

UNIVERSITY OF LJUBLJANA  
SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

**THE POTENTIAL OF FISCAL POLICY MEASURES TO MITIGATE  
THE ECONOMIC BURDEN OF DIABATES IN THE REPUBLIC OF  
NORTH MACEDONIA**

Ljubljana, May 2023

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## **LIST OF ABBREVIATIONS**

**WHO** – World Health Organization

**IDF**- International Diabetes Federation

**T2D**- Type 2 diabetes

**T1D**- Type 1 diabetes

**RNM**- Republic of North Macedonia

**FAOSTAT**- Food and Agriculture Organization Corporate Statistical Database

**ADA**- American Diabetes Association

**NICE**- National Institute for Health and Care Excellence

**BMI**- Body Mass Index

**IGT**- Impaired Glucose Tolerance

**GDP**- Gross Domestic Product

**FSD**- Food Systems Dashboard

**PHI**- Public Health Institute

**GDP PPP**- Gross Domestic Product Purchasing Power Parity

**EU**- European Union

**CPI**- Consumer Price Indices

**SSBS**- Sugar Sweetened Beverages

**KCAL**- Kilo calories

**KPI**-Key performance indicator

# INTRODUCTION

## 1.1 Background

The beginning of the third millennium, characterised by a rapid economic growth and production, is associated with many positive changes in population health compared to previous centuries. Economic development has led to expansion of education, improved medical care and public health technology while changes in food production systems, transport, processing and packaging, and larger open markets and trade liberalisation have increased year-round access to healthy food worldwide (World Bank, 2012). According to the World Health Organization (hereinafter WHO), since the second half of the 20th century, these developments have led to increased health and life expectancy and increased food availability per capita resulting with more affordable diets for many, if affordability is measured by cost per unit of energy or kilocalorie (World Health Organization , 2013).

However, this has induced major modifications in diet, first in industrial regions and more recently in developing countries (World Health Organization, 2021a). Throughout this ‘nutrition transition’, traditional, largely plant based diets have been replaced by animal-based energy-dense diets, a larger proportion of processed foods high in saturated and trans fats and increasing number of meals eaten outside the home (Pan et al., 2013; Zheng et al., 2020). Without underestimating the achievements in terms of hunger reduction, overconsumption has resulted in another burden, the one of non-communicable diseases such as obesity and diabetes, as an “unwanted by-product of economic development which encourages unhealthier lifestyles” globally (Bollyky, Templin, Andridge, & Dieleman, 2015; Gjuladin Hellon, 2014). It is widely accepted that the prevalence of diabetes worldwide is moving beyond even the gloomiest estimates of the past, for example, according to the International Diabetes Federation (hereinafter IDF), in 2004, the prevalence of diabetes in 2030 was estimated to reach 334 million people, while the actual prevalence of 387 million people with diabetes was already achieved in 2014 (International Diabetes Federation, 2015).

Diabetes is to a large extent preventable, healthy diet and maintenance of normal body weight are the cornerstone of prevention and management of diabetes (World Health Organization, 2003). For the first time the WHO in its recent global report on diabetes acknowledged that diabetes actually could be reversed, and its reversal can be achieved through weight loss and calorie restriction (World Health Organization, 2016). Indeed, targeted public health diabetes prevention programmes in several countries have showed to delay the onset and significantly reduce its progression to Type 2 diabetes: Public Health England report (Ashra et al., 2015) the Finish diabetes prevention study (Uusitupa et al., 2000) and the Chinese Da Qing diabetes prevention study (Li et al., 2014). However, despite



the, what seems relatively simple lifestyle approach aiming to achieve calorie deficit (by consuming less calories, burning more calories with physical activity or both), engaging and retaining people in such prevention programs and translating these programmes into real world setting is difficult (Gray , Yates , Troughton, Khunti, & Davies, 2016). As a result, in parallel with the galloping upward trend of overweight and obesity, in 2021 it was estimated that 537 million adults (20-79 years) were living with diabetes; every 5 seconds one person died due to the disease while the estimated health-related cost 966 billion USD (International Diabetes Federation, 2021). According to the International Diabetes Federation, (2021) prevalence of 783.2 million with highest relative increase in middle-income countries and expenditure of 1.054 billion USD were projected by 2045 (International Diabetes Federation, 2021).

The WHO recognises that a siloed approach via public health interventions is inefficient to mitigate the rising burden of diabetes and its associated morbidity and mortality, if not coupled by food policy interventions (World Health Organization , 2015). It is now well acknowledged that people's dietary choices are shaped by complex and interlinked factors such as food affordability, food availability, individual preferences and beliefs, cultural traditions, and social and environmental factors (World Health Organization, 2003). The food environment in which people develop their dietary habits seems to have a great impact on the foods people buy and ultimately consume. Namely, as shown in the systematic review and meta-analysis of 24 empirical and modelling studies, food prices to a large degree shape the quality and quantity of purchased food products (Thow, Jan, Leeder, & Swinburn, 2010). Although the included studies were mostly conducted in developed countries, policies targeting food taxes and subsidies showed the potential to alter people's food choices towards healthier alternatives at population level. A similar systematic review (Powell, Chriqui, Khan, Wada, & Chaloupka, 2012) showed that higher fast-food and lower fruit and vegetable prices were associated with lower body weight in children and adolescents, suggesting that policies that shape prices have the potential to reduce obesity especially among those with a lower socio-economic background.

Price policies that address food affordability and incentives for purchasing healthier foods are increasingly seen as an important policy intervention. There are several examples of fiscal policy interventions aimed at energy dense food products that increase the risk of diet related diseases: in Finland, excise duties have been levied on sweets, chocolate and non-alcoholic beverages since 2011 to generate revenue for government purposes; in 2011, France imposed a levy on drinks and liquid preparations with added sugar or sweeteners which has resulted with decreased consumption of sugary or sweetened beverages particularly in young people, low-income groups and households with adolescents while contributions were directed to the national health and social care service; the same year, Hungary introduced taxing non-staple pre-packaged foods with higher level of sugar, salt and methylxanthine which has led to reduced consumption, increased reformulation and achieving the estimated tax revenue (World Health Organization , 2015).

Even though the existing evidence base is generally scarce and of a low-quality, pricing instruments show the potential to improve health outcomes among the population and should continue to be considered and assessed in the prevention of diet related diseases. However, there is an increased need to investigate the potential of economic policies for promotion of healthier diets in developing countries such as the Republic of North Macedonia (hereinafter RNM). For RNM, given the low capacity of its public health sector to mitigate diabetes and the associated morbidity and mortality (Gjuladin Hellon , Davies, Penson, & Amiri Baghbadorani, 2019), the current global crisis which further increases food insecurity and vulnerability of its population to food price volatility, their comprehensive monitoring and empirical evaluation using targeted indicators should be made research priority.

## **1.2 Purpose of the research and contribution to the field**

The continuous growth in non-communicable diseases and the widening social gradients in within most countries worldwide, especially in low and middle-income countries, pose major challenges to health and social systems and to development more generally (Bloom , Bond, & Van Reenen, 2007).

Lifestyle modification, such as the dietary choices people make, should be the first choice to prevent or delay the onset of diabetes related factors and manage diabetes. However, changes of lifestyle patterns that are often a result of environmental and societal shifts associated with development require supportive policies in sectors such as public health, economy, agriculture, transport, urban planning, environment, food production and distribution, marketing and education (Samitz, Egger , & Zwahlen, 2011; Egger & Dixon, 2009; McMichael, Powels, Butler , & Uauy , 2007).

Given the well-established role of price as a driver of food choice, interest in fiscal policies (taxes and subsidies) to improve diets and prevent diet related chronic conditions is growing. Many economists and government policymakers continue to explore the opportunities that price policies can offer for public health, including health gains and health care cost savings (World Health Organization , 2015). Evidence from simulation studies or modelling is extensive and shows that price changes are likely to influence consumers' decision-making and the amount of food and drink they buy.

Considering the importance and the recognised burden of diabetes worldwide and the big gap in knowledge and understanding of its main drivers especially in the developing world, this research aimed to explore the overall burden of diabetes and its contributing risk factors and the potential for introducing fiscal policies or other economic measures that would encourage healthy dietary habits in RNM to reduce the economic burden of diabetes.

In order to understand the scope of the burden of diabetes, it was necessary to vertically explore this phenomenon in a way that shows the current magnitude of its impact and directions of the main risk factors associated with the disease.

Namely, this research explored the global and national diabetes prevalence trends, global and national economic burden of diabetes and its associated complications, direct and indirect costs of disease, attributable modifiable and non-modifiable risk factors globally and nationally, such as population demographics, obesity and food consumption trends and patterns and food security. The in-depth interviews on issues regarding effectiveness of fiscal policies to improve diet insights drawn from the opinion of various national experts and policy makers to promote healthier food choices were also carried out. However, other modifiable risk factors such as level of physical activity, level of education and information were out of the scope of this research.

Countries' capacity to respond and mitigate the negative effects of diabetes relies on the generation of reliable, relevant, and up-to-date information. The current and anticipated burden alone is reason enough to make preventing diabetes a priority for a developing country such as RNM. Clearly, the prevailing models and policies of mitigation which advocate a siloed approach, have failed to give long-term positive results. The situation becomes even more concerning, considering projected population dynamics, including changes in population growth rates, age structures and distributions of people as these are closely linked to national and global developmental challenges and their solutions.

Although the health systems of the RNM could be improved, health and public health approaches have little capacity and alone cannot solve this problem requiring urgently cost-effective, sustainable strategies to curb the diabetes epidemic (Gjuladin Hellon , Davies, Penson, & Amiri Baghbadorani, 2019). By analysing and quantifying the impact of the risk factors attributable to diabetes and the effectiveness of global fiscal policies, it could be possible to assess and understand the current crisis level of these issues and the possible economic and fiscal measures and policies at national level aimed at curbing this upward trend.

In a broader context, this research increases the awareness about the addressed problem which is mitigation of one the biggest challenges of the 21st century in the RNM.

### **1.3 Methodology**

This is a mixed-method study design which utilises both quantitative and qualitative approaches.

For the quantitative part, a desk research method that involved summarising and collating existing data was used. Data were collected from appropriate databases and official publications of international organisations such as the WHO, Food and Agriculture Organization Corporate Statistical Database (hereinafter FAOSTAT), IDF and the World Bank, as well as government official publications of relevant ministries of the RNM covering, when possible, the period 2000-2022. To visualise the trends of diabetes and associated risk factors, figures, charts, and tables were generated.

Individual interviews with different stakeholders were chosen for the qualitative approach. Stakeholders that were invited for the in-depth interview included:

- A representative of diabetes association in the RNM
- Nurse
- Medical doctor endocrinologist
- Public health academic and researcher
- Professional from the Public Health Institute of RNM

The in-depth interview contained open questions to facilitate the interviewees' own story and when needed follow-up. The main areas of interviewed medical staff and public health professionals included experiences and thoughts about main causes of diabetes in RNM, the efficiency of the health care system to prevent and manage diabetes, current government policies in tackling the burden of diabetes.

The interview with the patients' representative focused on their feelings, experiences and reflections regarding their nutrition knowledge, satisfaction with the care given by the health professionals, diabetes treatment, self-management, lifestyle changes and thoughts about possible governmental policies interference that might aid to prevent or manage diabetes.

Listed stakeholders were contacted by the author via email or social media, receiving written information about the purpose of the interview and areas of focus and after giving written confirmation for a face-to-face or a Zoom meeting was scheduled. The interviews were recorded digitally and transcribed verbatim. Transcriptions were emailed to interviewees for confirmation. In cases when face-to-face interviews could not be conducted, the questionnaire was emailed to the participants.

Detailed methodology for each approach is given in the relevant sections of chapters 3 and 4.

#### **1.4 Structure of the thesis**

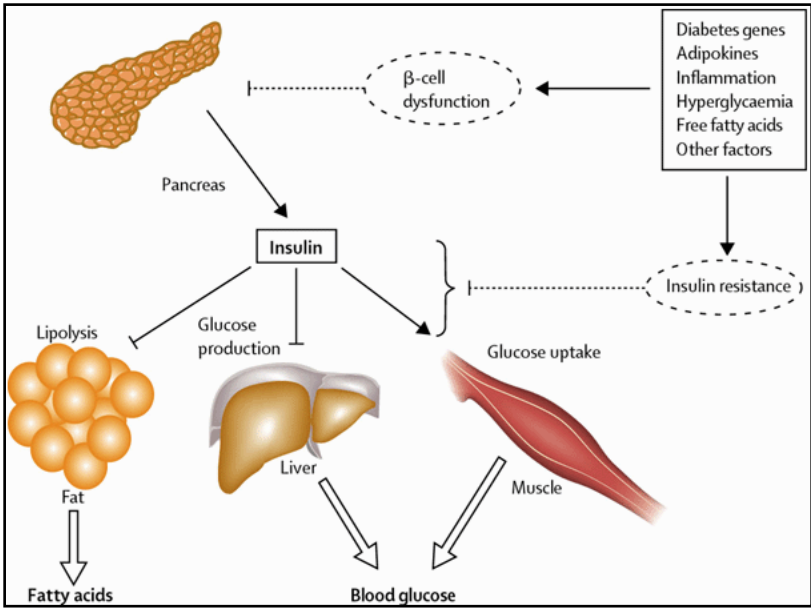
The thesis is organised in eight chapters. The problem statement and the aims of the thesis are stated in the introduction chapter. Chapters 2, 3 and 4 cover the economic burden of diabetes, diabetes prevalence and the potential to manage lifestyle related risk factors in RNM. Chapters 3 and 4 also contain the relevant results of the quantitative and qualitative analyses of diabetes economic, health burden and the risk factors associated with diabetes. The last concluding chapter evaluates and discusses the significance and implications of research findings, followed by a reference list and appendices. Appendices include the in-depth interviews conducted with the stakeholders.

## 2 ECONOMIC BURDEN OF DIABETES

### 2.1 Diabetes

Diabetes is a term that comprises of various metabolic disorders characterised by hyperglycaemia in the absence of treatment (World Health Organization, 2019). It is a chronic disease caused by defects in insulin secretion, insulin action or both, and it manifests itself with chronic hyperglycaemia and disturbances of carbohydrate, fat and protein metabolism resulting in damage of body tissues over time (Figure 1).

Figure 1: Etiopathology of diabetes



Source: Stumvoll, Goldstein, & Van Haeften (2005).

The commonly accepted underlying characteristics of all forms of diabetes and associated hyperglycaemia is the decline in function or destruction of pancreatic  $\beta$ -cells via a variety of mechanisms such as genetic predisposition, insulin resistance, auto-immune destruction, inflammation and/or environmental factors. Understanding the causes of such dysfunction or destruction of  $\beta$ -cells can help define the type, guide the management of diabetes and improve and maintain glucose tolerance (Skyler et al., 2017).

If left untreated, in the long term, hyperglycaemia may result in disabling and life-threatening health complications putting people with diabetes at an increased risk of co-morbidity and mortality (Rawshani et al., 2017; Samocha- Bonet et al., 2014).

Characteristic symptoms of diabetes include thirst, polyuria, polyphagia, blurred vision and unintentional weight loss, while in most severe cases ketoacidosis and coma which may result with death (Samocha- Bonet et al., 2014).

Diagnosing diabetes is of a great importance for individuals with immense implication not only in terms of their health but also because diagnosis causes biographical disruption as it affects individual's employment, insurance, social opportunities, and self-identity (Bury, 1982).

The latest WHO classification system gives priority to clinical care and guides diabetes healthcare professionals in choosing appropriate treatment once diagnosis is confirmed. According to the World Health Organization (2019) proposed new classification of diabetes includes the following types:

- Type 1 diabetes (hereinafter T1D)
- Type 2 diabetes (hereinafter T2D)
- Hybrid forms of diabetes
- Hyperglycaemia first detected during pregnancy.
- Drug- or chemical-induced diabetes
- Unclassified diabetes (with no clear diagnostic category)

Other specific types (for example Diseases of the exocrine pancreas, Endocrine disorders, Infections etc.)

It is important to note, however, that most cases fall into the first two broad etiopathogenetic categories. The first category, T1D, which accounts for only about 5 % of the total diabetic population is characterised by an absolute deficiency of insulin secretion identified by serological test and genetic markers and it frequently occurs in childhood (Mayer Davis et al., 2018). Individuals with this type of diabetes generally share some common characteristics: a lower body mass index (BMI), use of insulin within 12 months of diagnosis and increased risk of diabetic ketoacidosis (Thomas et al., 2018). According to the American Diabetes Association (hereinafter ADA) although patients are rarely obese when they present with this T1D, the presence of obesity is not incompatible with the diagnosis (American Diabetes Association, 2007). Evidence from a systematic review and meta-analysis suggests that obesity may hasten the development of T1D and that the increasing rate of T1D may be at least partly attributed to the rise of obesity and secular changes in linear growth in childhood (Verbeeten, Elks, Daneman, & Ong, 2011).

The second category, T2D, is the most prevalent type and accounts for 90-95% of all diabetes cases and is most common in adults, however an increasing trend among children and young people is also detected (World Health Organization, 2016). It occurs as a combination of resistance to insulin action and an inadequate compensatory insulin secretion (Stumvoll, Goldstein, & Van Haeften, 2005). This is often accompanied with a degree of hyperglycaemia below the diabetes diagnostic threshold (known as impaired glucose tolerance or prediabetes) for a long period of time, sufficient to affect various body tissues in absence of clinical symptoms of diabetes (Rawshani et al., 2017; Samochoa- Bonet et al., 2014). According to WHO and ADA, at the time of diagnosis, but often throughout their

life, people with T2D do not require insulin therapy to survive while insulin resistance may be improved with weight loss in combination with pharmacological hyperglycaemias (World Health Organization, 2016; American Diabetes Association, 2009).

The IDF conducts regular monitoring and reporting of diabetes across its seven socioeconomically and geographically highly diverse regions in terms of incidence and prevalence, mortality and healthcare expenditures: Africa (AFR), Europe (EUR), Middle East and North Africa (MENA), North America and Caribbean (NAC), South and Central America (SACA), South East Asia (SEA) and Western Pacific (WP). The reports of the surveillance are published as ‘‘Diabetes Atlas’’ in ten editions so far, covering the period 2000-2021 (Internatioanl Diabetes Federation, 2000; International Diabetes Federation, 2003; International Diabetes Federation, 2007; International Diabetes Federation, 2010; International Diabetes Federation, 2011; International Diabetes Federation, 2013; International Diabetes Federation, 2015; International Diabetes Federation, 2017; International Diabetes Federation, 2019; International Diabetes Federation, 2021).

*Table 1: Global prevalence of diabetes, adult population in years 2000-2021*

Year	2000	2003	2007	2010	2011	2013	2015	2017	2019	2021
No. of people with diabetes (million)	151	194	246	285	366	382	415	425	463	537
Prevalence (%)	4.6	5.1	6.0	6.6	8.2	8.3	8.8	8.8	9.3	10.5

*Source: International Diabetes Federation (2000); International Diabetes Federation (2003); International Diabetes Federation (2007); International Diabetes Federation (2010); International Diabetes Federation (2011); International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021)*

Based on the compilation of all available IDF data depicted in Table 1, in 2021 approximately 537 million people of the age range 20-79 years or 10.5% of the total world adult population suffered from diabetes, representing a devastating increase of 255.6% since 2000: (Internatioanl Diabetes Federation, 2000; International Diabetes Federation, 2003; International Diabetes Federation, 2007; International Diabetes Federation, 2010; International Diabetes Federation, 2011; International Diabetes Federation, 2013; International Diabetes Federation, 2015; International Diabetes Federation, 2017; International Diabetes Federation, 2019; International Diabetes Federation, 2021).

According to International Diabetes Federation (2021) if the current trends continue the total number of people with diabetes globally is predicted to rise to 642.7 million (11.3%) by the year 2030 and to 783.2 million (12, 2%) by the year 2045.

## 2.2 Diabetes Risk Factors

The causes of diabetes are complex, multifactorial and only partly investigated and understood. This disease is generally considered multifactorial, involving several predisposing conditions and risk factors. In most cases genetics, lifestyle and environment may all contribute to a person's diabetes. The risk of developing T2D is positively correlated to several risk factors such as increasing age, increasing body weight, malnutrition and sedentary lifestyle or existence of other comorbidities such as polycystic ovary syndrome (Whicher , O'Neill, & Holt, 2020). However, recent evidence published by National Institute for Health and Care Excellence (hereinafter NICE) shows that the prevalence of T2D is rapidly increasing among children and young adults (National institute for health and care excellence, 2015). These risk factors can be described as either unmodifiable, such as genetics, race/ethnicity and age, or modifiable, such as physical inactivity, malnutrition and environmental factors (World Health Organization, 2016). People cannot alter their unmodifiable risk factors, but they can lower their risk of developing diabetes by reducing modifiable risk factors through improved health habits; however, identification and management of risk factors for diabetes mellitus and its complications, as well as timely diagnosis of the condition, are vital for their effective prevention and treatment of diabetes (American Diabetes Association, 2007).

