.234	0.112	4.407	0.036	1.264
Constant	1.770	1.126	2.470	0.116	5.872

The results are similar. The most important predictor is BMI (Wald = 96.96, $p < 0.001$), the second most influential predictor is use of soft drugs (Wald = 43.3, $p < 0.001$), while the third place may be attributed to unemployment (Wald = 17.5, $p < 0.001$). Given that the importance of unemployment has also been confirmed in a model with another 10 predictors and not been reduced due to the risk factors included, it once again proves its significance.

By summing up the results of both the multifactor analysis and the regression model which was developed for the thesis, the interactions between all of the risk conditions and risk factors can be represented in one scheme of health influencing risks conditions and risk factors (see Fig. 4.1.).

TB is a multifactorial disease, which is caused due to the interactions between several psychosocial, lifestyle and biological risk factors, as well as a number of risk conditions, which have a significant role in the individual's susceptibility to TB. The scheme developed is quite complex due to the fact that the interactions between the 5 risk conditions and the 8 risk factors are multidimensional and with varying strength of income. The scheme only

reflects the impact of risk conditions on the risk factors, as well as the impact of risk factors on the disease risk. The interdependence of risk conditions, as well as risk factors was purposefully not reflected in order to not complicate the scheme even more, with the exception of two core risk factors – gender and age, which often play a fundamental role in causing several risk factors.

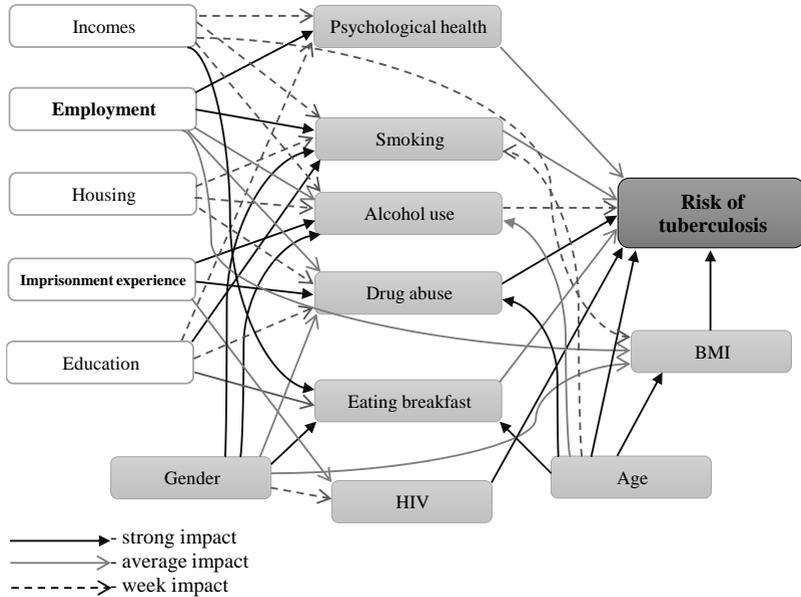


Figure 4.1. Scheme of TB risk factors and risk conditions

TB morbidity risk is directly affected by 8 risk factors and mediately affected by 5 risk conditions. The strongest impact on morbidity risk is left by BMI, and its contribution in increasing the risk of disease is extremely powerful. The results of the thesis suggest that BMI is also of biological nature, as in the regression analysis it was demonstrated that BMI influencing predictors have a very small role in BMI changes. BMI is mostly affected by age and gender, but the only social risk condition that may impact it is unemployment. Employed individuals have a higher BMI, and there is also a weak impact of income. Nutrition has a very weak or non-existent impact on

BMI, moreover the regression analysis did not demonstrate any impact of physical fitness and the intensity of physical exercises on BMI. A weak connection between the self-evaluation of one's physical fitness and BMI was found – individuals subjectively link their physical fitness with BMI, but in fact there is no objective statistically significant relationship between the two. Therefore it should be concluded that BMI should not just be analysed as a result of individual's lifestyle choices, but as a biological risk factor as well. Consequently TB control programs should pay special attention to individuals with low BMI, regardless of their lifestyle.