The gender differences in prevalence and incidence of T2D are relatively small and appear to be accounted for by differences in other risk factors such as obesity and physical inactivity. In most populations, the prevalence of T2D increases with age up to the age of 65 after which there is a levelling off and a downward trend as mortality increases (World Health Organization, 2019; American Diabetes Association, 2010). The older population is at a high risk for the development of T2D due to the combined effects of increasing insulin resistance and declining pancreatic function and insulin secretion with aging. Age-related insulin resistance appears to be primarily associated with adiposity, sarcopenia (loss of muscle mass) and physical inactivity (Amati et al., 2009). Genetic predispositions to diabetes are an essential factor in the aetiology of diabetes, however, the presence of certain environmental and behavioural factors, can trigger the activation of a genetic predisposition (Murea , Ma, & Freedman , 2012).

The group of modifiable risks comprises of several factors related to dietary and other lifestyle patterns. These factors can be altered to a high degree by changes in human behaviour which consequently have the potential to increase or decrease individual's risk of developing diabetes. The most significant factors are overweight, abdominal obesity and physical inactivity (Qatanani & Lazar, 2007; Stumvoll, Goldstein, & Van Haeften, 2005; Kaprio et al., 1992). Thus, in contrast to type 1 diabetes, diabetes type 2 is a common consequence of changing lifestyle, and it is potentially preventable through lifestyle modification.



Furthermore, the estimates show that about 90% of people who have T2D are either overweight or obese (Whicher , O'Neill, & Holt, 2020). International Diabetes Federation (2021) defines overweight and obesity as abnormal or excessive fat accumulation that may have negative physical, psychological, and social consequences for both adults and children and affects people's quality of life. The fundamental cause of these conditions lies in the imbalance between calories consumed and calories expended. The body mass index (hereinafter BMI), defined as a person's weight in kilograms divided by the square of his height in meters ( $\text{kg}/\text{m}^2$ ), is a useful population measure to classify underweight ( $\text{BMI} < 18 \text{ kg}/\text{m}^2$ ), overweight ( $\text{BMI}$  of  $25\text{-}29.9 \text{ kg}/\text{m}^2$ ) and obesity ( $\text{BMI}$  of  $\geq 30 \text{ kg}/\text{m}^2$ ) in adults of both genders of any age. Obesity-associated insulin resistance is one of the main drivers of T2D, accounting for 80-85% of the overall risk; increased body weight, especially in people with central obesity (visceral/abdominal fat accumulation), activates several endocrine, neural and inflammatory pathways resulting in a decreased capacity of insulin to inhibit glucose output from the liver and to promote glucose uptake in fat and muscle tissues (Whicher , O'Neill, & Holt, 2020).

Apart from the quantity, the quality of food consumed is thought to play an important role in the aetiology of diabetes, although the mechanisms behind the effect of diet on diabetes is not well explored. High consumption of saturated fats and trans-fatty acids is linked to heart disease, increased insulin secretion and impaired fasting glucose concentration, while adequate consumption of fruit and vegetables reduces the risk for cardiovascular diseases (Bazzano , Serdula , & Lui , 2003). As suggested by several studies, there is convincing evidence that the consumption of high levels of high-energy foods, such as processed foods that are high in fats and sugars, promotes obesity compared to low-energy foods such as fruits and vegetables (Gjuladin Hellon , Davies, Penson, & Amiri Baghbadorani, 2019; Poti, Breaga, & Qin, 2017).

Overall, maintenance of body weight within the normal range and promoting healthy eating habits are considered a priority in the prevention and management of diabetes (World Health Organization, 2003; World Health Organization, 2021b).

### **2.3 Diabetes related complications and their prevalence**

Once the clinical stage of the disease progression has been reached, chronic diseases are less or no longer amenable to curative intervention and instead require careful "maintenance management" to suppress the disability associated with the co-symptoms and morbidities that accompany them. Thus, in the meeting on non-communicable diseases, prevention programmes must be recognised as a cornerstone in a global response to the chronic disease burden of diabetes (Colagiuri & Keeling, 2011). The major cause of the high morbidity and mortality rate associated with diabetes is due to complications affecting multiple organ systems and posing a huge burden to the patients and their families and has a negative impact to countries' economy at the same time (International Diabetes Federation, 2021). However,

due to the lack of good quality data and internationally agreed standards for diagnosing and assessing diabetes complications, the IDF does not report estimates on complications attributed to diabetes.

Generally, diabetes complications are divided into microvascular caused by a damage to small blood vessels and macrovascular due to damage to larger blood vessels (Cade, 2008).

According to Vithian & Hurel (2010) microvascular complications include damage to eyes (retinopathy) with risk of blindness, kidneys (nephropathy) with risk of renal failure, nerves (neuropathy) with risk of foot ulcers, amputation and features of autonomic dysfunction, including sexual dysfunction. According to World Health Organization (2016) the prevalence of any retinopathy in people who suffer from diabetes is 35%, while 7% of the cases are in the vision threatening retinopathy category. The data gathered from 54 countries suggests that at least 80% of cases of end stage renal disease are caused by diabetes, hypertension or a combination of both while the number of cases with end stage renal disease that are attributed only to diabetes is presumed to be somewhere between 12% and 55 % globally (World Health Organization, 2016). People with diabetes have 25 times greater risk of amputation of the low limbs, due to damaged nerves (International Diabetes Federation, 2021). According to World Health Organization (2016), there are about 1.5-3.5 events of non-healing foot ulcers per 1000 persons per year. Encouragingly, some of the more developed countries such as United Kingdom, Sweden, Denmark, America and Australia have shown 40% to 60% reduction rates in amputation during the last 10-15 years (World Health Organization, 2019).

Macrovascular complications include cardiovascular diseases such as heart attacks, strokes and insufficiency in blood flow to legs (Cade, 2008). People with diabetes are at increased risk of cardiovascular, peripheral vascular and cerebrovascular disease (World Health Organization, 2011; American Diabetes Association, 2010). Diabetes is also a strong independent predictor of risk of stroke and cerebrovascular disease; patients with T2D have an increased risk of stroke of 150-400% (Beckman, Creager, & Libby, 2002). Historically speaking about the link between diabetes and cardiovascular complications, the adults who have diabetes have three-time higher rate of developing cardiovascular problems, than the people who don't have diabetes (World Health Organization, 2003).

As described by World Health Organization (2016), the levels of the glucose in the blood have an impact on the morbidity and mortality, and this starts to happen even before the entering into the diabetic phase. The chronic diabetic hyperglycemia is associated with long-term damage, dysfunction, and failure of various organs and is one of the major drivers of mortality in the world. According to the International Diabetes Federation (2021), in 2021, approximately 6.7 million people ranging from 20-79 years old have died as a result of diabetes or its complications worldwide, out of which a 32.6 % occurs in people of working age meaning under the age of 60 (see table 2). Compared to the first mortality rate reported

(2007, 6.2%), there is an evident increase of the mortality attributed to diabetes over the years.

*Table 2: Mortality attributed to diabetes. World in the years 2007-2021*

Year	2007	2010	2011	2013	2015	2017	2019	2021
Number of deaths (million)	3.8	4	4.6	5.1	5	4	4.2	6.7
Mortality rate (%)	6.2	6.8	8.2	8.4	14.5	10.7	11.3	12.2

*Source: International Diabetes Federation (2007); International Diabetes Federation (2010); International Diabetes Federation (2011); International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021)*

*Table 3: Mortality attributed to diabetes in RNM in the years 2000-2021*

Year	2000	2007	2010	2011	2013	2015	2017	2019	2021
Number of deaths	351	1649	1480	1507	2038	2034	1964	1962	2590

*Source: International Diabetes Federation (2000); International Diabetes Federation (2003); International Diabetes Federation (2007); International Diabetes Federation (2010); International Diabetes Federation (2011); International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021)*

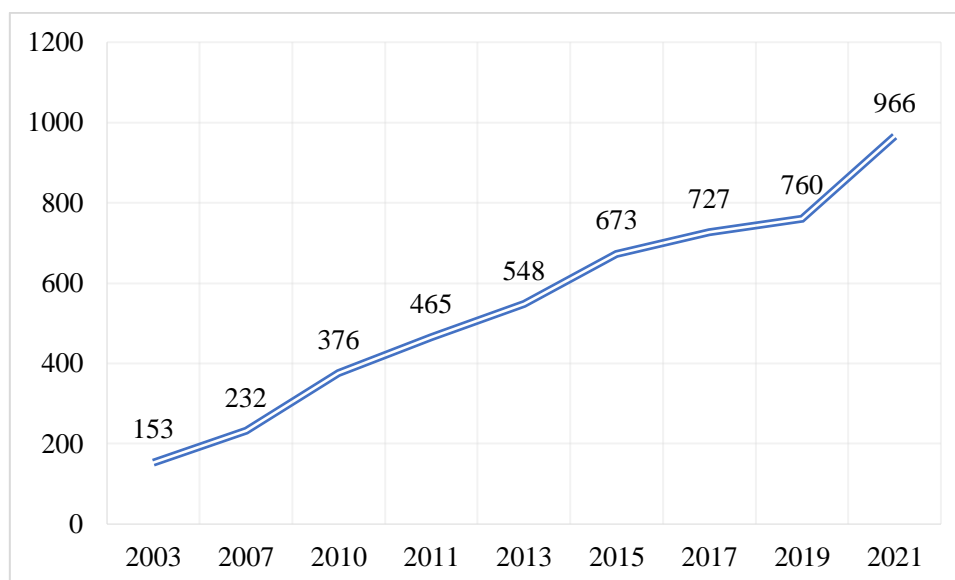
What can be concluded from Table 3 is that the numbers of diabetes related deaths in RNM is in constant rise. According to International Diabetes Federation, within the observed period the mortality attributed to diabetes has risen from 351 to 2590 deaths in 2000 and 2021 respectively, indicating a notable increase of almost 638% (International Diabetes Federation, 2000; International Diabetes Federation, 2021). What draws particular attention is the increase of over 30% of the total number of diabetes related deaths in the period 2011-2012 and 2019-2021. This indicates that there are local extremes in the curve that are repeated periodically, further analysis in the future will show whether this trend will continue. For clarification purposes it is important to mention that the IDF does not report any data prior to 2007 on a global level, so the analysis could only be performed for the period after 2007 for which reliable data for both RNM and global is available.

**2.4 Direct and indirect costs of diabetes**

The healthcare expenditure related to hospital inpatient care, medications to treat complications of diabetes, hypoglycaemic agents, diabetes supplies and physician visits (wheatear paid by the patient out-of-pocket, by a private or a public payer, or by the

government) are referred to as direct costs. The total global direct diabetes-related healthcare expenditures for the period 2003-2021 is presented in the following Figure 2.

*Figure 2: Total diabetes related health expenditures for adults in years 2003-2021, in billion USD*

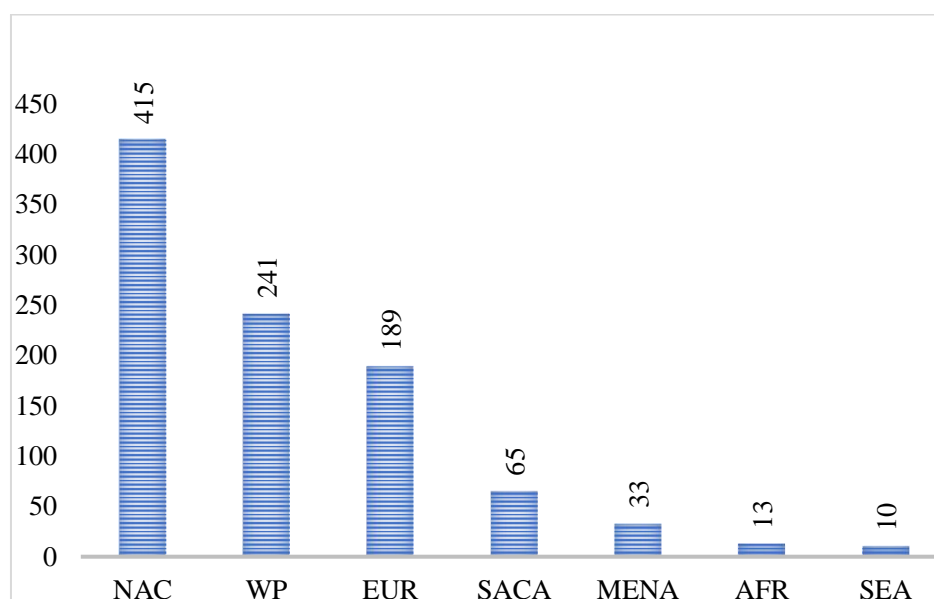


*Source: International Diabetes Federation (2003); International Diabetes Federation (2007); International Diabetes Federation (2010); International Diabetes Federation (2011); International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021)*

According to the IDF, globally, there is a continuous upward trend of the direct diabetes healthcare expenditure (personal, public and governmental) throughout the whole 2003-2021 period: (International Diabetes Federation, 2003; International Diabetes Federation, 2007; International Diabetes Federation, 2010; International Diabetes Federation, 2011; International Diabetes Federation, 2013; International Diabetes Federation, 2015; International Diabetes Federation, 2017; International Diabetes Federation, 2019; International Diabetes Federation, 2021). In 2021, the global health spending to treat diabetes and manage complications was estimated to USD 966 billion globally (International Diabetes Federation, 2021) and when compared to the USD 153 billion spent in 2003 (International Diabetes Federation, 2003), represents a staggering increase of 532% over just 18 years.

However, the global direct costs are unevenly distributed across the IDF regions with notable disparity between high, and middle and low-income countries (Figure 3).

Figure 3: Total diabetes related health expenditures (US billions) in adults by IDF region in 2021



Source: International Diabetes Federation (2021).

Note: NAC- North America and Caribbean; WP- Western Pacific; EUR- Europe; SACA- South and Central America; MENA- Middle East and North Africa; AFR- Africa; SEA-South- East Asia

Out of the seven IDF regions, North America and Caribbean has the highest diabetes related health expenditure (USD 415 billion) which accounts for 42.9% of the global diabetes related expenditures, followed by the Western Pacific (USD 241 billion) with 25% of the global expenditures related to diabetes in 2021 (International Diabetes Federation, 2021). The European region is the third highest in terms of diabetes related expenditures, with USD 189 billion spent or 19.6% of the global diabetes related health expenditure. However, the low and middle-income countries of South- East Asia, Africa, Middle East and North Africa and South and Central America where about 75% of the diabetes population live, just USD 121 billion or only 12.5% of the global diabetes related health expenditure was spent (IDF, 2021). It is important to note that exactly these regions are battling the dual burden of diseases, those of communicable and non-communicable nature further exacerbating countries' attempts to curb the rising of diabetes and associated risk factors (World Health Organization, 2016).

In addition to direct costs, diabetes also imposes high indirect costs associated with productivity losses. Indirect costs take into account the following sources: increased absenteeism, reduced productivity at work for those employed (presenteeism), unemployed due to diabetes related disability (labour force drop out) and lost productive capacity due to premature (mortality). The only available IDF data related to indirect global cost were reported for 2015 and these are presented in Table 4. Namely, the indirect costs attributed to diabetes ranged from 31.7% in middle income countries to 37.8% in low-income countries out of the total (direct and indirect combined) expenditures for 2015 (International Diabetes

Federation, 2019) with labour-force drop out (48.5%) and mortality (45.5%) dominating the global picture, while absenteeism and presenteeism accounted for only 6% of the total indirect costs of diabetes.

However, the socioeconomic disparities notable across indirect costs as well, according to International Diabetes Federation (2019), in 2015, mortality accounted for 63.6% of the total indirect costs in middle-income countries, whereas in low-income countries the indirect costs due to mortality were significantly higher (90.6%). The discrepancy in values between Figure 2 and Table 4 is due to different sources of information. The only available information regarding this indicator could be found in the IDF atlas, (International Diabetes Federation, 2019), which in turn quotes (Bommer et al., 2017).

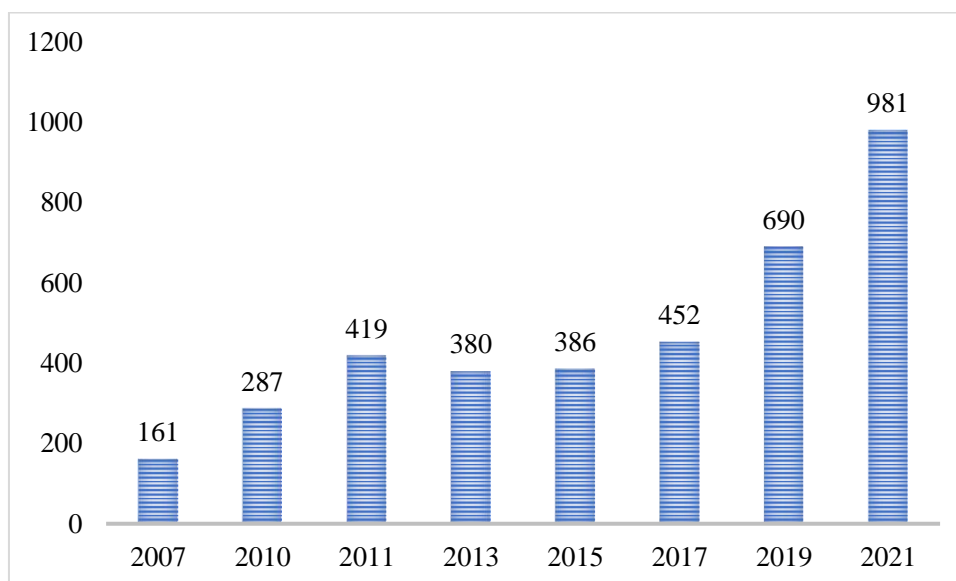
*Table 4: Direct and indirect costs of diabetes (2015) in high-, middle- and low-income countries.*

Country income level	High - income	Middle-income	Low-income
Number of countries	53	202	29
Direct costs (USD billion)	510.7	344.7	1.56
Indirect costs, USD billion	293.66	160.20	0.95
Indirect costs as % of total	36.5	31.7	37.8

*Source: Bommer et al., (2017).*

For the RNM, which belongs to the middle-income countries of the European region, the IDF estimated a similar trajectory of continuous increase in costs regarding diabetes healthcare expenditure during the period 2007-2021IDF (Figure 4).

Figure 4: Diabetes related expenditures (USD) per person with diabetes in RNM in the years 2007-2021



Source: International Diabetes Federation (2007); International Diabetes Federation (2010); International Diabetes Federation (2011); International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021).

For example, in 2007 the total diabetes related expenditures in the RNM amounted to 161 USD per person (International Diabetes Federation, 2007), whereas the number in 2021 is considerably higher (981). This presents an increase of 509% for the investigated period.

In summary, diabetes presents a large economic burden on individuals and their families, health and social care systems with an adverse impact on sustainable economic development. The increasing direct as well as indirect costs associated with diabetes is a considerable economic impact to the individuals, health and social care systems and overall economies across all countries. Developing countries and the lower socioeconomic strata in the developed regions are especially impacted.

### 3 PREVALENCE OF DIABETES AND ITS RISK FACTORS

#### 3.1 Methodology and data collection

For analysing the prevalence of the disease and its associated risk factors in more detail, an explorative desk-top research method was used, utilising existing and published literature with the objective to investigate the subject as per the objectives stated previously. Systematic searches were conducted via a range of relevant websites and databases using the following main search terms such as Diabetes mellitus, obesity, diabetes

prevention, mitigation, economic cost, complications. The focus of these searches was upon reports, papers and other documents published between 2000 and 2022. Editorials, letters, news articles and publications in languages other than the ones stated above were excluded in the search criteria. Publications prior to the year 2000 were omitted, except where relevant.

This research was based upon published findings inclusive of the following criteria relevant to the subjects:

- Official publications reporting the global incidence, prevalence, mortality rate and complications of diabetes.
- Official publications reporting the incidence, prevalence, mortality rate and complications of diabetes in the Republic of North Macedonia.
- Official and peer reviewed research publications of analysis of risk factors associated with diabetes and preventive measures.
- Official and peer reviewed research publications reporting the economic burden and sustainability of diabetes, globally and nationally.
- Papers published in English, Macedonian, Serbian or Albanian languages.
- Papers published since 2000.

Based on the described search and review of all material, the publications of the following organisations were used for the quantitative analysis presented in this chapter:

- WHO Global Health Observatory Data Repository
- (Hereinafter FSD)
- World Bank
- FAOSTAT
- IDF
- State Statistical Office of RNM
- Public Health Institute of the RNM (hereinafter PHI)

Comparative prevalence diabetes data based on age, gender, region, setting (urban versus rural) and the global and national prevalence of main risk factors were collected and organised so that times series data could be presented either graphically in charts or in tables. Where appropriate, growth rates were also calculated.



## 3.2 Global prevalence of diabetes and its risk factors

### 3.2.1 Global prevalence of diabetes

As shown in chapter 2, there is a concerning trend of a constant increase of the global prevalence of diabetes, which has more than doubled in the observed period (2000-2021) from 4,6% to 10,5 % in 2000 and 2021 respectively. This would indicate that on average the increase of the prevalence is approximately 5% per annum. However, the trend is not linear and by the end of the period between the years 2019 and 2021 the curve becomes significantly steeper reaching an average increase of prevalence of around 6.5% per annum (International Diabetes Federation, 2000; International Diabetes Federation, 2003; International Diabetes Federation, 2007; International Diabetes Federation, 2010; International Diabetes Federation, 2011; International Diabetes Federation, 2013; International Diabetes Federation, 2015; International Diabetes Federation, 2017; International Diabetes Federation, 2019; Institute for public health of the Republic N. Macedonia, 2021).

Data shown so far refer to estimated number of patients with diabetes. Not all of them have been formally diagnosed by doctors and not all are treated. Estimates for the number of undiagnosed diabetic cases aged between 20 and 79 years are monitored and reported for the years 2011, 2013, 2015, 2017, 2019 and 2021 (International Diabetes Federation, 2011; International Diabetes Federation, 2013; International Diabetes Federation, 2015; International Diabetes Federation, 2017; International Diabetes Federation, 2019; International Diabetes Federation, 2021).

*Table 5: Undiagnosed diabetes. World in the years 2011-2021.*

Year	2011	2013	2015	2017	2019	2021
Undiagnosed (million)	183	175	193	212.4	231.9	240
Total diabetes (million)	366	382	415	425	463	537
Undiagnosed rate %	50	45.8	46.5	50	50.1	44.7

*Source: International Diabetes Federation (2011); International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021).*

As stated by (International Diabetes Federation, 2021) most of the people with undiagnosed diabetes have T2D. The significance of the above figures is that IDF estimates that approximately 50-55% of the people affected by diabetes are actually diagnosed or aware of

their condition. The large share of undiagnosed cases may be among the reasons for high mortality rates for diabetes discussed and presented in Chapter 2.3.

Taking in consideration the significant demographic changes on a global level on the one hand and the almost exponential increase of diabetes prevalence on the other, a potential correlation between the two phenomena has been assumed and explored. In order to determine possible causal relation between demography and the increase of prevalence of diabetes, the latter has been analysed from several aspects such as: prevalence of diabetes by age group, sex distribution of diabetes prevalence and distribution of diabetes in accordance with the place of living (urban vs. rural).

According to, the IDF highest levels of prevalence of diabetes is historically recorded in the age group 40-59 years (International Diabetes Federation, 2021). In 2007, a total of 113 million in the age group 40-59 years are evidenced to have diabetes accounting for 46% of the total diabetic population. In 2010, the same age group stands out with a number of 132 million, however the contribution of 46% to the total diabetic population remains unchanged. In 2011 the number of people of this age group affected by diabetes has increased to 179 million, which has shifted the percentage of contribution of this age group to total diabetics to a level of 49%. In 2013 a significant increase of affected people in absolute terms in the same age group can be evidenced, reaching a level of 382 million. However, this has not affected significantly the rate of contribution of this age group to total affected population, which remains at about 50%, signifying that a similar increase of the number of diagnosed people can be assumed also for the remaining age-groups. The results of this analysis do show a certain increase of prevalence of diabetes in this age group, but this increase does not suffice to explain the doubling of the prevalence of diabetes. In fact, what can be concluded from the above analysis is that there are two periods of relatively constant contribution of this age group to the total number of diabetics. Until 2011 this figure has been kept at a level of around 46%, while since 2013 it accounts for approximately half of the total diabetic population. The 4 percentage points raise in this period, although signifying a potential trend of increase, leads to a conclusion that the increase of prevalence of diabetes, cannot be attributed to the increase of prevalence in this particular age group.

Since no conclusive evidence of correlation of age group distribution of diabetes and its increased prevalence could be identified by the above analysis, a second analysis on an extended age group of 20-64 years has been conducted on parallel tracks with the analysis of the age group of 65-99 years. The rationale behind the choice of these two particular age groups was to analyse the figures of people of working age (20-64), due to the impact of the disease on their respective productivity on the one hand and on the other the developments in the group of elderly people since aging of the population is considered to be one of the more significant contributors to the economic burden of diabetes. The latter aspect will be analysed in more detail below in the following chapters during the analysis of the risk factors of diabetes.

In 2015 there were 320.5 million people with diabetes in the age group 20-64 years, representing 77% of the total affected population, whereas 94.2 million people fall in the age group between 65-79 years, accounting for 22% of the affected population. In the year 2017 the working age ranging from 20-64 years shows a number of 326.5 million, still representing 77% of the total affected population, while the age group between 65-99 years show a number of 122.8 million, accounting for 29% of the total diabetic population. This provides yet another proof that the increase of the diabetes prevalence does not “target” a particular age group and a rather even distribution of increase could be assumed in all age groups. An exception can be observed in the development of prevalence of diabetes in the youngest analysed age group of 20-24 years which has almost doubled from 1.4% and 2.2% in a very short period of time between 2019 and 2021 respectively, and the prevalence among the adults aged 75-79 estimated at 19.9% and 24.0% respectively.

Despite the obvious increase of the number of affected people in the observed period, in relative terms there is only a minor change of the proportion of the diabetics belonging to the largest age group in relation to the total number of diabetics. On the other hand, there is a more significant increase of prevalence among the elderly people (group over 65). A concerning trend of increase of prevalence is also observed in the youngest group 20-24, However, due to the low values of contribution of this group to the total number of diabetics, this increase does not play a significant role in the overall increase of the prevalence of diabetes on a global level.

Data shown indicates that developments of prevalence within different age groups alone cannot provide a comprehensive answer to the issue of the increasing economic burden of diabetes. This implies that other underlying factors should also play an important role. Therefore, the demographic factors analysis has been extended to evaluation of the gender distribution of the prevalence. The number of diabetic patients by gender in the period 2000-2021 is presented in Table 3.

*Table 6: Gender distribution of diabetes. World in years 2000-2021.*

Year	2003	2007	2010	2011	2013	2015	2017	2019	2021
Number of people with diabetes (million)	194	246	285	366	382	415	425	463	537
Male in %	48.5	49.6	50.2	50.5	51.8	51.8	52	51.8	53.3
Female in %	51.5	50.4	49.8	49.5	48.2	48.2	48	48.2	46.7

*Source: International Diabetes Federation (2003); International Diabetes Federation (2007); International Diabetes Federation (2010); International Diabetes Federation (2011); International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021).*

The analysis of the prevalence of diabetes in the period 2003-2021, reveals two opposing trends related to the gender distribution of the disease. While in the period prior to 2010 a greater prevalence of diabetes can be evidenced among the female population, in the following period until 2021 the trend is reversed reaching to over 53% affected males out of the total annual prevalence (International Diabetes Federation, 2000; International Diabetes Federation, 2003; International Diabetes Federation, 2007; International Diabetes Federation, 2010; International Diabetes Federation, 2011; International Diabetes Federation, 2013; International Diabetes Federation, 2015; International Diabetes Federation, 2017; International Diabetes Federation, 2019; International Diabetes Federation, 2021). Bringing the above shift in gender distribution in correlation with the increase of the economic burden of diabetes would require a targeted study of the average direct and indirect diabetes related costs generated by the male and the female population. It is relatively safe to assume that there are no significant differences between the two sexes when it comes to the direct costs of diabetes, leaving the indirect ones as a subject of potential scrutiny. Given the gender inequality in terms of employment and average remuneration, it could be potentially assumed that the increase of the prevalence among the male population could have an impact on the increase of the economic burden of diabetes. However, when this assumption is observed in correlation with the trends of global costs of diabetes presented in Figure 2, no significant change in the trend of the burden can be identified before and after 2010.

The distribution of the diabetes prevalence in accordance with the place of living i.e., urban vs. rural population is also analysed, the results of these findings are presented in Table 7, showing a relatively insignificant increase of prevalence among the urban population, which can most probably be attributed to the internal migration processes.

*Table 7: Urban/ rural distribution of diabetes. World in the years 2000-2021*

Year	2013	2015	2017	2019	2021
No. of people with diabetes /mill	382	415	425	463	537
Urban %	64.4	65	65.7	67	67
Rural %	35.6	35	34.3	33	33

*Source: International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021).*

In the entire period in which IDF provides comprehensive data about the urban vs. rural distribution of diabetes (since 2013), the proportion of rural to urban population affected by diabetes is approximately 1/3 to 2/3.

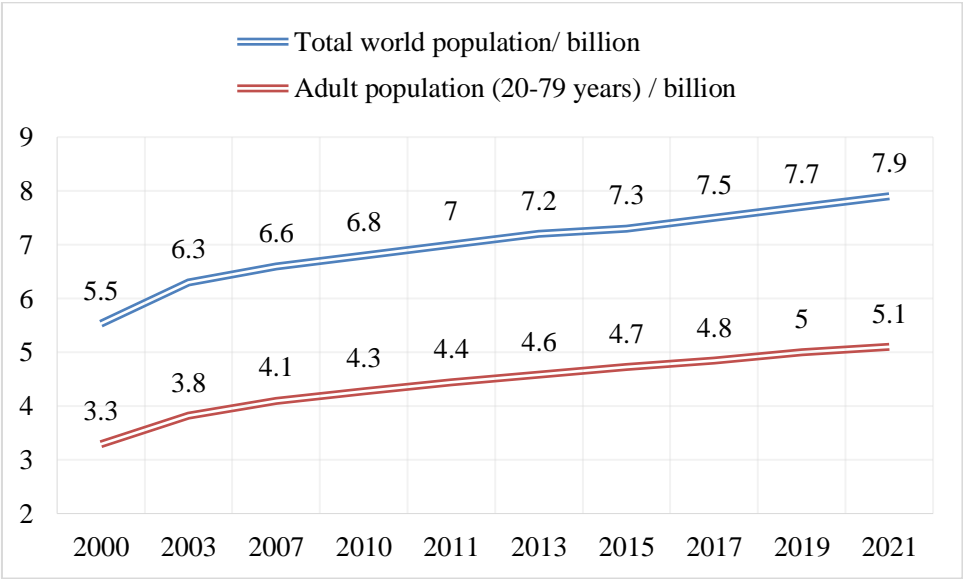
3.2.2 Global prevalence of diabetes risk factors

The causes of diabetes are complex and only partially understood; this disease is generally considered multifactorial, involving several predisposing in general the contemporary medical science distinguishes between two general types of factors that fuel the development of the disease: unmodifiable and modifiable (World Health Organization , 2005). To understand what drives this galloping global upward diabetes and IGT trends described previously, a cross-section of the major diabetes risk factors should be considered.

As shown in Chapter 3.2, during the analysis of the age-group distribution of diabetes prevalence, an increase of the number of affected elderly people could be observed accompanied by a concerning trend on increase of prevalence among the youngest scrutinized age-group. This has led to an assumption that a major unmodifiable factor that contributes to increasing diabetes prevalence is the demographics change worldwide and in particular: population growth, aging and increased life expectancy.

Population across all IDF regions was steadily growing for the whole 2000-2021 period (Internatioanl Diabetes Federation, 2000; International Diabetes Federation, 2003; International Diabetes Federation, 2007; International Diabetes Federation, 2010; International Diabetes Federation, 2011; International Diabetes Federation, 2013; International Diabetes Federation, 2015; International Diabetes Federation, 2017; International Diabetes Federation, 2019; International Diabetes Federation, 2021) reaching nearly 8 billion globally (Figure 5). This represents an increase of about 30% or nearly 2.5 billion since 2000 (Internatioanl Diabetes Federation, 2000).

Figure 5: Total world and total adult population in the years 2000-2021



Source: International Diabetes Federation (2000); International Diabetes Federation (2003); International Diabetes Federation (2007); International Diabetes Federation (2010); International Diabetes Federation (2011); International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021)

*Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021).*

However, according to (Internatioanl Diabetes Federation, 2000; International Diabetes Federation, 2003; International Diabetes Federation, 2007; International Diabetes Federation, 2010; International Diabetes Federation, 2011; International Diabetes Federation, 2013; International Diabetes Federation, 2015; International Diabetes Federation, 2017; International Diabetes Federation, 2019; International Diabetes Federation, 2021) the population is increasingly aging as shown by the continual increase of the ratio of the adult versus total population, although this increase seems to have reached a plateau in the period 2017-2021 (Table 8).

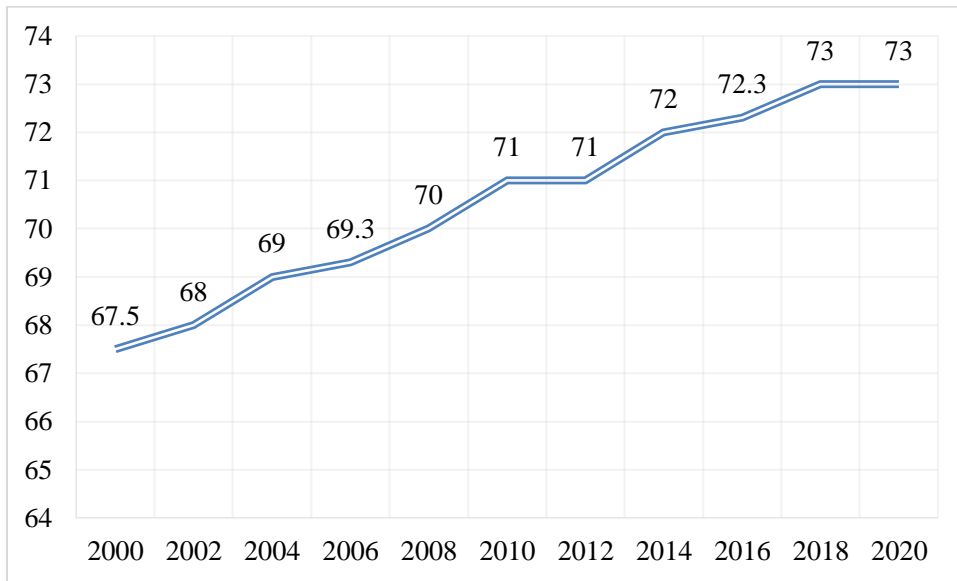
*Table 8: Global adult versus total population ratio in the years 2000-2021*

Year	2000	2003	2007	2010	2011	2013	2015	2017	2019	2021
Adult/Total ratio (%)	59.5	60.7	62.1	62.8	63.4	63.6	64.6	64.5	64.9	64.5

*Source: International Diabetes Federation (2000); International Diabetes Federation (2003); International Diabetes Federation (2007); International Diabetes Federation (2010); International Diabetes Federation (2011); International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021).*

A potential explanation of this trend of aging can be found from the result of the analysis of the development of life expectancy in the period 2000-2020. According to data from the World Bank, in parallel with the population growth, the life expectancy is also continuously increasing, from 67.5 years in 2000 (World Bank, n.d.d.) to 73 in 2020 (World Bank, n.d.d.) (Figure 6). As depicted in Figure 6, from the year 2000 to the year 2020 an increase of 8.1% in terms of life expectancy can be noticed.

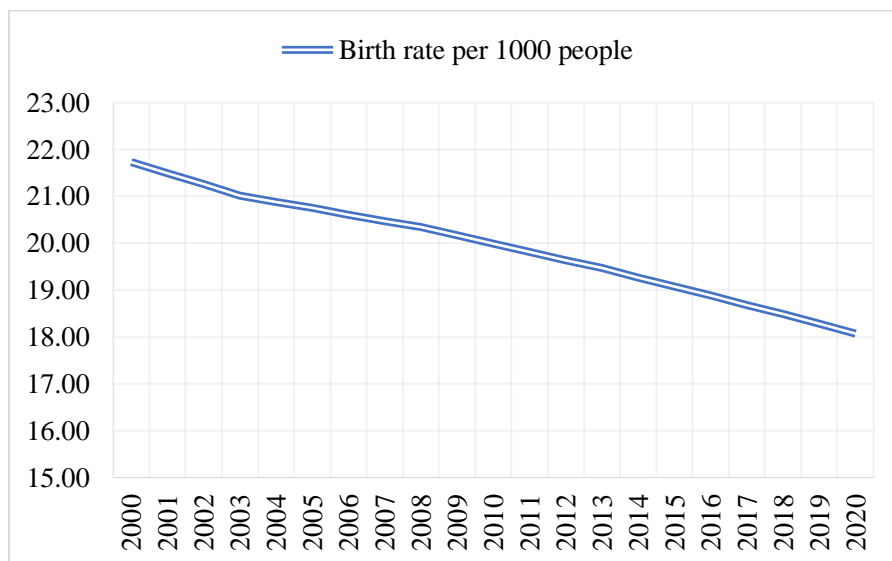
Figure 6: Life expectancy. World in the years 2000-2022



Source: World Bank (n.d.d.).

Deriving from the birth rate trends as presented in Figure 7, which shows an evident and constant decrease of the newly born globally and evaluating them from the point of view of the permanently growing number of total global population, as well as the ratio of adult to total population, the only possible conclusion is that the growth of the population is exclusively a result of the growing number of adult population, as a direct consequence of increased life expectancy. The analysis of the birth rate trends reveals a decrease of approximately 17% in 2020 as compared to 2000, or on average a decrease of 0.8% per annum.

Figure 7: Annual global birth rate per 1000 people



Source: United Nations (2022).

Bearing in mind that the adult age group accounts for the lion's share of the prevalence of diabetes and moreover the prevalence within the group itself shows a trend of growth, it can be concluded that the number of living diabetic population will show a significant growth in the future.

The combination of the increase of total population, increase of prevalence (as discussed above) with the extension of life expectancy points out towards a significantly increased budgetary funds allocation for treatment of the diagnosed diabetics.

In addition to demographic changes ethnicity also represents an important unmodifiable risk factor. As stated by Kyrou et al., (2020) South Asian, Chinese and Japanese overweight or obese individuals have a significantly greater risk for developing insulin resistance and T2D compared to individuals of Caucasian origin. Looking into the South Asian subgroups, Bangladeshi, Pakistani and Indians have the highest T2D risk compared to Europeans. Several studies in Europe point out to the much greater prevalence of T2D in migrant and ethnic minority groups rather than the European host population (Kyrou et al., 2020). In the United Kingdom the prevalence of T2D among migrants and ethnic minorities is three to five time higher than in the British white population. Nationwide data point out that asylum seekers from Somalia, Sri Lanka and Sudan arriving in the Netherlands between the years 2000 and 2008 had a greater risk of developing T2D than the Dutch population (Kyrou et al., 2020).

The discussion related to the unmodifiable factors contributing to diabetes cannot be considered comprehensive without taking in consideration the developments of the risk factors linked to genetic predisposition. Among those factors, the most significant is considered to be the Impaired Glucose Tolerance (hereinafter IGT). People with IGT are at risk for developing T2D, as well as at increased risk of cardiovascular disease, even if they do not develop diabetes (Tominaga et al., 1999). In addition, IGT serves as best indicator for early detection and potential prevention of T2D. The global distribution of IGT rate during the period 2000-2021 is shown in Table 9.

*Table 9: Impaired glucose tolerance. World in the years 2000-2021*

Year	2000	2003	2007	2010	2011	2013	2015	2017	2019	2021
IGT prevalence rate (%)	7	7.2	7.5	7.9	6.4	6.9	6.7	7.3	7.5	10.6
IGT prevalence (million)	300	314	308	344	280	316	318	352.1	373.9	541

*Source: International Diabetes Federation (2000); International Diabetes Federation (2003); International Diabetes Federation (2007); International Diabetes Federation (2010); International Diabetes Federation (2011); International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021)*



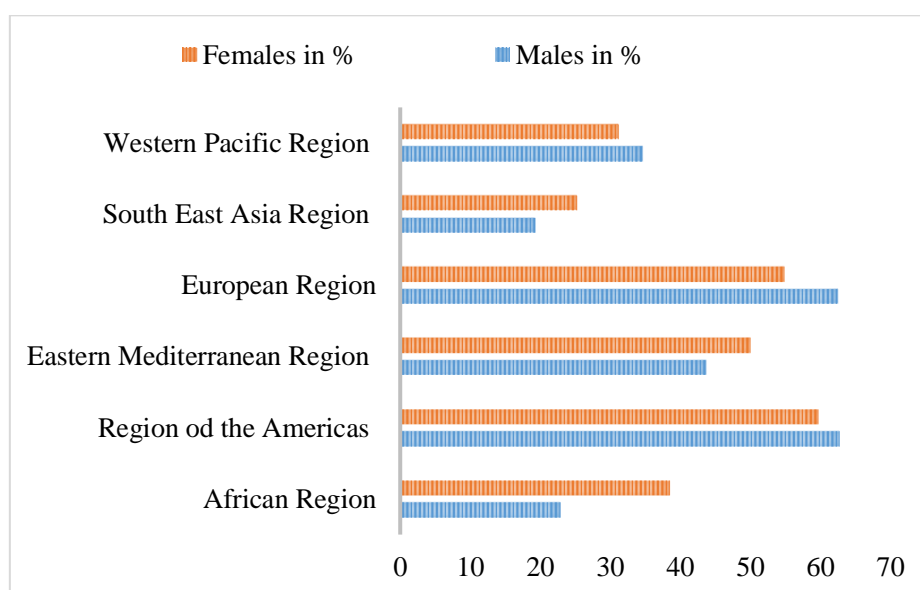
The data in Table 9 points out to an inevitable conclusion that the IGT prevalence has risen for more than 50% in the last two decades, reaching a level of over 10% of the entire world adult population in 2021. The projections of IDF estimate that by 2045, around 11.5% of the entire adult world population will be affected by IGT (International Diabetes Federation, 2021). In addition, according to IDF, almost half (48.1%) of adults aged 20–79 years with IGT are under the age of 50 years and, if left untreated, are at high risk of progressing to T2D later in life (International Diabetes Federation, 2021). It is important to note that nearly one-third (28.3%) of all those who currently have IGT are in the 20–39 years age group and are therefore likely to spend many years at risk of T2D and of adverse cardiovascular diseases.