The second strongest risk factor increasing the disease risk is **drug use**. This result is not surprising, as drugs leave a devastating effect on the immune system. It also corresponds with common stereotypes that TB is the disease of individuals with deviant lifestyle. Both the impact of risk factors and the risk conditions that impact the risk factors is associated with deviant behaviour – the biggest contributor to the drug use is experience of imprisonment and to a lesser extent – homelessness, unemployment, low level of education, as well as the impact on biological risk factors – age and gender, as drugs are mostly used by young men. In order to reduce the impact of risk factors on the disease risk, it is necessary to take into account that potential TB patients are younger men with an experience of imprisonment.

The impact of other risk factors related to bad habits is not as powerful as that of drug use. The impact of **alcohol use** was not statistically proven by the multifactor analysis. The regression analysis shows that the same predictors that contribute to the drug use also increase the risk of alcohol abuse. Thus, if TB control programs paid particular attention to persons with imprisonment experience, it would be possible to achieve a reduction in the disease risk, as well as mediately affect drug and alcohol abuse.

Third risk factor related to bad habits – **smoking** – has different influencing risk conditions than drug and alcohol use – in addition to usual

factors like age and gender, it is more affected by risk conditions non-related to deviant behaviour – education and employment. Smokers tend to have a lower education and are more likely to be unemployed. Education is the strongest contributing risk condition, and it is through smoking when this risk condition affects the disease risk the most. Therefore by increasing the level of education in society, or at least through awareness campaigns, it is possible to reduce an individual's risk of disease, by reducing the prevalence of smoking.

The last lifestyle risk factor influencing individual's risk of disease is the habit of **eating breakfast**. In addition to age and gender, this risk factor is primarily affected by the individual's income and to a lesser extent by the level of education – individuals with higher incomes and higher level of education eat breakfast frequently, thereby having a better diet. Thus higher level of education not only lowers the prevalence of smoking, but also positively impacts the habit of breakfast eating, thereby reducing the risk of TB. Although the risk condition of income has a weak impact on a number of risk factors (psychological health, smoking, alcohol abuse, BMI), it strongly affects breakfast eating habits. This phenomenon should be further explored by using qualitative methods in order to find out more about this connection, as employment does not affect the habit of eating breakfast in a statistically significant way, despite the fact that income and employment do have a statistically significant relationship ($r_s = 0.423$, $p < 0.001$). This could be explained that the income is a stronger predictor than having a job.

Psychological health, in comparison with biological or lifestyle risk factors, has a moderate, yet statistically significant impact. Multifactor analysis has shown that individual's mental state before the illness is worth researching. Psychological health is most affected by the employment (unemployment) – the psychological health of the unemployed is worse. There is also a weak impact by income and education. The regression analysis showed no statistically

significant impact of experience of imprisonment and homelessness on one's psychological health.

As a result it is evident how each risk condition impacts disease risk through risk factors. Out of the 5 risk conditions included in the analysis, unemployment and experience of imprisonment are of the strongest impact, whereas the effects of income, homelessness and education are moderate.

Employment (unemployment) is a risk condition with the strongest impact on morbidity. It also affects a number of unrelated psychosocial and lifestyle risk factors, through which one can see employment's mediated effect on the disease risk. Unemployment primarily leaves a negative impact on one's psychological health and increases the prevalence of smoking, but secondarily it increases alcohol and drug use, and even reduces BMI, which in turn, has a stronger effect on the risk of disease. Thus an increase in the number of unemployed in the country, may worsen the psychological health of the population, increase the spread of bad habits, and even a slight decline in BMI, which in turn can increase the overall incidence of TB in the country.

The impact of the second most important risk condition – **the experience of imprisonment** – primarily manifests itself through deviant behaviour – excessive use of alcohol and drugs and secondarily through HIV, which also has features of deviant behaviour. It is not surprising, because the fact that an individual has been imprisoned already shows his past deviant behaviour, therefore having a connection with risk factors of deviant behaviour.

Low income level of an individual, which is often subjectively linked to a high risk of morbidity, is only the third strongest risk condition that primarily affects the habit of eating breakfast, and also has a weak impact on one's psychological health, smoking and drinking habits. Given that the impact of low income is not statistically significant in multifactor analysis (see Table 4.3.), one can deduce that individual's income might not be as important as it is generally believed.

The situation is similar in regards to **homelessness**. This risk condition is often linked to an increased risk of morbidity by the society. The regression analysis demonstrated a statistically significant impact, nevertheless its impact can be seen through a weak impact on risk factors related to bad habits, but homelessness does not have a statistically significant impact on the rest of the risk factors.

The impact of the fifth most important risk condition – **education** primarily manifests itself through smoking and secondarily through eating breakfast. Education also has a weak impact on psychological health and drug use.

Thus, in the framework of the thesis, the main TB morbidity influencing risk factors and risk conditions affecting them were identified. The understanding of the impact of risk factors and the risk conditions has an important role in the combat against TB and its prevention, moreover the TB control measures, in order to achieve the maximum efficiency, should take into consideration the results obtained by the research of the thesis.

CONCLUSIONS

In order to reach the aim of the thesis – to determine risk factors influencing TB morbidity in Latvia – 5 tasks formulated.

On the basis of the **Task 1** theoretical materials on models of health influencing factors pertaining to the medical, socioenvironmental and behaviour approach were gathered and analysed. The medical approach model was not used for the analysis of health influencing factors, as it includes only risk factors related to medicine, nevertheless the preventative measures of this approach, for example, vaccination or TB testing are beneficial for the individual, because they help to diagnose a number of diseases at an early stage.

Whereas all models of Socio-Environmental approach underline the importance of the individual's social environment in the analysis of disease causes, by emphasizing that the individual's behaviour or lifestyle not always depend on the individual itself, but this choice is determined by the surrounding environment the individual lives or works in. In the framework of this approach, three models have been discussed, underlining the mediate impact of risk conditions on risk factors. Paradigm that characterises health as physical, psychological and social well-being and stresses the importance of social environment has been reviewed. Nevertheless the Paradigm does not include age and gender, as well as risk conditions and risk factors have not been differentiated into micro and macro levels. Socio-Environmental approach has the same disadvantages as the Paradigm under study, as well as biological risk factors are defined as potentially adjustable. Nevertheless this was the first model that included and emphasized the importance of psychosocial factors as potential lifestyle related health determinants.

In order to reach the aim of the thesis, the Four layers of health determinants model pertaining to the Socioenvironmental approach was chosen,

as in the opinion of the author it describes the potential health influencing risk factors on an individual and societal level in a most precise and comprehensive way, by including societal and individual lifestyle and working risk conditions, which have an indirect impact on TB morbidity risk., as well as psychosocial, lifestyle and biological factors with direct impact on TB morbidity. After making minor adjustments by elaborating on groups of psychosocial and biological risk factors, the model was employed for the identification and analysis of TB risk determinants.

In order to fulfil the aim of the task 2, data on TB risk factors of research conducted in other countries was gathered and 19 of the most influential risk conditions and risk factors were identified. By grouping them into the Four layers of health determinants model, scheme of TB influencing risk factors and risk conditions was developed (see Table 2). According to this scheme, the TB morbidity risk is mainly determined by immune disorders that are affected by non-adjustable or almost non-adjustable biological risk factors (gender, age, HIV and diabetes). Morbidity risk is also impacted by the fourth level – individual lifestyle factors – smoking, alcohol abuse, drug use, malnutrition and BMI, as well as psychosocial risk factors of the third level – social exclusion and depression. The risk factors of the third and fourth level are impacted by the factors of the second level – living and working conditions – poverty, imprisonment, employment (unemployment), housing conditions, homelessness, as well as the risk factors of the first level – general socioeconomic conditions – incidence of TB in the country, immigration processes, urbanisation and GDP.

According to the Four layers of health determinants model, risk conditions and risk factors of all the four levels are constantly influencing each other. The statistical significance of the each determinant differs from country to country, but it has been determined that the most influential determinants of TB morbidity in the world are presence of HIV, homelessness and drug use.