This points out to a problem of increasing of the number of the active population becoming potentially impaired to fulfil their regular daily activities, thus diminishing their contribution to the generation of Gross Domestic Product (hereinafter GDP), the increased number of the “diabetes candidates” in the budget projections would have to be accounted for as well.

The significance of regular monitoring of IGT is very important for prevention of T2D. For the purposes of this study IGT, due to its etiology is treated as an unmodifiable risk factor, in compliance with the guidelines of the contemporary medical science. However, if detected at an early stage and treated correctly including changes of dietary habits and lifestyle, in general its progression towards T2D can be put under control. Therefore, it can also easily be considered as a transition from analysing the unmodifiable factors to the analysis of the ones, over which we as human beings have a significant degree of control.

The modifiable, or as they are usually referred to as, lifestyle-related risk factors primarily include overweight and obesity. For purposes of consistency and comparability, a similar methodology of analysis has been utilized for addressing the issues linked to the modifiable risk factors, meaning it has been analysed from the same points of view as the unmodifiable ones. The assessment of the impact of the modifiable risk factors starts with correlating the prevalence of overweight and obesity with different demographic indicators. Figure 9 presents the distribution of prevalence of overweight by sex and region on a global level.

Figure 8: Prevalence of being overweight by sex and region. World, 2016.

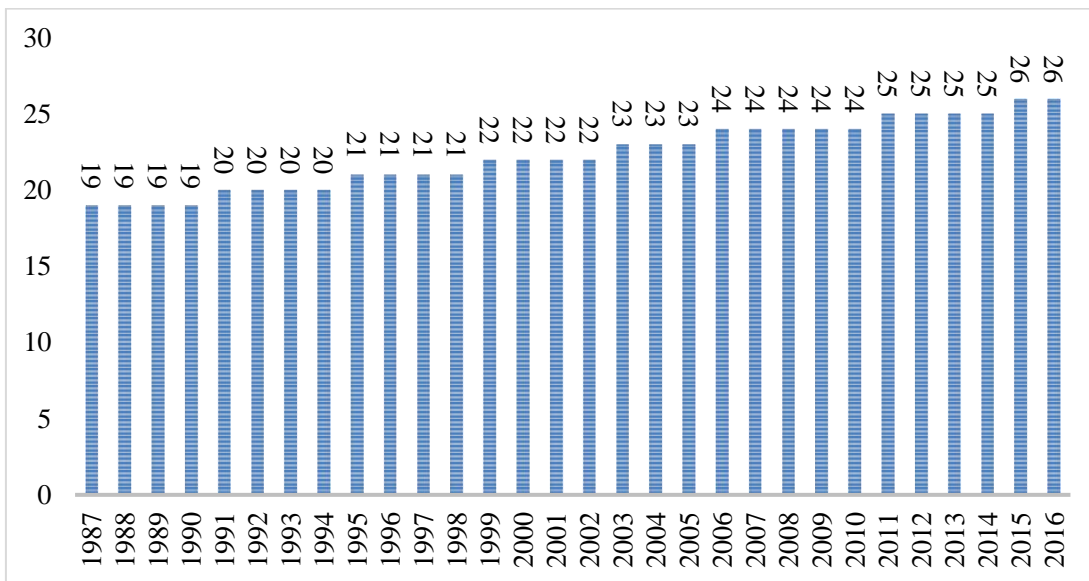


Source: World Health Organization (2016).

As can be concluded from Figure 9, according to WHO the American region is the one with the highest share of the overweight population, meaning that in this region there are most women (59.8%) and men (62.8%) living with a body mass index (hereinafter BMI) higher than 25, which increases exponentially the risk of developing diabetes type 2 (World Health Organization, 2016). The region showing the lowest percentages in terms of BMI is the South-East Asia Region, with 19.3% of the total male population and 25.3% of the female population with a BMI above 25.

The rising trend of a BMI between 25-30 is shown in Figure 10. According to FSD, there is an increase of cases with a BMI between 25-30 over the years, ranging from 19% in 1987 to 26% in 2016, when the overweight population reached its peak worldwide (Food Systems Dashboard, n.d.c.). This suggests an increase of 36.8% for the period 1987-2016.

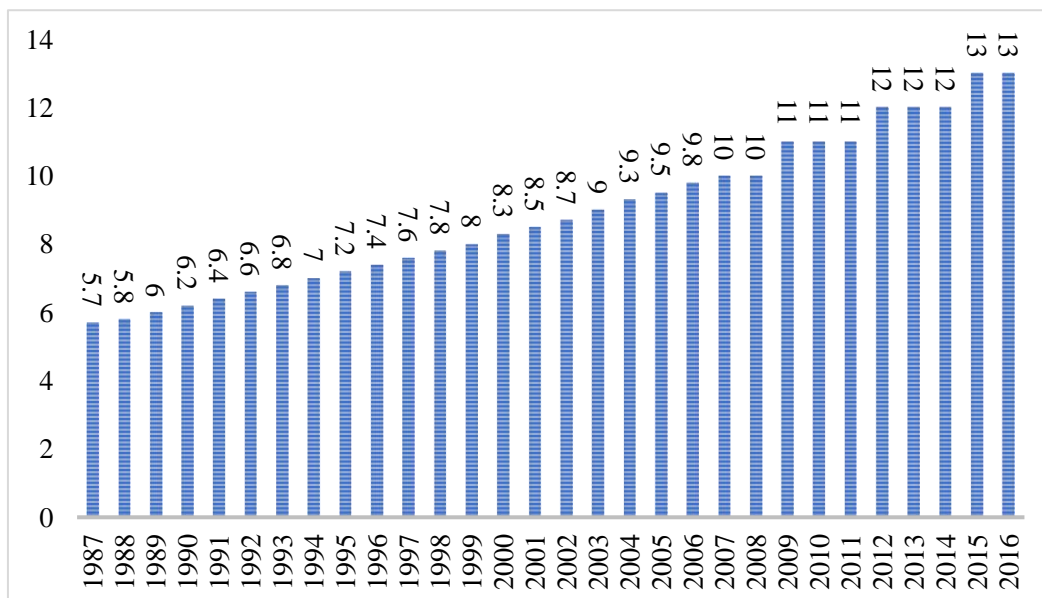
Figure 9: Adult overweight (BMI 25 to <30) in %. World in years 1987-2016



Source: Food Systems Dashboard (n.d.c.).

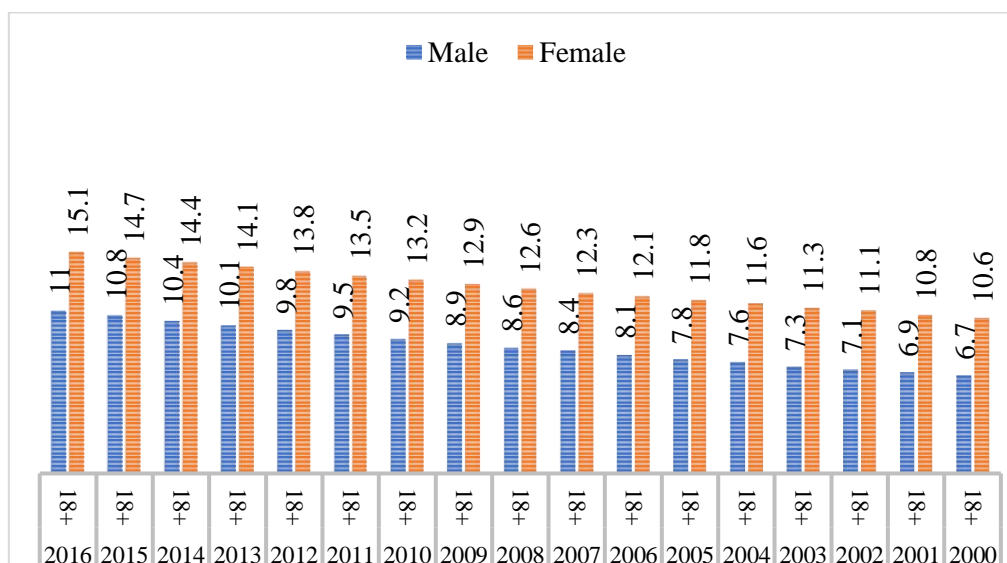
Similar trajectory is noticed in the prevalence of obesity (BMI>30). Based on the FSD, the percentage of people with obesity in 1987-2016 more than doubled (Figure 11) (Food Systems Dashboard, n.d.d.). Namely, while the total global obese populations were represented with 5.7% (Food Systems Dashboard, n.d.d.), in 2016 the proportion of obese adults was 13% (Food Systems Dashboard, n.d.d.)

Figure 10: BMI over 30. World in the years 1987-2016



Source: Food Systems Dashboard (n.d.d.).

Figure 11: Prevalence of obesity among adults (male and female) BMI  $\geq 30$ . World in years 2000-2016



Source: World Health Organization (n.d).

According to WHO globally between the years 2000-2016 there are more adult obese women than men and this constant thought the years, an increase of 35% in obese adult women is noted between the years (2000-2016), whereas the increase in obese adult men in the same year range amounted to 49.4% (World Health Organization, n.d).

As presented, overweight and obesity are independent risk factors contributing towards increasing diabetes prevalence trends. According to Kyrou et al., (2020), the risk of developing diabetes rises exponentially with a BMI over 30kg/m<sup>2</sup>. A range from 1987 when 5.7% of the population globally had a BMI higher than 30, until the latest available data in 2016 when the total world percentage of people with a BMI over 30 reaching to 13% is shown and a total increase of 128% is noted over these years. BMI has been reported to predict the development of diabetes with an incidence rate from three to ten times higher in people with BMI ranging from 25 to 30 kg/m<sup>2</sup>, as in people with more than 30 kg/m<sup>2</sup> (Kyrou et al., 2020).

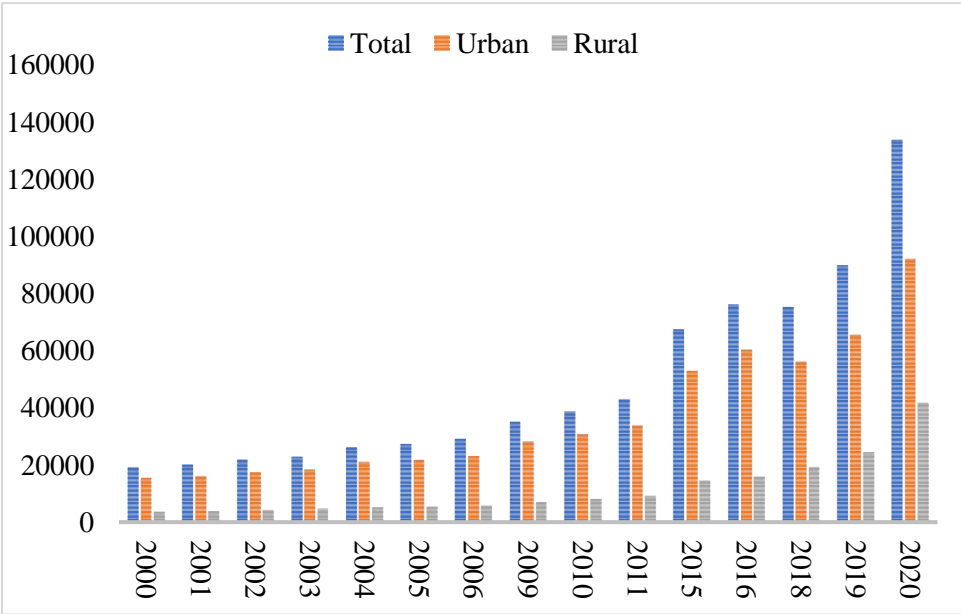
### 3.3 Prevalence of diabetes and its risk factors in Republic of North Macedonia

#### 3.3.1 Prevalence of diabetes in Republic of North Macedonia

Since 2000, when the total number of people from RNM with diabetes was 19,224, a massive increase of people having been diagnosed with diabetes is noticeable, reaching a total of 133,803 in 2020 (Figure 13), signifying a notable increase of approximately 600% within two decades. When analysing the contribution of the diagnosed diabetics to the total population in the related year, it can be concluded that in 2000 the percentage of diabetics was 0.9% of the total population, which according to the WHO was 2,03 million (*World*

Bank, n.d.a.). This ratio in 2020 has reached 6.5% of the total population of 2,07 million (World Bank, n.d.c.). There are two trends that can be distinguished when analysing Figure 13. From 2000-2015 there is a relatively linear growth rate of the total diabetics in RNM, while in the succeeding period of 2015-2020 there is an exponential increase of the absolute numbers of diabetes prevalence, with two major extremes of around 50% as compared to the previous years in 2015 and in 2020. Compared with the trends on a global level for the same period, a very significant difference between the developments in RNM and globally is evident. In fact, in the observed period the total increase of affected population in RNM is 6 times higher than the one on a global level. As shown in Figure 13, the distribution of urban to rural population diagnosed with diabetes follows pretty much the same trend as the one on a global level, with 92,011 of them living in urban areas while the remaining 41,792 being rural residents. There is a high level of probability that partially the distribution of diabetes prevalence as described can to a great extent be attributed to the internal rural to urban migration of population.

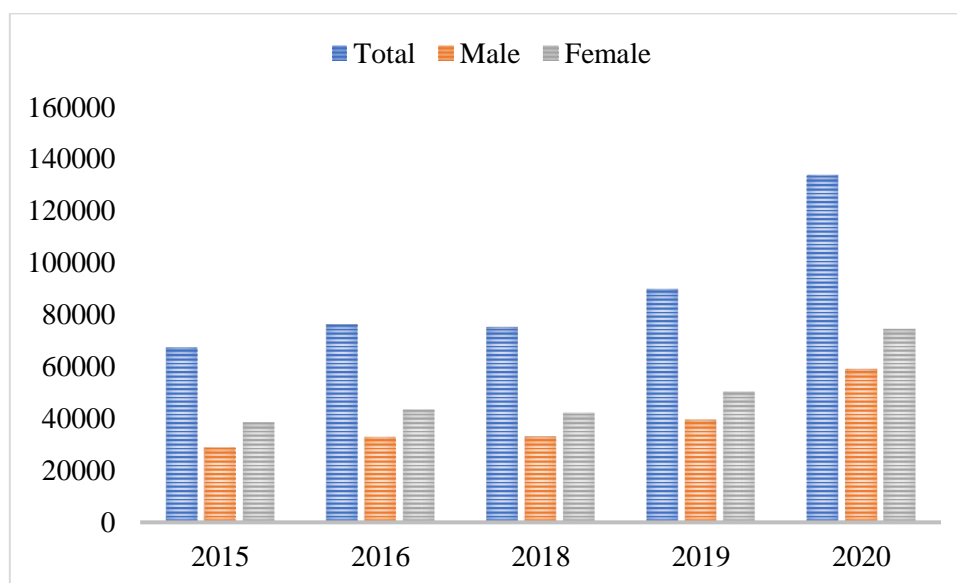
Figure 12: Total diabetes prevalence, regional distribution in RNM in years 2000-2020



Source: Institute for public health of the Republic N. Macedonia (2001); Institute for public health of the Republic N. Macedonia (2002) ; Institute for public health of the Republic N. Macedonia (2003); Institute for public health of the Republic N. Macedonia (2004); Institute for public health of the Republic N. Macedonia (2005); Institute for public health of the Republic N. Macedonia (2006); Institute for public health of the Republic N. Macedonia (2007); Institute for public health of the Republic N. Macedonia (2010); Institute for public health of the Republic N. Macedonia (2012); Institute for public health of the Republic N. Macedonia (2016); Institute for public health of the Republic N. Macedonia (2017); Institute for public health of the Republic N. Macedonia (2019); Institute for public health of the Republic N. Macedonia (2020) ;Institute for public health of the Republic N. Macedonia (2021).

As for the sex distribution of the disease in 2020 the female population shows a greater prevalence of diabetes with a number of 74,660, whereas the male population shows a number of 59,143 affected. The sex distribution is presented in Figure 14. As opposed to the global trends showing a shift of prevalence from female to male population, in RNM the female population has constantly a higher contribution to the total number of diabetics as compared to the male.

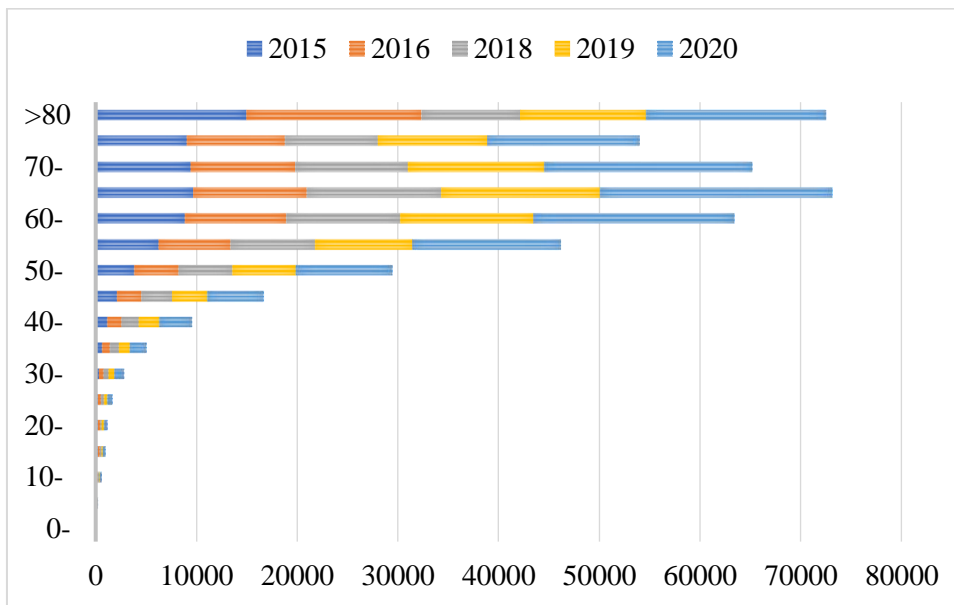
Figure 13: Total diabetes prevalence, sex distribution in RNM in the years 2015-2020



Source : *Institute for public health of the Republic N. Macedonia (2016); Institute for public health of the Republic N. Macedonia (2017); Institute for public health of the Republic N. Macedonia (2019); Institute for public health of the Republic N. Macedonia (2020) ;Institute for public health of the Republic N. Macedonia (2021)*

For the purpose of the analysis of sex distribution only the data from 2015-2020 were taken into consideration for reasons of lack of existence of reliable data for the period prior 2015. The trend in RNM once again confirms the conclusion from chapter 3.2.1 that the gender of the affected people does not play a major role in terms of economic burden of the disease, given the fact that as presented in chapter 3.4 the burden does not show any kind of gender related sensitivity.

Figure 14: Age distribution of diabetes in RNM.



Source : Institute for public health of the Republic N. Macedonia (2016); Institute for public health of the Republic N. Macedonia (2017); Institute for public health of the Republic N. Macedonia (2019); Institute for public health of the Republic N. Macedonia (2020) ;Institute for public health of the Republic N. Macedonia (2021)

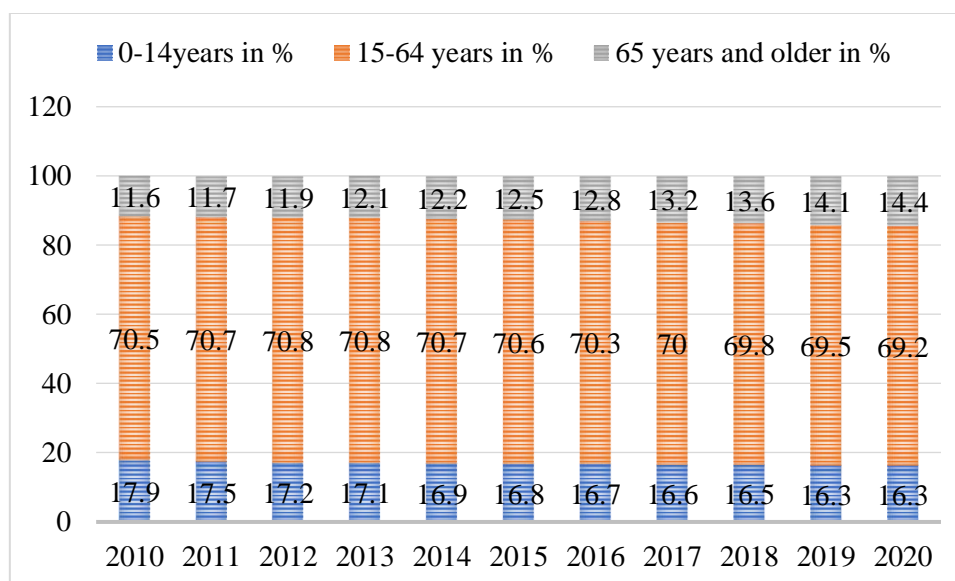
The Figure 15 clearly shows that the distribution of diabetes is not even throughout the age groups, the age groups above 50 show considerably greater number than those in the age group from 0-45. What is also a continuous trend in the adult age group (50-80+) is the constant increase of prevalence thought the years. The age group of 65 years shows the greatest number of above 23,000 for 2020. This points out to a conclusion that the trends in RNM follows a similar pattern of the one on a global level, as argued in chapter 3.2.1, with a difference that the largest number of affected people is recorded in the age group of 50 and above, which might, as we discuss in the next subchapter, indicate that aging as a risk factor is more severe in RNM. As already explained in the discussion of gender distribution, the lack of reliable available data, limited the analysis to the period from 2015-2020.