Based on this information hypothesis was formulated that in Latvia the most influential TB morbidity risk factors may be factors related to individual's bad habits, but the biological and psychosocial factors are of secondary importance due to the fact that the most significant TB determinants in the world are primarily connected with the individual's bad habits.

As part of the **task 3**, the socio-economic profile of TB patients in Latvia was determined and it was compared to the data of the Latvian population. It was found out that the income of TB patients per family member and the income per household is lower than on average in the country, TB patients are more likely to have credits, delays of rent and public utilities payments than on average in Latvia. There is also a higher number of unemployment among the TB patients compared to the Latvian population, and the TB patients who are employed, tend to be low-skilled. They are likely to experience long-term unemployment and to have a lower level of education. TB patients have worse housing conditions – they live in older and less spacious dwellings with less rooms. Their housing is less often equipped with a central sewage system, hot and cold water supply, WC with a waterpipe, bath or shower than on average in Latvia. There is a higher prevalence of homeless people, as well as people who are/have been imprisoned.

These results show that the psychological health of TB patients is worse than that of the average population. TB patients suffer from anxiety, stress, depression and even suicidal thoughts more often than the general population.

Indications of social exclusion were not established.

There are more smokers among TB patients and they pick up this bad habit earlier and tend to smoke for a longer period of time. They also have a higher consumption of alcohol than on average in Latvia. TB patients prefer beer in large quantities or spirits. There are also more drug addicts among TB patients.

In comparison with the BMI of the general population, TB patients tend to be underweight or have normal weight. It was also observed that TB patients are less likely to eat breakfast prior to their hospitalisation.

TB patients have a higher prevalence of HIV in comparison to the rest of the population, and men have TB more often than women. Based on this comparison of socioeconomic status, most influential TB risk conditions and risk factors in Latvia were identified.

In order to fulfil the **task 4**, the importance of each potential risk condition and risk factor was statistically estimated. The most influential risk conditions and risk factors are the ones who increase the morbidity risk the most on an individual level. It was determined that the most significant living and working risk conditions are homelessness and imprisonment.

The most important lifestyle risk factors are low BMI and use of drugs, but the most significant biological risk factor is HIV, which is also the most influential TB determinant. Individuals who have at least one of these risk factors and conditions, have the highest risk of TB, therefore they should be especially cautious.

At the level of the society most influential risk factors are low income level and unemployment, the most significant lifestyle risk factors are smoking and consumption of alcohol at least one time per week, but the most important biological risk factor is gender. Therefore we can deduce that smoking men with low income are the ones who affect the prevalence of TB in Latvia the most.

According to the results of multifactor analysis, BMI is the most influential TB risk factor. The second most significant risk factor is drug use and the third one is gender. Therefore these three predictors impact TB risk the most.

The most important immediate risk conditions are unemployment and imprisonment. The impact of unemployment mostly manifests itself through

psychosocial risk factors and risk factors related to bad habits, as it may lead to smoking and alcohol abuse, as well as negatively affects psychological health. The experience of imprisonment manifests itself through mainly deviant lifestyle risk factors – use of alcohol and drugs, as well as having HIV.

In order to fulfil task 5 and that the research results would be of practical use, based on the calculations of the strength and impact of risk conditions and risk factors, practical recommendations for TB prevention and control programme were developed.

According to the hypothesis the most influential TB risk factors in Latvia are related to the individual's bad habits, whereas biological and psychosocial risk factors are of secondary importance, meaning that the most significant risk factors are smoking and use of drugs and alcohol, but the results of the research show that the most influential risk factor is BMI, which does not belong to risk factors related to bad habits, but is a lifestyle and biological risk factor. The second most important risk factor is drug use, which is pertinent to bad habits, whereas the third most significant factor – age is not part of risk factors related to bad habits. Therefore the hypothesis have been partially verified.