### 3.3.2 Prevalence of diabetes risk factors in Republic of North Macedonia

In the Figure 16 a constant increase of the 65+ years age group old can be detected. At the same time in the observed period the population falling into the first age category of 14 and below is in constant decrease, from 17.9% in 2010 to 16.3% in the last year taken into account. The next age group (15-64 years old) shows a slight decrease during the years taken into account. The only conclusion that can be derived by the above is that the birth rate in RNM is in decline, as opposed to the trend of constant growth of the elder population as a result of the increase of life expectancy as presented in Figure 17. Having in mind that as shown in Figure 13 the highest level of prevalence is recorded particularly in the age group

of 65 years and older, the constant increase of the number of people belonging to this age group signifies that the total number of diabetics will continue to rise.

Figure 15: Aging population in RNM in years 2010-2020.



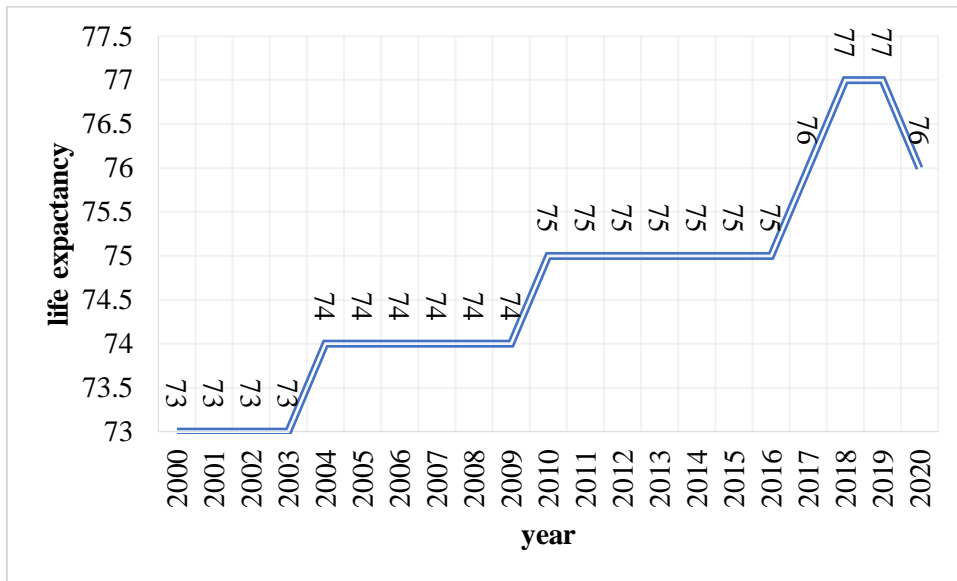
Source: Statista (n.d.).

The above analysis has to be observed also from the point of view of the trends of life expectancy in RNM.

According to data from The World Bank life expectancy is continuously growing (*World Bank, n.d.e.*). From the year 2000 to the year 2020 an increase of 4.1% in terms of life expectancy is noticed. Observing the trends in all age groups from the aspect of the average age of population it can be concluded that the RNM population faces a significant aging problem.

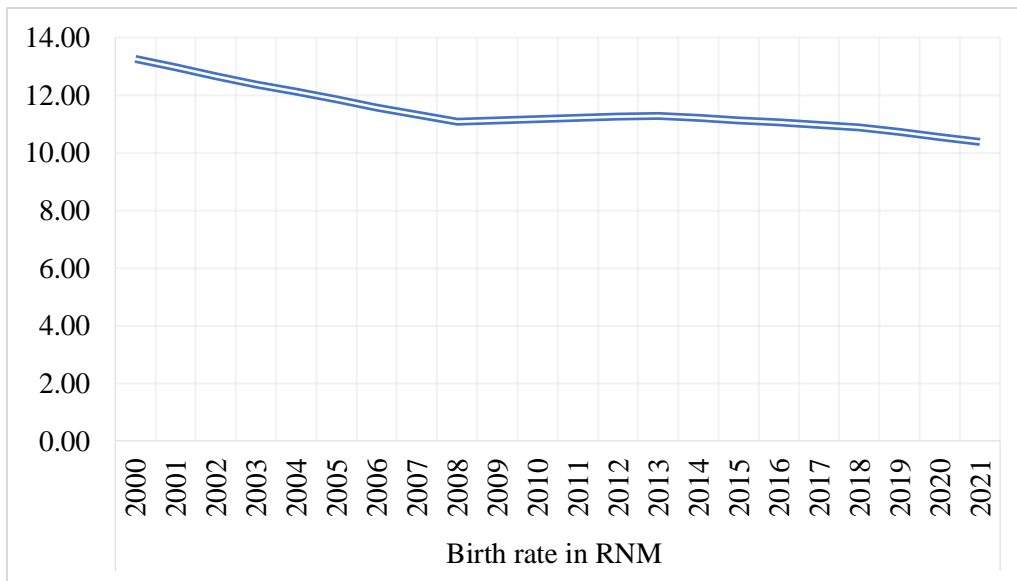


Figure 16: Life expectancy in RNM in the years 2000-2020.



Source: The World Bank (n.d.e.).

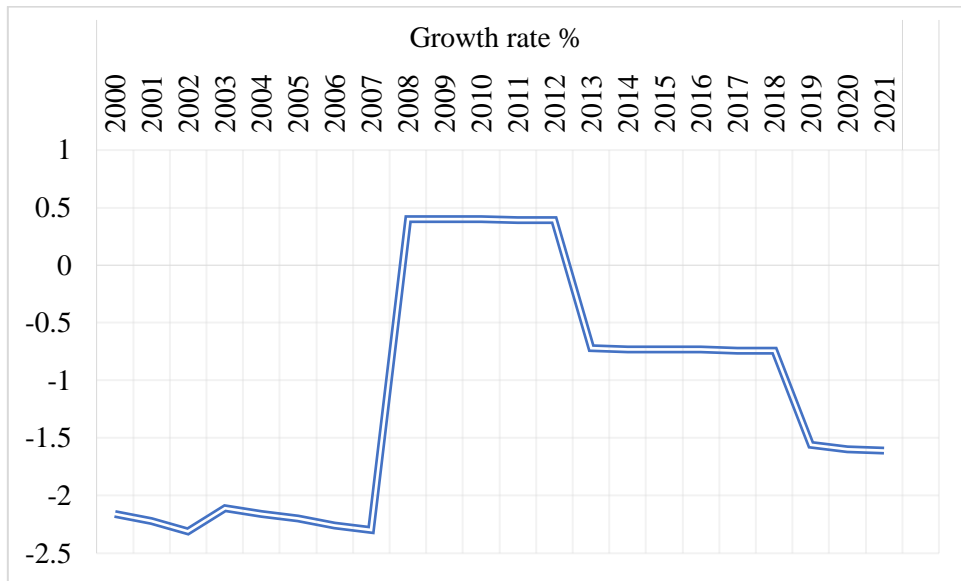
Figure 17: Birth rate in RNM in the years 2000-2021.



Source: United Nations (2022).

In contrast to the constantly increasing of the adult population, the demographic statistics show a negative development of the birth rate trend in the period 2000-2021 as presented in Figure 18, according to which, the number of newly born is permanently decreasing. The total decrease during the period from 2000-2021 is around 22%.

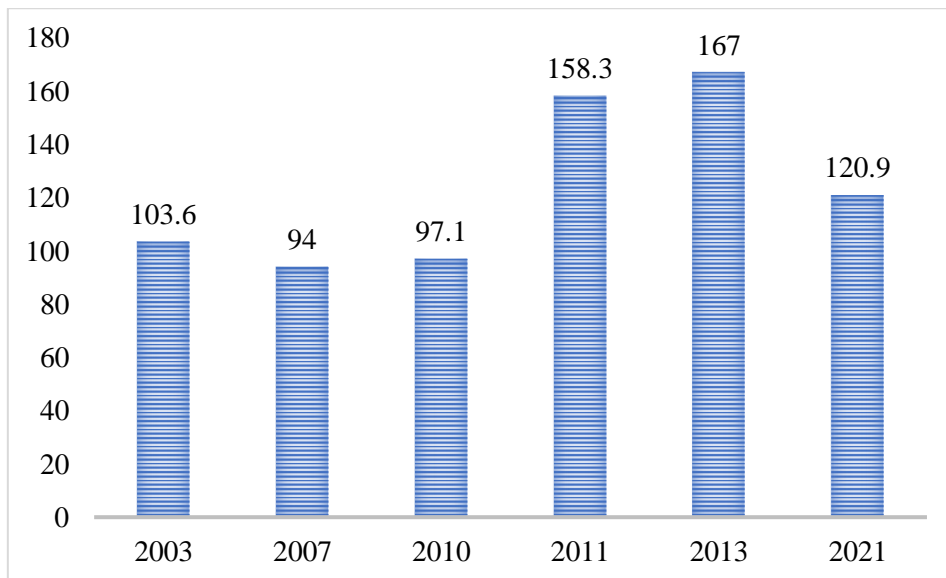
Figure 18: Annual birth rate change in % in RNM in the years 2000-2021



Source: United Nations (2022).

Having in mind that the adult age group in RNM which accounts for the biggest share of the prevalence of diabetes shows a trend of growth, following the same trend as on a global level and moreover the prevalence within this particular age group is in constant rise, combined with the trend of increase of life expectancy, it can be concluded that the number of living diabetic population will show a significant growth in the future. The combination of the increase of total population, increase of prevalence (as discussed above) with the extension of life expectancy points out towards a significantly increased budgetary funds allocation for treatment of the diagnosed diabetics.

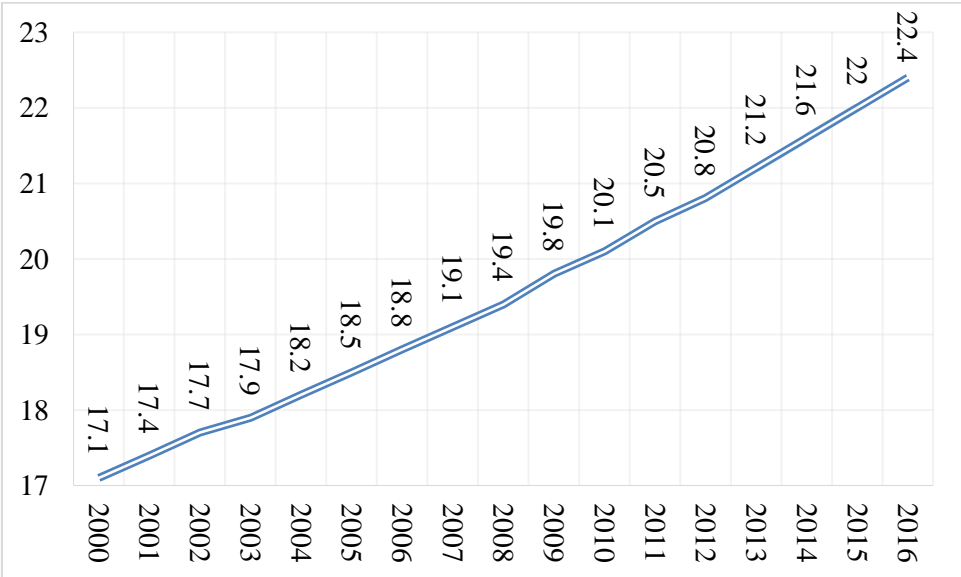
Figure 19: Number (in thousand) of people with impaired glucose tolerance in RNM in the years 2003-2021



Source: *International Diabetes Federation (2003); International Diabetes Federation (2007); International Diabetes Federation (2010); International Diabetes Federation (2011); International Diabetes Federation (2013); International Diabetes Federation (2015); International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021).*

The second most important risk factor for developing diabetes as argued above, is the IGT. There is a gap of 8 years in which IDF does not report on the development trends of prevalence of IGT in RNM. What is even more compelling is that exactly in this particular period the IGT prevalence trend is reversed, bringing the IGT prevalence in 2021 to a level of approximately 121,000 people, which compared to 2013 is a decrease of prevalence of almost 30%. Results concerning IGT prevalence rate show a considerable increase in 2013 as compared to 2003, with a relatively insignificant decrease in 2007 and 2010. The trend is reversed in the period 2013-2021, where a considerable decrease in the number is noticeable. Observed in correlation with the diabetes prevalence in the same period, up to 2013 there is a high degree of convergence between the two curves which supports the assumption that IGT is a very significant risk factor for developing T2D. Although, some T2D prevalence indicators in the period 2013-2021 show a degree of flattening of the prevalence curve, which can probably partially be attributed to the degree of decrease of IGT prevalence, due to limited availability of data related to prevalence of IGT, no evidence-based conclusion can be drawn for this period.

Figure 20: Prevalence of obesity (BMI>30) in adults in RNM in the years 2000-2016



Source : FAOSTAT (n.d.d.).

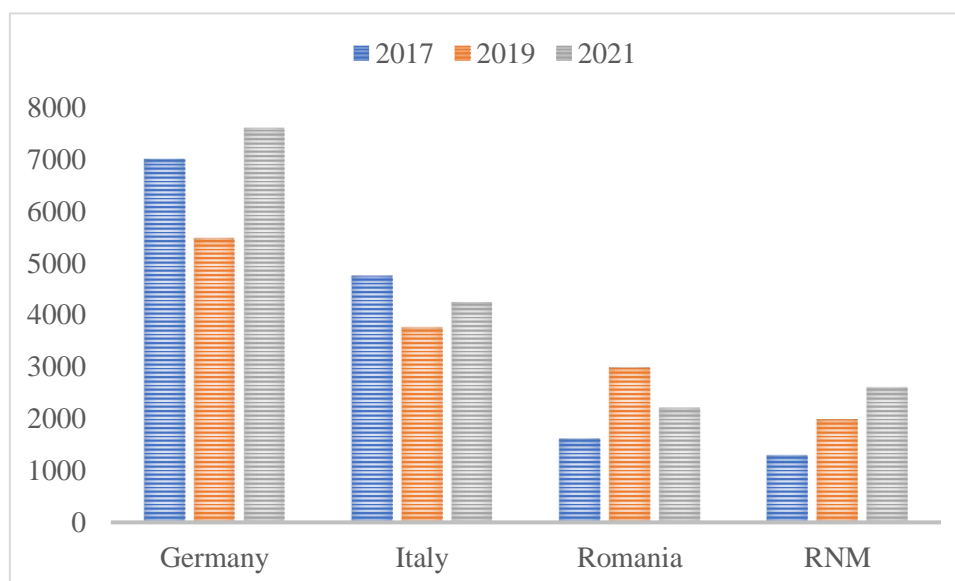
The analysis of the statistical indicators, without entering into medical deliberations, confirm the assumption that IGT is a very important and potent risk factor not only for the development of T2D, but also has a direct influence over the prevalence of obesity as another highly important risk factor. According to FAOSTAT, as presented in Figure 21, there is a

constant growth of prevalence of obesity in the Republic of North Macedonia. This trend is almost a linear throughout the observed period, reaching a disturbing level in 2016 in which more than 1 out of 5 citizens of RNM could be characterized as being obese.

### 3.4 Short comparative analysis of diabetes burden in Republic of North Macedonia and selected European countries

In this chapter, three EU countries were selected in order to make the comparison of the factors such as the absolute prevalence of diabetes and the prevalence rate in each of them, diabetes related expenditures and the per capita burden of the disease. For the purposes of this comparison the various socio-economic aspects of Italy, Germany and Romania were selected to be compared to the ones in RNM. This particular EU countries were chosen under the assumption that the GDP might play an important role in combating and preventing the spread of diabetes. Therefore, Germany as the richest county in EU together with another member of G7- Italy were selected to be compared to RNM trends. In order to determine whether the rate of GDP plays a role even within the EU, this comparative analysis includes also Romania, whose macroeconomic indicators are much closer to the ones of RNM.

*Figure 21: Diabetes related expenditure per person PPP (USD) in Germany, Italy, Romania and Macedonia in the years 2017-2021.*



*Source: International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021).*

The Figure 22 explicitly shows that the diabetes related expenditures in most of the analysed countries has increased in 2021 compared to 2019. The only exception being Romania, showing an opposite trend. The trend of development of diabetes related expenditures does not follow the pattern of the prevalence curve, which leads to a conclusion that there is an additional underlying reason influencing the level of these expenditures. One possibility can

be that due to the Covid pandemics most of the health-related budget was allocated to combating the virus, thus in 2021 more diabetic patients were perhaps treated to offset lower accessibility to health care in 2020. In this comparison the RNM shows a completely different pattern of constant steady increase of the costs throughout the observed period. On the other hand, the level of per capita PPP expense in RNM is significantly below the levels of the two wealthier EU countries, while in comparison with Romania in 2021, per capita expenditures in RNM are slightly higher.

In order to access the relative burden generated by the diabetes related expenditures, those expenditures are compared with the per capita Gross Domestic Product Purchasing Power Parity (hereinafter GDP PPP) for the observed countries.

*Table 10: Relative burden of per capita GDP PPP. In the years 2017-2021.*

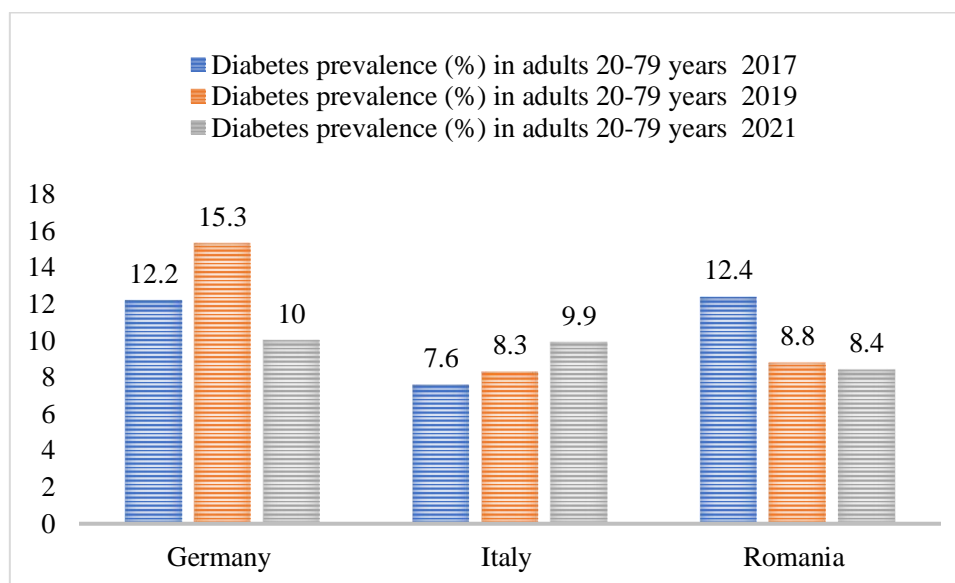
Year	GDP PPP per capita			Diabetes related costs per capita (PPP)			Relative burden of the per capita GDP PPP		
	2017	2019	2021	2017	2019	2021	2017	2019	2021
Germany	53,000	55,600	58,000	6,992	5,466	7,605	13%	10%	13%
Italy	41,600	44,400	46,000	4,751	3,756	4,244	11%	8%	9%
Romania	27,200	31,900	35,400	1,624	2,987	2,215	6%	9%	6%
RNM	15,700	17,500	17,900	1,302	1,989	2,610	8%	11%	15%

*Source: International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021); World Bank (n.d.b.).*

It becomes very obvious that RNM is the poorest country in this comparison, with a per capita GDP PPP of more than 3 times lower than Germany as the richest one. Therefore, the comparison of the per capita expenditures related to diabetes would only make sense if they are presented in terms of PPP and shown in relative terms, as a percentage of the per capita GDP PPP. As presented in Table 10, at the beginning of the observed period the more economically powerful countries have a far greater budgetary allocation for combating the diabetes, which in Germany rises to an exceptionally high level of 13% of the per capita GDP PPP, in 2019 all of countries taken into consideration show a very similar burden of the GDP PPP with an average between 9 and 10%. In 2021 all of the countries in this comparison show an increase of the burden, apart from Romania. Germany has returned to its pre-covid levels, while in Italy the increase is more moderate. Romania has also returned to its pre-covid levels of burden showing a completely reversed pattern from the other 2 EU member countries. The only case that has an expected or predictable pattern of the diabetes-related budget to prevalence ratio is the RNM and a clear conclusion can be drawn in this case. The steady increase of the budgetary allocations to combat the diabetes at levels of 8, 11 and 15% in 2017, 2019 and 2021 respectively follows the increase of prevalence. It is worth noting that in 2021 RNM although being the poorest in this comparison, has the highest level of burden. The reasons for this can be found in the rapid increase of prevalence,

which is not always followed by a corresponding increase of the level of the GDP PPP, leading to a conclusion that RNM could potentially run into a situation in which it will be over-burdened. This analysis of the potential correlation between the level of GDP PPP and the prevalence of diabetes was performed under the assumption that the richer counties would provide more opportunities for healthier dietary habits of the population, thus decreasing the rate of increase of prevalence by minimizing one of the main risk factors.

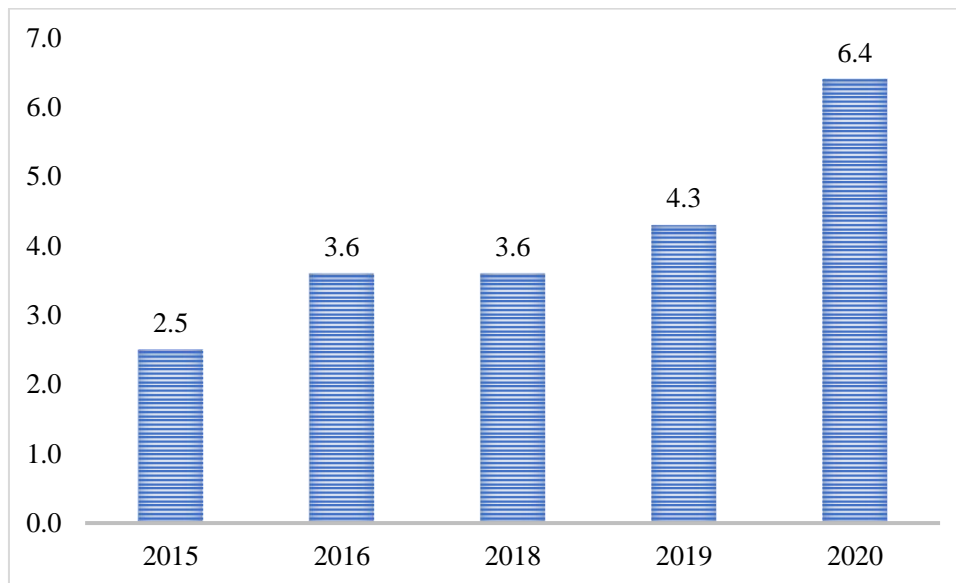
*Figure 22: Diabetes prevalence in % in Germany, Italy, Romania in the years, 2017,2019,2021*



*Source: International Diabetes Federation (2017); International Diabetes Federation (2019); International Diabetes Federation (2021).*

The results in Figure 22 prove wrong the assumption that wealthier countries have a lower rate of prevalence which is obvious in the case of Germany which despite being the richest country in this comparison, shows the highest rate of prevalence. In fact, all EU member countries compared to RNM show considerably higher rates of prevalence, to the contrary of the assumption that economically more powerful countries might provide better environment for prevention of diabetes and its risk factors.

Figure 23: Diabetes prevalence in % in RNM in years 2015-2020



Source : Institute for public health of the Republic N. Macedonia (2016); Institute for public health of the Republic N. Macedonia (2017); Institute for public health of the Republic N. Macedonia (2019); Institute for public health of the Republic N. Macedonia (2020); Institute for public health of the Republic N. Macedonia (2021).

The primary aim of this comparison was to establish potential correlation between the prevalence of diabetes and the funds allocated by the budget to cover the direct and indirect costs of it. On parallel tracks, the analysis was performed in order to establish the relative burden of the countries' economies by the diabetes related costs and potentially identify the threat of overburdening their respective health-related budgets.

RNM despite being the poorest county in this comparison, shows by far the lowest rates of prevalence of diabetes in the period of 2015-2020. However, what is concerning is the trend of rapid growth, which within the last 5 years has almost tripled. In conclusion it can be seen that the poorer countries such as RNM and Romania do tend to show lower prevalence rates, which might also be due to less effective diagnosis of these countries. However, Romania in particular has even accomplished to lower the prevalence rate for some 33% between 2017-2021.

After completion of the above analysis, it is very difficult to come to a data driven conclusion, since there are no clear common patterns to be identified among the observed countries. The cases of Romania and RNM point out to a phenomenon that could potentially be worth exploring in a more detailed study. Namely, it would be interesting to determine whether an increase in the diabetes-related budget could potentially lead to decrease of prevalence if applied as a consistent long-term policy targeted at prevention of diabetes and its risk factors such as: increase of awareness, expansion and systemic application of randomized blood glucose level and IGT tests.

The results of correlating the budgetary allocations for coverage of the diabetes related costs and the prevalence of the disease show that most of the developing countries would soon run into a problem of impossibility to cover the expenditures of the ever-growing number of affected population. This, on the other hand raises yet another issue worth exploring. The underlying dilemma that would require a resolution is whether the state through the instruments of its fiscal policy could somehow influence the lowering of the prevalence of diabetes and its risk factors, or at least lowering of their respective growth rate. This possibility has already been explored in numerous countries and the following Chapter 4 will attempt to explore the optimal interventions of the state to achieve a long-term sustainability of the diabetes related expenditures.

## **4 THE POTENTIAL TO MANAGE LIFESTYLE RELATED RISK FACTORS IN RNM**

### **4.1 Methodology and data collection**

To design targeted economic measures that would have the potential to contribute towards diabetes prevention and management, it was important to provide a broad overview of the main underlying issues that fuel the rising trend in diabetes in a multifaceted approach as experienced through the eyes of stakeholders involved in the provision, implementation and use of diabetes care as well as those involved in researching evidence-based measures and policies in the RNM. Thus, for the second, qualitative part of this research, semi-structured in-depth interviews with relevant stakeholders were conducted to elicit detailed and contextual discussion and generate ideas unique to the specific cultural context. Semi-structured interview approach was chosen as it allows a more natural and intuitive conversation while questions could be adapted based on the specific direction of responses received (*Patton, 2002*). Opposite from the unstructured interviews, the semi-structured approach aims at addressing the research objective by having an interview guide designed for that particular purpose (*Adeoye- Olatunde & Olenik , 2021*). This approach has been utilised in several qualitative diabetes studies (*Gillani, Sulaiman, Abdul, & Saad, 2017; Abdoli, Abazari, & Mardanian, 2013; Rafique & Shaikh, 2006*). The reason why this approach was selected is due to the fact the semi- structures interviews are very practical when conducting in-depth interviews, since it allows the interviewer to critically scrutinize the conversation which will help to draw precise conclusions (*Kakilla, 2021*).

Interviewed participants included: patients' representative of the Macedonian Association of People with Diabetes, Mr. Viktor Lukarski (hereinafter VL); a doctor, specialist in endocrinology, Dr. Nadica Bozinovska (hereinafter NB); a nurse providing diabetes care, Ms Gordana Komljenovic (hereinafter GK); a professional from the Institute of Public Health of RNM, Msc. Shenaj Skenderoska Adzija (hereinafter SHSA) and a Public Health



Nutrition lecturer and evidence-based researcher in the field of T2D, Dr. Teuta Gjuladin Hellon (hereinafter TGJH).

Each interview contained open ended questions specifically designed for different stakeholder. The key explored topics were aligned with study objectives and were divided into 4 themes:

- risk factors,
- prevention,
- efficacy of current policies, and
- any other potential measure and/or policy that could be implemented to improve prevention and management of diabetes.

The questions such as awareness of the quality and quantity of foods are important to identify the main modifiable diabetes risk factors in RNM, as diet is the cornerstone of diabetes prevention and self-management (World Health Organization, 2016; Ashra et al., 2015). Although the prevalence of modifiable risk factors is easier to quantify (Chapter 3 Section 3.3), it is difficult to understand what determines the engagement and retention in diabetes prevention and management programs and thus further disease progression (Gray , Yates , Troughton, Khunti, & Davies, 2016). Even more complex is to understand what drives people’s dietary choice as these are influenced by factors such as food affordability, food availability, individual preferences and beliefs, cultural traditions, and social and environmental factors (World Health Organization, 2003). Hence, the first and second group of interview questions regarding diabetes risk factors, prevention and self-management have the potential to an extent to clarify the main reasons that drive the obesity and thus other risk of T2D upward trends.

Understanding the efficacy of existing policies, and the receipt of optimal diabetes care are important indicators that should guide future national policies and practices (World Health Organization , 2015). Thus, the third set of questions were related to the experiences and perceptions of stakeholders regarding the efficacy of existing policies aiming at diabetes prevention and diabetes self-management.

Lastly, based on the increasing economic burden in the RNM (Chapter 3 section 3.4) and increasing prevalence of diabetes and its associated risk factors (Chapter 3 section 3.4), it becomes apparent that public health policies alone are unlikely to have the capacity to curb diabetes upward trend. Siloed approach via public health interventions is inefficient to mitigate the rising burden of diabetes and its associated morbidity and mortality (*Gjuladin Hellon , Davies, Penson, & Amiri Baghbadorani, 2019; World Health Organization, 2016*),. Hence, the potential of the fiscal policies and any other measure that has the potential to impact diabetes risk factors were investigated in the last set of interview questions.

This approach also enabled to determine whether the “real-world” experiences, observations and attitudes of the interviewees that are unique, are in line with the results presented in the quantitative analysis.

All interviews were planned to be conducted face-to-face at participants’ work place. The participants were given the choice of a face-to-face or zoom interview. The interviews took place during September, 2022, three face-to-face interviews were conducted at: the Institute of Public Health of the RNM with SSA, the secondary hospital Acibadem-Sistina with the specialist nurse (GK) and via zoom with the Public Health Nutrition lecturer and evidence-based researcher in the field of T2D (TGJH). Duration of the interview varied from approximately 30 minutes (with GK and SSA) to 60 minutes (TGJH). When conducting the face-to-face interviews, the discussion was recorded, right after which each interview was transcribed and sent to the interviewees by email for authorisation.

Unfortunately, the remaining two interviews could not be conducted face-to face. Due to COVID restrictions and workload, the specialist endocrinologist in the secondary hospital Acibadem- Sistina (NB) and the patients’ representative of the Macedonian Association of People with Diabetes preferred to provide answers via email.

The interview answers for each stakeholder are provided in the Appendices 1-5 as follows: Appendix 1 (In depth Interview with a representative of a diabetes association); Appendix 2 (In depth Interview with a specialist endocrinologist); Appendix 3 (In depth interview with a specialist nurse); Appendix 4 (In depth interview with a professional from the Institute of Public Health of RNM (SSA) and Appendix 5 (In depth interview with a public health lecturer and researcher TGJH).

Since all the interview responders locate the reason for the significantly increased prevalence of diabetes in the lifestyle related risk factors, the following subchapters 4.2 and 4.3 deal with detecting and analysing them, as well as identifying potential approaches for their management and mitigation. The responders make a very clear correlation between the lifestyle related risk factors and the level of poverty, suggesting that the poorer dietary habits of the population are dictated by the deterioration of the overall economy in the country. Furthermore, the lifestyle related risk factors and their management were chosen to be analysed into more detail in the quoted subchapters, because they are in fact the only factors that can be influenced.

#### **4.2 Key lifestyle related risk factors in RNM**

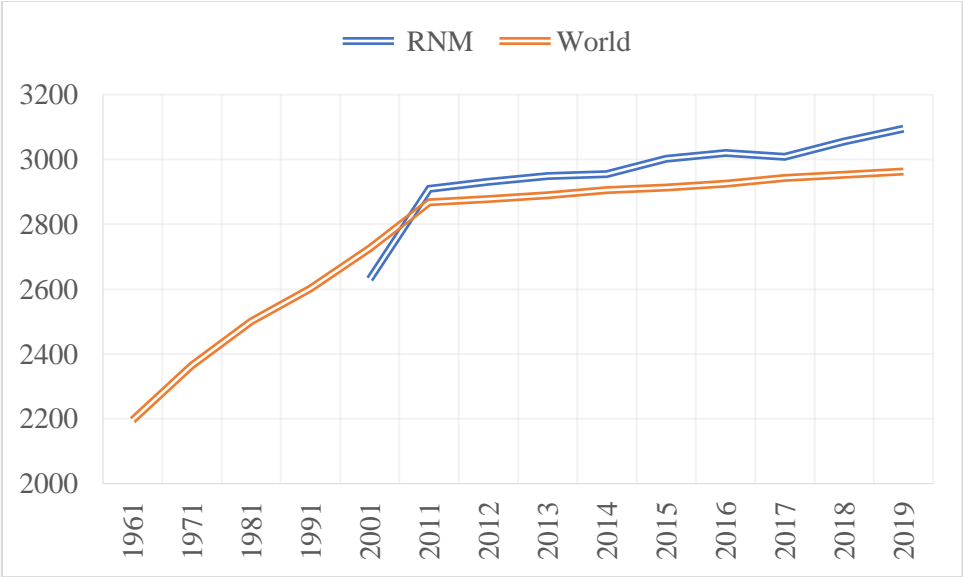
The conducted semi-structured in-depth interviews shed light to the subject matter from the perspective of the professionals that are concerned with the problematic of diabetes in RNM. The interview questions are formulated in a way to provide a full insight regarding the lifestyle related risk factors such as the increased BMI and lack of physical activity, the responders’ opinion about the high percentage of obese people in RNM, as well as the

opinion of the interviewees regarding the role of the state in preventing, controlling and treating of diabetes and its complications in the RNM. The rationale behind this exercise was to assess the level of alignment of the subjective opinions of the representatives of the concerned groups with the conclusions from interpretation of the collected and analyzed data.

In summary, the responders confirm the conclusions derived from the data analysis, mentioning that obesity and lifestyle are seen as the main reason for the concerning high prevalence of diabetes in RNM. Furthermore, as will be presented below in this chapter, the economic reasons appear to be the main factor contributing to poor dietary habits and the consequent increase of BMI.

Therefore, in this chapter, a short comparative analysis of some key socio-economic and nutritional indicators at a global, as well as at the level of RNM, will be conducted, to confirm the perception of the interview responders.

Figure 24: Food supply in RNM and World in kcal/capita/day 1961-2019 period.



Source : FAOSTAT (n.d.c.).

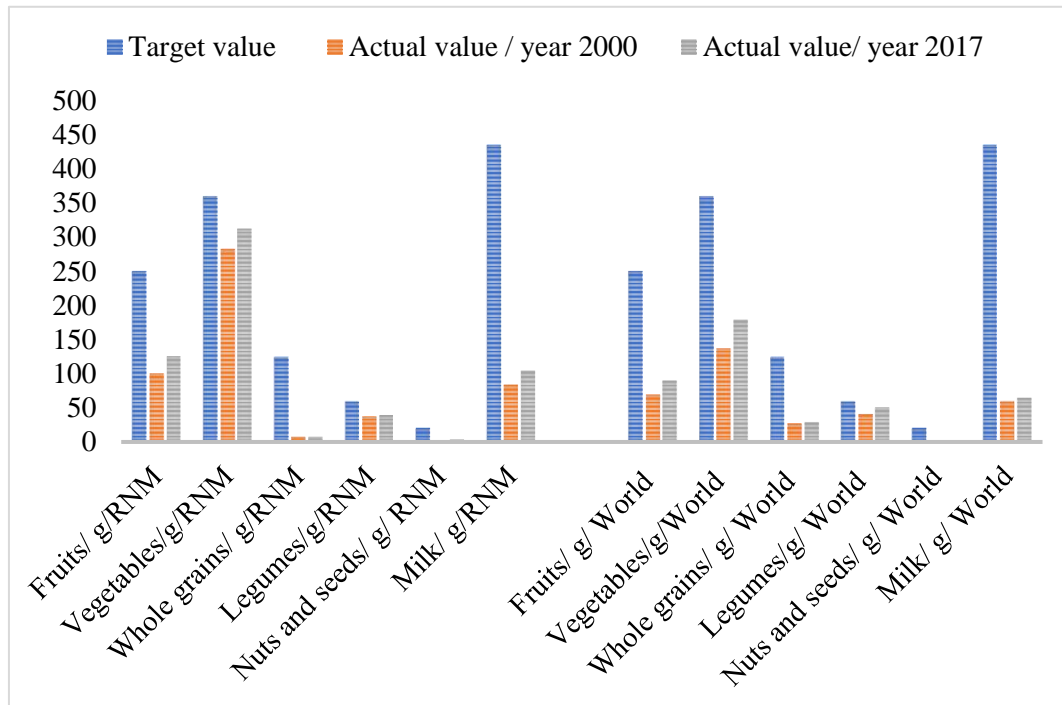
The first factor taken into account is the energetic value of the consumed food per capita per day in kilocalories (hereinafter kcal) in RNM and world. For RNM there is less data available, meaning that a smaller period of time is covered, starting from year 2001, whereas on a global level data from 1961 is available. On a national level from 2631 kcal per day per capita in 2001, the number reached 3095 kcal per day per capita in the year 2019, showing an increase of 17.6%.

It is very clear in Figure 25 that the food supply in kcal is in constant rise, the same trend as in RNM applies on a global level as well. In the year 1961 the per capita consumption on daily basis was 2196 kcal, whereas this number rises to 2963 kcal per day per capita in 2019,

a rise of 34.9%. When comparing the same period (2001-2019) in both cases it is noticeable that the RNM shows a steeper rise of the daily energetic intake, taking into consideration the fact that in this particular period the increase of calories consumed on a global level was little above 8%. These indicators show a disturbing trend in RNM of more than double of the increase of daily calorie intake in comparison with the global numbers. This data just proves what is already argued in the in-depth interviews conducted, as interviewee TGJH reflects in her interview “Cultural influences and traditional cooking high in fat, salt and sugar and portion sizes certainly add to the increased risk of obesity and diabetes”. Interviews reveal that the professionals think that the level of obese people as well as the level of prevalence of diabetics in the RNM, is a consequence of the food choices and the volume of food people consume on a daily basis. In the interviews it is mostly argued that people have the tendency to consume a lot of food that falls into the category of “unhealthy food”, due to many reasons. As GK, VL, TGJH and NB argue that although culture has a part in the reason for poor eating habits, they think that the prices of food are the ones that influence the dietary habits the most. When interviewees are asked about what affects the poor eating habits in RNM, the interviewee SHSA said ‘The lifestyle of the population that includes high intake of foods with significant amounts of sugar, fat (saturated and trans) and salt.’”

Having already confirmed that the calorie intake is in constant increase and might be the reason for the level of prevalence of obesity and diabetes in county, it is of essence to look in the consumption patterns of the people, which would clarify the source of the calories consumed. All the interviewed professionals agree that it is not always only important to control the level of the energetic intake, but it almost as important to analyze the compliance with the recommended doses of different sources of nutrients, which they define as healthy dietary habits. Therefore, a comparative analysis was conducted to measure the target recommended quantities of a variety of essential nutrients with the actual consumption. In addition, as shown in Figures 26 and 27 the data is analyzed separately on a global and on a national level.

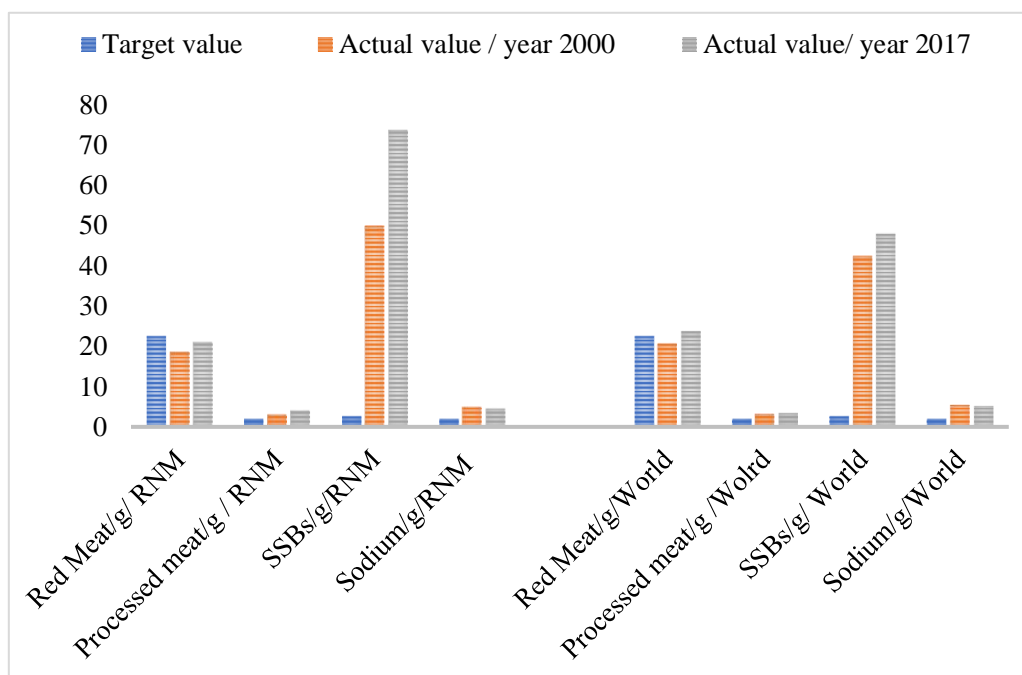
Figure 25: Estimated per capita intake of fruits, vegetables, whole grains, legumes, nuts, seeds and milk. RNM and World in the years 2000 and 2017.