PRACTICAL RECOMMENDATIONS

Authors of the Four layers of health determinants model Göran Dahlgren and Margaret Whitehead believe that in order to maximise the effect of any conception of health promotion, it should include measures that would reduce the impact of the potential first and second level risk conditions and the third and fourth level risk factors. After gathering information on TB influencing risk factors and risk conditions, it was possible to develop the most effective programme of TB control that would take into consideration risk conditions and risk factors of all the levels of the Four layers of health determinants model.

Determinants of the first level of the model under study were not included in the analysis, as this research is of a national level, whereas the importance of the risk conditions of this particular level may only be explained by transnational studies. Disease control programs on a national or international level, action plans and other important documents for the reduction of morbidity can also be attributed to this level. In Latvia such documents include the National TB control plan for 2013 – 2015 which was adopted by the Ministry of Health March on 12 March, 2013. This plan is no longer valid, nevertheless it is the newest document where the main lines of action of curbing the spread of TB in Latvia have been defined. A new Regulation of the Cabinet of Ministers or a control program that would focus on the fight against TB has not yet been developed.

A sufficiently narrow circle of persons was mentioned in this program – people who are at greater risk of developing TB and who have to undergo mandatory chest radiography in accordance with the Regulation of Cabinet of Ministers No. 413, adopted on 14 June, 2005. These target groups include persons who are in **temporary detention facilities, homeless people** and

immigrants. HIV-infected persons are mentioned separately, as after being diagnosed with HIV, they also need to be tested for TB, as well as people with low incomes are mentioned as a potential risk group (Latvijas Vēstnesis, 2005).

The research conducted in the framework of the thesis has confirmed that the groups of people included in the aforementioned TB control plan do have the highest individual risk of TB morbidity, nevertheless there are other population groups that have an increased risk of TB.

Among the **2 level** living and working risk conditions The National TB control plan especially emphasizes low-income individuals as a potential risk group, nevertheless the multifactor analysis, carried out in the framework of the thesis, has shown that the role of low-income risk conditions has been exaggerated in comparison to other risk conditions. The key economic risk condition is employment instead of income (see Table 4.3.).

These two risk conditions are interconnected with each other, but employment should be considered to be more important, as it determines person's income and it also affects the third and fourth level risk factors to a greater extent than income. Unemployment leaves a negative impact on an individual's psychological health, causing additional stress and depression; contributing to bad habits like smoking, alcohol and drug abuse.

Whereas employment status has a moderate impact on the biological risk factor – BMI. Income has a similar effect, but its impact on both the psychological health, as well as bad habits, is much weaker than that of employment status. Therefore the new Regulation of Cabinet of Ministers should pay greater attention to the unemployed instead of people with low incomes. In cooperation with the State Employment Agency and other institutions, the unemployed should be educated on potential TB symptoms and informed about the possibility to have a free chest radiography even without a GP referral, free treatment options (because often individuals do not see the doctor due to fears of the high costs of the visit), encouraging them to give up

bad habits and educating them about their negative consequences, as well as providing psychological support, if necessary.

The second most important risk factor is the experience of imprisonment, which has an impact on an individual's deviant behaviour risk factors. To minimize the risk factors for morbidity, the future TB control program in cooperation with the Prisons Administration and the State Education Development Agency should inform former prisoners about the potential TB symptoms, free treatment options, as well as, where appropriate, encourage involvement in alcoholism, drug addiction and HIV treatment programs.

Homelessness was recognised as a serious risk factor in *The National TB control plan* due to the fact that individuals without a permanent dwelling are defined as a potential risk group and according to the Regulation of Cabinet of Ministers No. 413 (Latvijas Vēstnesis, 2005) should undergo mandatory chest radiography. Given the high risk of disease for the homeless, mandatory chest radiography should certainly be continued.

Taking into account the effects of education on smoking and the habit of eating breakfast, family doctors or other medical personnel, should inform individuals with lower levels of education about TB symptoms and possible prevention, and especially emphasize the adverse effects of smoking and skipping breakfast (or unhealthy diet). Perhaps by encouraging such individuals to attend special support groups, where people with similar problems (more likely in case of alcohol or smoking addictions) can both receive help and support each other.

These psychological support groups are attributable to the **third** – psychosocial level. The thesis has proven that psychosocial risk factors have a moderate impact on the risk of disease – unresolved social problems result in psychological issues, thus negatively affecting the immune system and making a person more susceptible to TB. It should also be noted that the psychological

problems do not disappear after the person gets sick, on the contrary, the disease is likely to exacerbate depression.

Social workers play an important role in reducing patient's depression, as well aggressiveness, by solving some of the patient's social problems, and keeping them busy during the lengthy treatment, thus facilitating convalescence.

At present, social workers working in an out-patient clinic not only help to solve the patient's psychological problems, but also to prevent negative risk conditions and risk factors, thus protecting the patient from a recurrent disease. This is of special importance, as after the end of the treatment, patients return to their daily environment, where in most cases there no longer is the support of a social worker.

It should be noted that the important role of social workers was not mentioned in *the National TB control plan*. Therefore in order to mitigate manifestations of the negative psychosocial risk factors during the treatment, as well as reduce the impact of living and working risk factors and risk conditions after the treatment, the aforementioned control plan should pay more attention to the potential support of the social worker in resolving patient's psychological problems, also the number of social workers should be increased. Increased capacity of social workers would not only help the patient during the treatment, but the patient could also continue to receive psychological and social support after his discharge from an out-patients clinic from a social worker at his local municipality.

The most important **level 4** lifestyle risk factor, contrary to popular belief, is not individual' bad habits, but low BMI. It was determined as the most important factor for influencing individual's risk of disease by multifactor analysis. Nevertheless this risk factor has not been mentioned at all in the National TB control plan, therefore people with low BMI have not been defined as a TB risk group, and The National TB Registry does not gather data on this

risk factor either. Taking into account the significance of this risk factor, the author of the thesis recommends that the future TB control program should define individuals with low BMI as a potential and independent on lifestyle or socio-economic conditions risk group. TB prevention campaigns should also pay attention to this group of individuals by educating them about potential TB symptoms and treatments. In cooperation with the institution of general practitioners, general practitioners could also educate patients about TB.

Healthcare specialists tend to pay more attention to the risk factors related to bad habits – patients who smoke or abuse alcohol or drugs are encouraged to stop smoking, to undergo alcohol or drug treatment. Drug users have been identified as a risk group by *the National TB control plan*, and according to the Regulation of Cabinet of Ministers No. 413, HIV-positive persons have to undergo mandatory testing for TB (Latvijas Vēstnesis, 2005).

Therefore by employing the knowledge on TB prevention, risk groups and risk factors, acquired over the years both in Latvia and the world, and by adding the results of the thesis on TB influencing risk factors and risk conditions, it would be possible to develop a more comprehensive and detailed *National TB control plan* in order to reduce TB morbidity and its socio-economic burden.

ACKNOWLEDGEMENTS

I would like to express my gratitude to the joint stock company “Olainfarm” for the support in the conduction of the research of the thesis. The research was also facilitated by the European Social Fund scholarship granted by the Riga Stradins University.

I sincerely thank to my supervisor asoc. prof. Ritma Rungule for active cooperation and support, as well as my supervisor prof. Ludmila Vīksna for motivation, support and valuable advice during the writing process of the thesis.

I am grateful to the reviewers of the thesis asoc. prof. Signe Dobelniece, Ilze Koroļova and asoc. prof. Anda Nodieva for the reviews of the thesis.

Thanks to my colleague Ieva Salmane-Kuļikovska for the support during the studies and her constructive feedback and recommendations on writing scientific papers and conference abstracts.

I would like to express my gratitude to Dace Bantauska for editing the language and style of the thesis.

Thanks to pneimonologist Vija Riekstiņa for helping me with the data of the National TB Registry, as well as for simple explanations related to TB aetiology, pathogenesis and possible treatments.

My thanks also go to nursing professionals of The Centre of TB and Lung Diseases for handing out surveys and helping patients in filling them, to the former secretary of The Centre of TB and Lung Diseases for conducting the survey, as well as the patients themselves for their participation in the research and filling in the long surveys.

And last but not least, I would like to express my gratitude to my wife for the understanding and support during the writing of the thesis.

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