Source: Food Systems Dashboard (n.d.b).

In Figure 26, the per capita intake of fruits, vegetables, whole grains, legumes, nuts and seed as well as milk is shown for the years 2000 and 2017. The analysis provided the results that apart from legumes on a world level and vegetables on the level of RNM, all other nutrient fall drastically below the target recommended values. This analysis was extended to evaluation of intake of sugar sweetened beverages (hereinafter SSBs), red meat, processed meat and sodium on both levels.

Figure 26: Estimated per capita intake of SSBs, red meat, processed meat and sodium. RNM and World in the years 2000 and 2017.



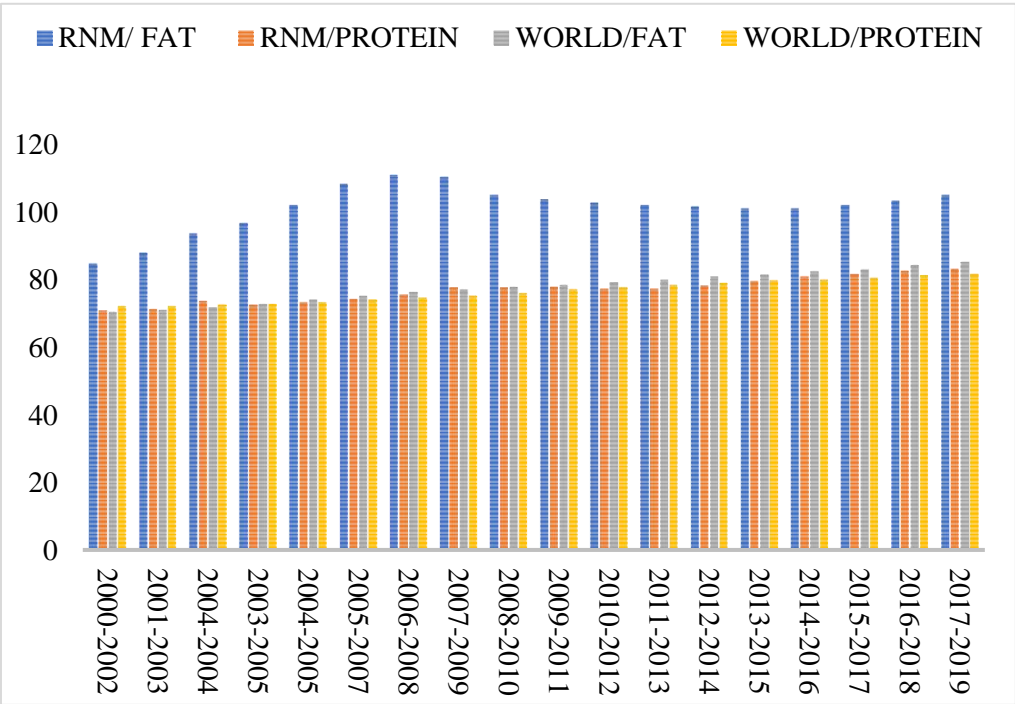
Source: Food Systems Dashboard (n.d.a.).

The data provided in the Figure 27 give an insight on one very important aspect of the dietary habits on both global as well as RNM levels. The quoted figure shows that most of the consumption of red meat is at levels which are comparable or close to the target values. Additionally, what can also be concluded from the analysis of the data is that there is a trend of overconsumption of all the other nutrients, which in the case of processed meat and sodium reaches twofold the target values. A realistically drastic level of overconsumption is seen in the case of SSBs, which in the case of RNM in 2017 reached almost 30 times the target value. When the interviewees are asked for their personal opinion on what is the main reason for the large number of diabetics and obese people, NB answer “Fast food full of fats and carbohydrates is more easily available, in addition, there is no so-called sports culture with regular practice of sports activities “points out the poor diet, overconsumption of “junk” food and sugar. According to Nurse GK, when asked about her opinion for the main reason for the growing number of obese people and diabetics in RNM she says “I believe it is due to poor eating habits and physical inactivity”. What is very easily concludable in both Figure 26 and 27 is that, the same trends apply on a global level as well as on the national ones. Estimated per capita intake of fruits, vegetables, whole grains, legumes, nuts and seed as well as milk do not by far meet the target daily values, meaning they are under-consumed, in a total contrast to the consumption of SSBs, processed meat and sodium which are all at an extremely higher level than the ones that are set as a daily target. As argued by interviewee TGJH “Analysis showed that 38.5% of children in the second grade in RNM were overweight or obese. Daily soft drinks consumption was among highest when compared to other countries in the WHO European region, consumption of both sweet and savory snacks

was above European average, obesity among girls is gradually closing the gap and approach the prevalence present among boys which was not the case previously, while improvements should be done in terms of fruit and vegetable consumption”. As already mentioned, the daily target for SSBs on a national level is 2.5 grams per day, while the actual consumption of 2017 stands at 73.64 grams daily. This trend is also detected at a global level, although arguably on a lesser scale, only confirming that the food intake poses potentially the greatest threat at the moment.

Expanding the analysis on the daily supply of fat and protein reveals yet another potential reason for the rapid increase of obesity and consequently diabetes in RNM. As can be observed from Figure 28, while the supply of protein in RNM is at a comparable level with the global average, the supply/consumption of fat is visibly higher, reaching peak values of 45% higher supply in RNM than globally in 2006-2008 and dropping to 23% of higher supply in RNM than on a global level by the end of the observed period. Looking at the figure 28 from the point of view of trends, there is an identifiable increase of supply of fat in RNM from 71 to 105 g/day, in 2000 and 2019 respectively, indicating an increase of almost 50 % in the last two decades.

Figure 27: Supply of protein and fat in the years 2000-2019. RNM and World.

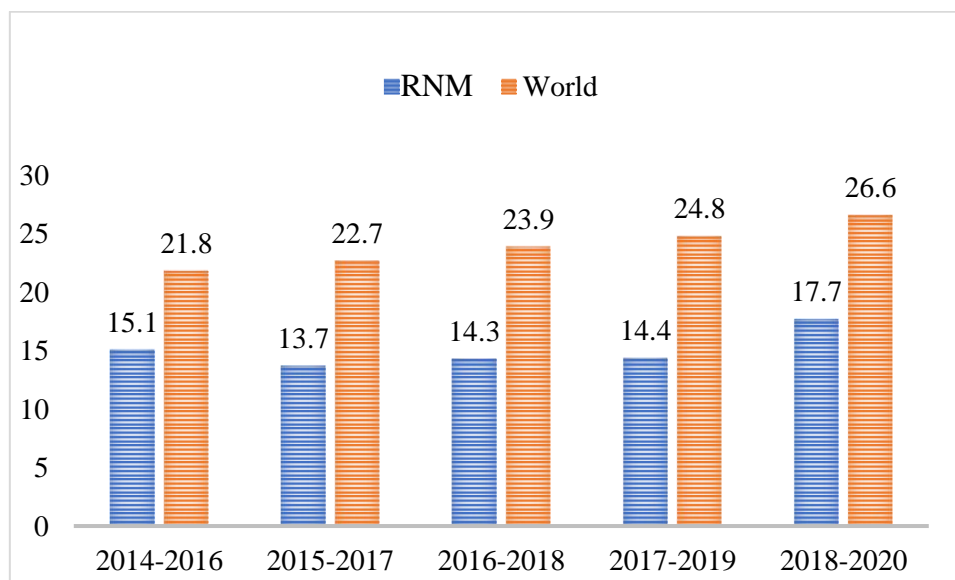


Source : FAOSTAT (n.d.e).

The analysis confirms the subjective perception of the interview responders that the above argued calorie intake increase presented in Figures 26 and 27 is due to overconsumption of low-priced calorie dense food, such as SSBs, processed meat, sodium, as opposed to under-consumption of the healthier options such as nuts, seeds, fruits, vegetables and grains,

pointing out to the financial aspect for decision making when buying food for the household. As nurse GK explains in her interview when asked to what extent does she think that the eating habits of people in RNM are driven by a personal choice rather than driven by affordability, she says “I think that purchasing power is key, not everyone has enough funds to provide food that is healthy, ecological or organic.” Tackling the same problem TGJH in her interview says “The high economic insecurity and increasing food prices indicate that more people struggle to meet their daily calorific demand, opting for cheap energy dense foods to satiate their hunger, with little consideration of the nutritional value of foods”. Taking in consideration that all the interviewed have mentioned that the economic situation and the food insecurity is also a major factor determining the choice of food, a short overview of some key economic and socio-economic indicators has been elaborated to establish potential correlation between the poor dietary habits of the population and the deteriorated economic situation and decreasing purchase power of the population.

*Figure 28: Prevalence of moderate or severe food insecurity in % in RNM and World in the years 2014-2020.*



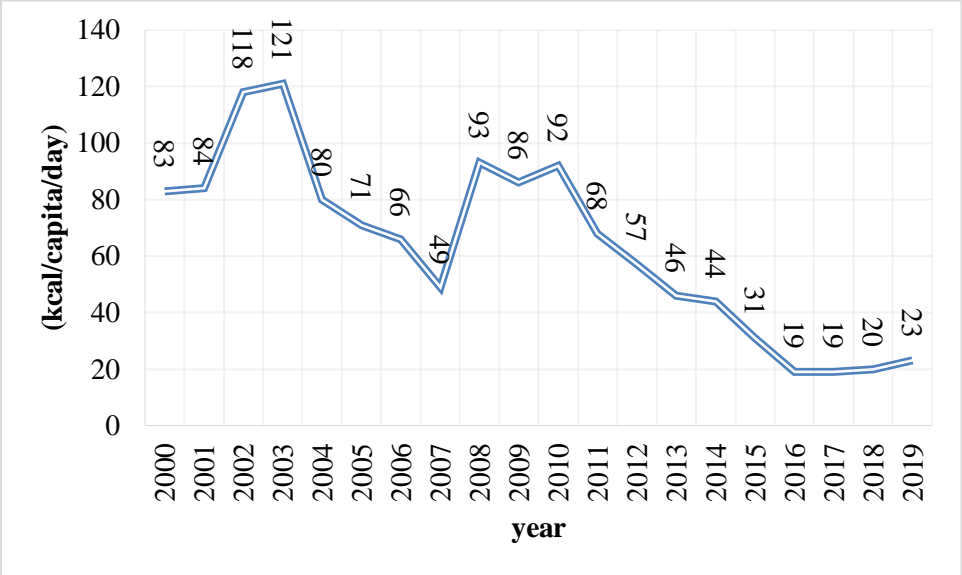
*Source : FAOSTAT (n.d.a).*

The first analyzed indicator is the one related to food security, which defined by (FAOSTAT, n.d.a.) is defined as lack to enough safe and nutritious food for a normal life. As presented by the Figure 30 the world is facing an increasing food insecurity problem, which by the year 2020 has reached a level according to which, more than a quarter of the total world population is facing moderate to severe food insecurity. Those indicators are slightly better in the case of RNM with almost 18% of its population being threatened by the same problem. However, in both cases (global and RNM) there is an upward trend which if not addressed could have a potential to affect the health and life of billions of people. The above conclusion is furthermore confirmed with the data provided in Figure 30 with a notable decrease of food variability, which according to FAOSTAT measures the annual food supply fluctuations



over the year (FAOSTAT, n.d.f.). This in fact is very much in line with the conclusions of Figures 26, 27 and 28 that depict a clear trend of prevailing of only few types of food in the dietary habits among the Macedonian population.

Figure 29: Per capita food supply variability. RNM in the years 2000-2019.



Source : FAOSTAT (n.d.f.).

The decrease of the numbers of food supply variability might be due to combination of production on a national level as well as the trade, additionally it can be subject to government policies regarding the trade restrictions, taxes and subsidies given to the local production (Lele et al., 2016). As TGJH explains “Agriculture sector should encourage rural development and agriculture as Macedonia is a net food importer. This would increase food security and lower the impact of global price volatility on the most vulnerable population.”

**4.3 Approaches for managing lifestyle related risk factors in RNM**

The overwhelming degree of convergence between the subjective perceptions of the interview responders and the official data related to food patterns, has dictated to conduct limited analytical research of a few macroeconomic and socio-economic indicators in order to identify potential correlation between the dietary habits of the population and the standard of living. The analysis of the standard of life and the purchase power of population could provide at least a partial answer to the issue of the deterioration of the dietary habit trends in RNM.

The in-depth interviews show that in the opinion of all the experts the economic instability and increased food insecurity are the main factors that cause the poor diet habits, thus consequently contributing to the rising numbers of obese and diabetic people, In addition, the interviewees go even a step further and instead of only identifying and defiling the

problem, they also provide their personal suggestions on what measures and policies can be put into place so that the current situation with rapid increase of consumption of unhealthy food and increase of the prevalence of obesity and diabetes can be improved.

According to TGJH “Priority should be given to solutions that have the potential to improve people’s health and wellbeing given the interconnections between non-communicable diseases, climate change, food production and food security and the urban environment in which people live and work.”

Furthermore, she argues that awareness about the diabetes itself and its related risk factors should be increased starting with policies that would help reduce the risks. According to her opinion these measures should be introduced at a very early stage, by reforming school and education sector policies in the direction of promoting a “healthy, active and sustainable lifestyle by: ensuring school canteens offer nutritional and balanced diets to children, promoting ‘carbon efficient’ meals; introducing compulsory cooking classes, where children will learn in practice what a healthy meal means, not only in terms of human health, but in environmental terms; promoting organic school farms, where children and teachers can grow some of the food needed for cooking classes, learning about sustainable agriculture.”

In addition, TGJH recommends that “Cost-effective and sustainable strategies are urgently required to curb the obesity and diabetes epidemic. Increased healthcare expenditures for people with diabetes (which are more than twice higher than for the ones without), high morbidity and mortality rates, economic loss due to increased absenteeism and presenteeism, should be a sufficient incentive for the government of the RNM to urgently implement multifaceted approach of mitigation diabetes and diabetes risk factors, considering the projected prevalence of the disease and stop the siloed single sector approach which does not yield any positive impact on prevention or management. This should include many governmental sectors (ministries) such as the health, food and agriculture, economic, environment and urban planning and education sectors.

Urban sector policies should include a number of initiatives, that if implemented will assist with promoting a healthy lifestyle such as a network of cycle paths, free bicycle schemes or subsidized public transport passes to promote active travel.

Agriculture sector should encourage rural development and agriculture as Macedonia is a net food importer. This would increase food security and lower the impact of global price volatility on the most vulnerable population.

Food policies should: provide incentives to the production, distribution and marketing of healthy foods and encourage local small-scale production; subsidize innovative production of alternatives/analogues to highly processed products especially of animal origin that taste similar, but are easier to cook, less expensive and healthier; enforce comprehensive nutritional information on food packaging such as the traffic light color system understandable to the lay users. Here I would also add that restaurateurs should offer greater

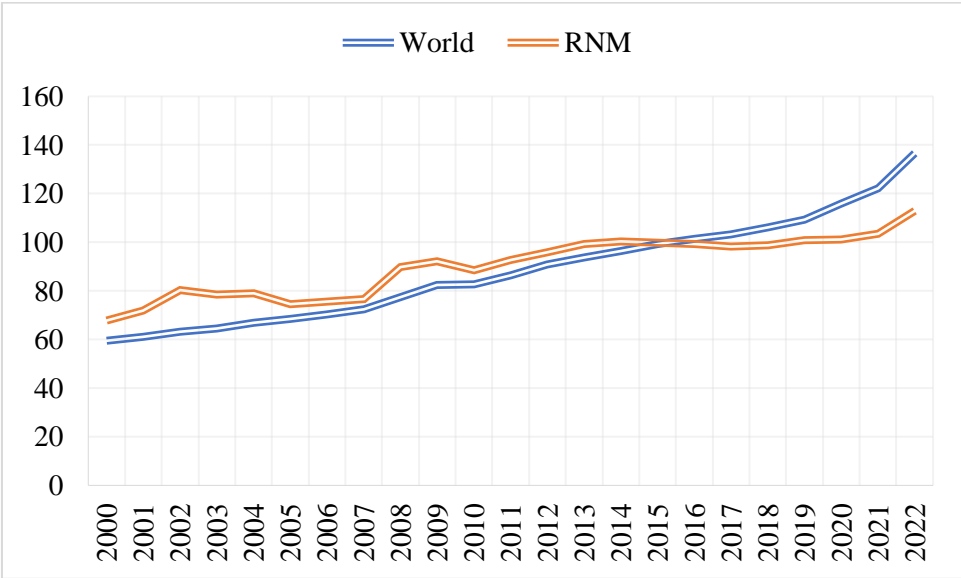
choices of healthy food meals in their menus and provide calorific value of meals in the menu.

Coordinated policies, responsibilities and actions should aim towards setting realistically achievable time-framed goals, including the most relevant sectors such as the health, education, transport, urban and agriculture sectors. This would ensure that information will reach the public and will potentially increase public awareness of health and environmental issues.”

The interviewee SHSA also gives her recommendations regarding the potential policies that would help in prevention of diabetes, as she reflects in her interview when asked about the policies that play a significant role in reducing its risk factors, she says “ Adopting EU regulation on banning trans-fats, front of package labelling, fiscal measures at least on sugar-sweetened non-alcoholic beverages or more comprehensively on all products with high content of sugar, salt and fats, incentivize physical activity (improving infrastructure, payment-fee PA, regulate food marketing to children.”

Analyzing the underlying reasons contributing to the unhealthy dietary habits of the Macedonians, has revealed a possible close interconnection between the affordability of certain products and the purchase power of the people, and on the one hand the prevalence of overweight and obesity.

Figure 30: Consumer prices food indices (2015=100) in RNM and World in the years 2000-2022.

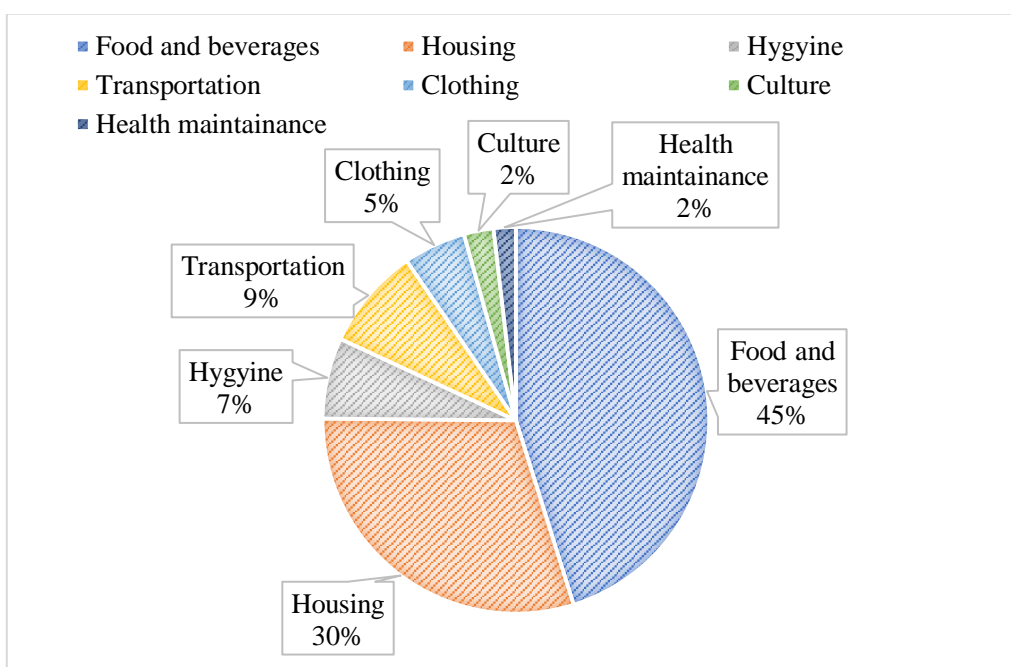


Source : FAOSTAT (n.d.b.).

This perception of the responders is in fact getting a confirmation when the trends of the CPI are observed. As depicted in Figure 31, this index shows a permanent growth throughout the entire observed period. The total increase of the price of the average basket of goods and

services purchased by a household during the years is 66.5% in the period from 2000-2022 in RNM. The same, but much more emphasized trend is noticed on a global level. The price of the average basket of goods and services purchased by a household has increased for 126.6% during the period taken into consideration. In the year 2000 a number of 60 USD is shown as opposed to the 2022 number of 136.6 USD. Interviewees NB, GK, TGJH, VL raise this as a huge, if not the key problem for poor diets of people on national level. As doctor NB noted in her interview regarding the rationale behind the choices made by the people (whether they are driven by the personal choice or driven by affordability)- “Two-thirds is the result of purchasing power, but decades of food intake habits originating from Turkey also has a great influence”. Reading the answers that the experts gave, it is very clear that they think the prices of food for many families in RNM are the decision makers when it comes to buying food for their family.

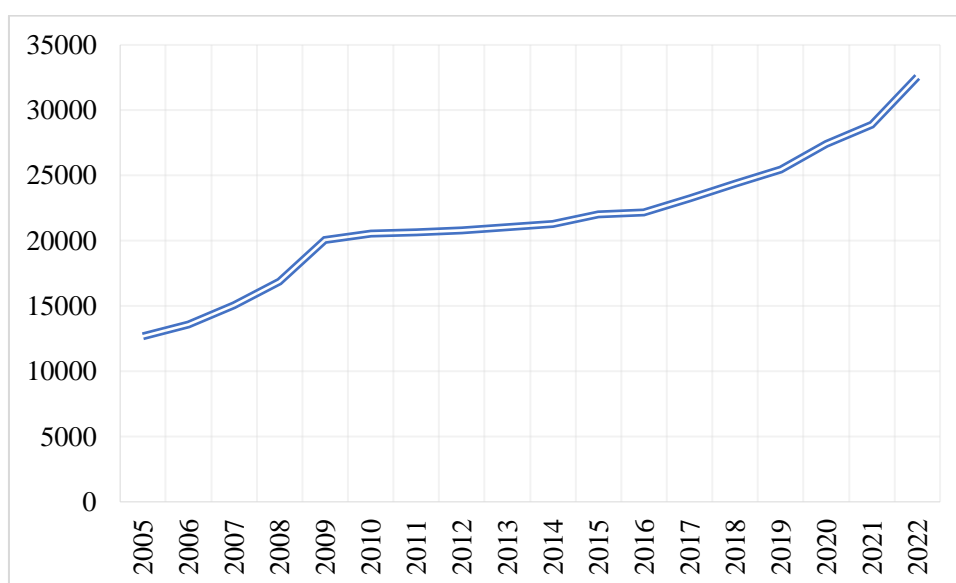
*Figure 31: Structure of household expenditures in RNM in October 2022*



*Source: Federation of trade unions of Macedonia (2022).*

The official statistics confirm the above perception, since as shown in Figure 32 almost half of the household expenditures are related to covering the basic food and beverage requirements. This indicator also shows that the consumer basket expenditures cannot be totally covered by the average net salary paid in the same period. According to Federation of trade unions of Macedonia the average salary can only cover around 75% of the average household needs (Federation of trade unions of Macedonia , 2022).

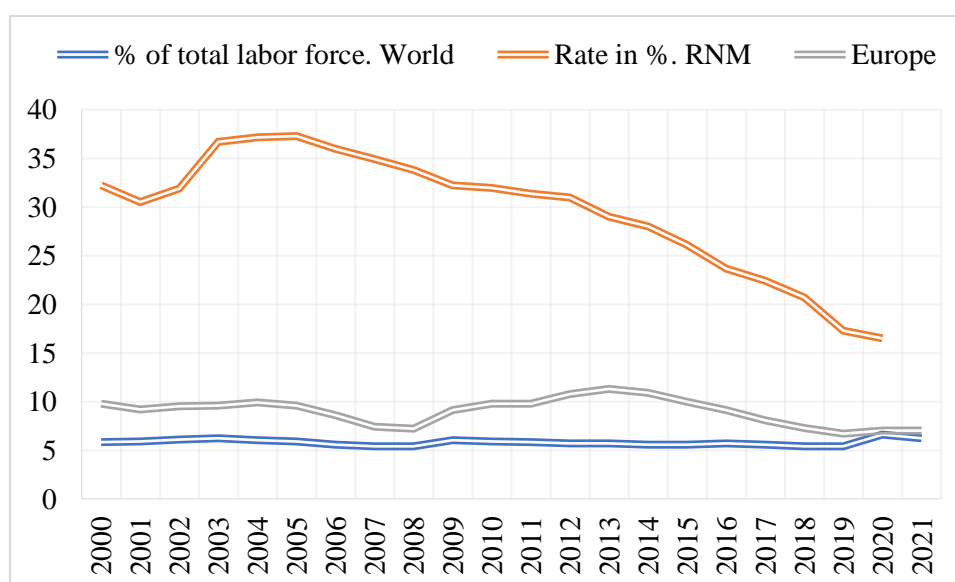
Figure 32: Average net salary in RNM in the years 2005-2022



Source: Makstat (n.d.).

Despite the positive developing trend of the average net salary depicted in Figure 33, and the fact that the salary increases (157%) in the period 2005-2022 in nominally higher than the CPI (51%) in the same period, the households still struggle to meet their basic needs, which inevitably leads to unhealthy dietary choices usually with high calories and low nutritional values.

Figure 33: Unemployment rate in RNM, World and European Union in the years 2000-2021.



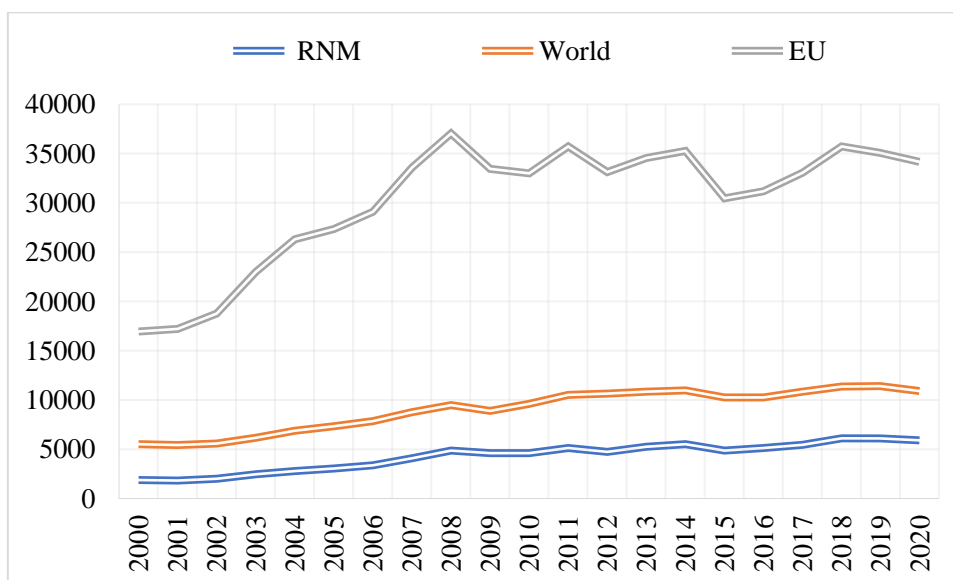
Source: The World Bank (n.d.f.).

Changes in household purchasing power are linked to the real growth of income and also to employment rates. RNM has a comparatively much higher level of unemployed people than

the global average and is in fact ranking among the countries with the highest degree of unemployment. Having in mind North Macedonia's geographical position and the start of accession negotiations for entering the EU, it was considered prudent to compare these indicators also with the EU average. This analysis reveals that the EU and the global trends show a very little difference between each other, which by the end of the observed period are totally negligible. Therefore, the conclusion related to the global trends are also applicable in the case of comparison of RNM with EU. Although the trend shows a decreasing tendency, with a level of over 16% it is still almost 2,5 times higher than the world and EU average. Figure 34 reflects to great extent the statements of the representative of the diabetes association VL "Culture has a great influence, but post-pandemic and now with the whole Ukrainian situation, the purchasing power of the population has drastically decreased.". As argued above the combination of several indicators provide a more comprehensive insight in the country's economy. The last three analyzed indicators as key determinants of the purchasing power are still at a undesirable level, putting RNM among the top European countries in terms of poverty levels. This leads to a conclusion that the combination of constant increase of CPI as presented in Figure 31 and the relatively high unemployment rate could potentially be a very important factors in determining the choice of diet, often forcing the population to opt for more affordable calorie dense food.

As shown in Figures 34 and 35 the global and the national trends related to real per capita GDP show a permanent increase during the entire observed period until 2019, when due to the impact of the Covid crisis, a recession trend can be observed.

Figure 34: Real GDP per capita, RNM, EU and World in the years 2000-2021.



Source: The World Bank (n.d.g.).

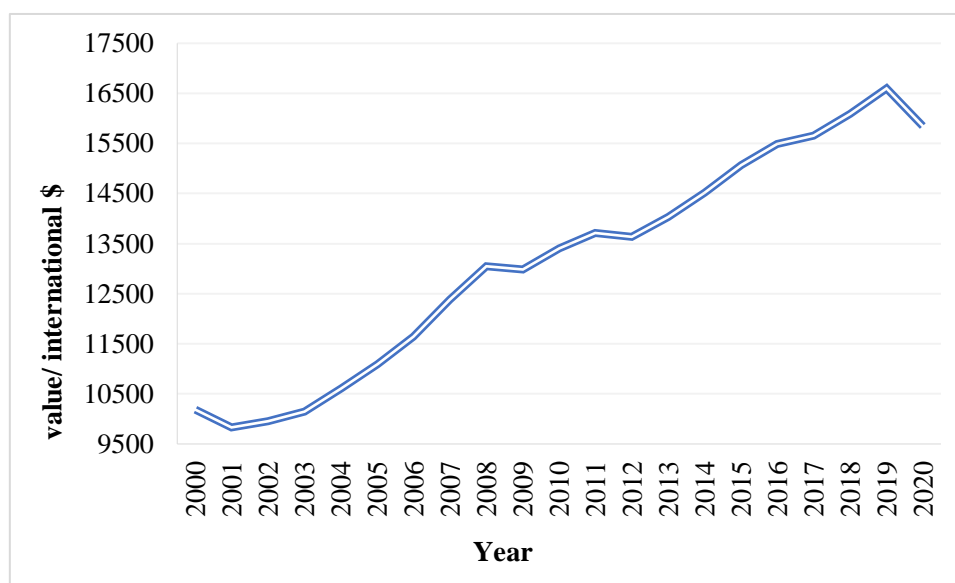
The analysis is conducted in order to find potential relations between the increased level of poverty and the unhealthy dietary habits of the population with an aim to confirm or deny the opinion of interviewees VL, NB, TGJH and GK claiming that the level of poverty has

significantly impacted the choice of food consumed. As interviewee TGJH reflects in her interview “Economic instability and increased food insecurity also influence us to a great extent what people chose to buy. The high economic insecurity and increasing food prices indicate that more and more people struggle to meet their daily calorific demand and opt for cheap energy dense foods to satiate their hunger, with little consideration of the nutritional value of foods.” Also nurse GK says “Standard of living has a great importance when it comes to people's habits” when explaining why does she think affects the poor eating habits of the population in RNM. To prove the above assumption that the healthy food is becoming increasingly less affordable a comparative analysis of the trends of development of GDP in RNM, EU and on a global level has been conducted. As presented in figure 35 globally in the last 2 decades the GDP has doubled, although in the last year most probably as a consequence of the global crisis and the pandemic there is a sign of recession.

As the global trends are usually biased due to the influence of the underdeveloped countries, the comparison has expanded with data for the EU in order to determine RNMs position in relation to the more developed countries, the levels of which RNM is aiming to achieve. The analysis of the trends of growth of GDP in EU shows a significant level of increase in the period 2000-2008, after which a flattening of the curve is noticeable with periodical oscillations. However, in general in the period from 2008-2020, the trends in EU seem to follow the same growth pattern as the ones in RNM, as well as the global ones. Despite the similarities in the trends as presented in Figure 35 it can be noticed that there is a considerable gap between RNM and EU in absolute terms, signifying that RNM is lagging behind the more developed countries, which could potentially be one of the main reasons for the dietary choice of the RNM population.

In the same period the GDP in RNM has almost tripled, which in general is a very positive indicator, but also needs to take into consideration the baseline value which in RNM in the year 2000 was very low at a level of below 2000 US dollars. For a more precise comparison the trends of developments of CPI should be observed in relation with the per capita GDP PPP, so that a realistic conclusion of the impact of the rise of the retail prices can be determined.

Figure 35: Gross domestic product per capita, PPP in RNM in the years 2000-2020.



Source : FAOSTAT (n.d.g.).

This data is shown in Figure 36. Despite the fact that both indicators show an increase in the observed period, the conclusion is that CPI index has a steeper increase curve resulting in increase of consumer prices of 66.5%, as compared to the increase of the per capita GDP PPP which shows an increase of 55%. The trend of the CPI development is influenced by many factors that are connected with the monetary policies of the central bank of RNM, which in turn are very sensitive to both the internal and external political factors. This has a direct impact on the exchange rate of the Macedonian denar and the central bank interest rates. It can be noticed that in the period following 2010 the monetary policy has been stabilized and as a consequence the fluctuations noticeable in the previous period are overcome. The stabilization of the exchange rate and the rate of inflation has almost flattened the CPI curve up until 2020-2021 when due to Covid crisis there is a change of the trend in terms of a steeper increase. This is another addition to support the perception of the interviewees related to affordability of food and the turn towards cheaper calorie dense and less healthy alternatives.

Taking in consideration the very high degree of convergence of the subjective perceptions of the all-interview responders with the analysis of the economic and socio-economic indicators, in particular having in mind the recommendations of TGJH and SHSA it has been considered necessary to scrutinize the potential of the policy related instruments of the state in combating diabetes and its risk factors. In this line, drawing from the results of the attempts to reduce the use of tobacco, the possibilities for influencing dietary habits of the population through the fiscal policies has been observed.



#### 4.3.1 Assessment of the potential of fiscal policies to encourage healthy dietary habits

As elaborated in the previous chapters, the noncommunicable diseases, including diabetes and obesity, are increasingly becoming a cause of major concern. This problem is particularly noticeable in developing countries, where 85% of premature deaths occur (World Health Organization , 2015).

In response to this challenge (World Health Organization , 2013) defined targets for the concerned stakeholders in promoting healthy diets and physical activity. These targets include halting the rise in diabetes and obesity in adults and adolescents as well as the increase of childhood overweight and obesity by 2025.

As argued in Chapter 3.2 the prevalence of diabetes has doubled in the last decade with trends that have exceeded even the most pessimistic scenarios. Furthermore, according to the line of argumentation in the same chapter, the official statistics account only for approximately one half of the realistic numbers of diabetics. Furthermore, according to the WHO the worldwide prevalence of obesity nearly doubled in the period 1980 -2014, with more than half a billion adults being classified as obese (World Health Organization, 2016). According to the same source, diabetes was directly responsible for 1.5 million deaths in 2012 and 89 million DALYs.

Having identified increased BMI and more precisely obesity as the major reason for the above phenomena this study also analyzed the underlying reasons contributing to the increase of the risk factors for developing diabetes, the analysis indicates that the combination of the dietary habits (food consumption patterns) with minimum physical activity are the most significant contributor to the rapidly increasing obesity prevalence. Analysis in chapter 4.2 point out to the fact that there is an excess consumption of calory-dense food, measured by the daily per capita energetic value consumed. The analysis in the said chapter also shows that the majority of the calories derive from “unhealthy” food with a high level of saturated fats, trans-fatty acids and sugars. While the consumption of fruits, vegetables, milk, unprocessed meat and milk and diaries fall well under the target values set by the WHO, the consumption of sugar sweetened non-alcoholic beverages reaches levels that in RNM are up to 50 times higher than the target ones. The conducted surveys indicate that foods and beverages with a high level of carbohydrates and in particular sugar, are seen as the main source of inadequate calories in the diet, especially in children, adolescents and young adults.

The responders to the in-depth interview have unanimously concluded that the state must play a key role in facilitating changes of the dietary habits by amending the currently applied policies that do not contribute to the preservation of the health of the population. The interviewee TGJH, SHSA have identified the taxation and subsidizing policy as the only instrument that can significantly influence the unhealthy dietary habits thus reducing the increase of the prevalence of the risk factors for developing diabetes and finally decrease the

incidence and prevalence of diabetes itself. This in fact is in line with the guidelines of WHO (World Health Organization , 2015) which has identified that “there is increasingly clear evidence that taxes and subsidies influence purchasing behavior, notably when applied to sugar-sweetened beverages and this contributes significantly towards addressing the obesity and diabetes epidemic” (World Health Organization, 2016, p. 11).

This approach has gained increasing support especially after the progress in implementing tobacco taxation (Specific excise taxes), charging tax for a specific ingredient on a given quantity. This approach discourages the buyers to even switch to cheaper options, reducing the risk to substitution, since they increase the prices to all the products that are affected by the tax.

The economic and health rationales for utilization of fiscal instruments for reduction of the diabetes-related risk factors are based on the meta-review of 11 systematic reviews on the effectiveness of fiscal policy interventions for improving diets and preventing NCDs, thus reducing the NCD-related health and economic burden (World Health Organization , 2015).

Meta review shows that the use of fiscal instruments could be most promising and most consistent in the case of taxation of SSB, resulting in decrease of consumption of 20-50% (World Health Organization , 2015) in combination with subsidizing fruits and vegetables, resulting in increase of their respective consumption of 10-30%. These targeted measures proved to have the greatest impact on lower-income, less-educated younger populations, and populations at greater risk of obesity.

Taking in consideration that there are a number of different factors that influence body weight and morbidities, the measures are designed to influence the retail price of the products rather than have an impact on the reduction of body weight. The subsequent researches would need to identify and preferably quantify the impact of the reduction of consumption of SSB on improvement of the BMI.

The state has in fact two key instruments at its disposal to influence the retail price thus, designing a targeted impact on the increase/decrease of consumption of certain products, relying on their respective price elasticity. The already mentioned example of the tobacco industry shows that levying additional taxes on certain products does influence to a great extent their affordability and consequently the volume of sales, therefore, when designing a targeted fiscal policy aimed at achieving reduction of consumption of certain product or group of products, additional taxation would be one of the two key tools to be utilized (World Health Organization, 2016). An additional lesson learned from the “tobacco case” is that promoting healthier alternatives in terms less harmful substitutes of sugar or fat could also be a potential field to be explored in mitigating the diabetes-related risks.

The second tool that is used to achieve the opposite effect, meaning to stimulate the consumption of a certain product is to introduce subsidies for its production and tax exemption for its sale. Both in fact are subsidies, in the sense that the state renounces a part

of its revenues in order to achieve either a qualitative or a quantitative overall benefit (World Health Organization, 2016).

In fact, having in mind the research that has been conducted for the purposes of this thesis and the macroeconomic specifics of RNM perhaps a combined approach could prove to be the most efficient providing the desired results in the shortest possible period of time. RNM as a county in which a considerable part of the GDP is generated by agriculture and food processing has already introduced incentives in terms of subsidies for production of most of the agricultural products. If those measures are complemented by imposing higher taxes on products bearing high risk for diabetes development the price gap between the cheaper calorie-dense products and their respective healthier alternatives would be considerably decreased thus eliminating the dilemma related to the choice of type of food to be purchased. In fact, one of the possible recommendations could be that the increased budget revenues generated by the additional taxation of the “unhealthy” products, could be directed in subsidizing the production of healthy food. Also, the state could take into consideration to channel part of the additionally generated revenues into two equally important factors in prevention of diabetes. Namely part of these funds could be designated for increasing awareness about the risks of diabetes on the one hand and on the other. the state could increase the level of randomized monitoring of IGT among its population aimed at early detection of this risk factor and provision of adequate treatment before the disease progresses T2D and becomes untreatable.

Various countries have in fact investigated various approaches to address the issue of obesity as one of the key reasons for the exponential rise of the level of NCD.

Those approaches vary in many aspects from country to country and there is no conclusive evidence about the “best approach”. One of the problems encountered when evaluating the impact of the fiscal interventions in reduction of obesity is that not all indicators are quantifiable and therefore it is very difficult to assess in a pure mathematical way the benefits of their implementation as opposed to the costs incurred to design them and put them in function.

The Table 11 provides an overview of several attempts of various states to tackle this problem. The table is divided in two major parts, making a clear distinction between the developed and the developing countries, in order to make it easier to foresee the potential results if applied in the context of RNM.

Table 11: Fiscal policies targeted at reducing diabetes risk factors in developed and developing countries

Developed countries				Developing countries			
Country	Measure	Year	Impact	Country	Measure	Year	Impact
Finland	Free school meals, paid by tax income	1948	The impact of the tax on purchase, consumption and health has not been formally evaluated; however according to unofficial reports it has led to decreased sales and consumption of non-alcoholic beverages and sweets	Mauritius	Excise duty on the sugar content of "soft drinks"	2013	The impact on the sale of soft drinks has not been assessed.
	Milk subsidies not given to products high in fat or salt	2009					
	Excise duties have been levied on sweets, chocolate and non-alcoholic beverages	2011					
	Tax rates increased	2012 2014					
France	Levy on beverageshat containing added sugar or other sweeteners.	2011	A positive effect on purchase patterns from a public health perspective, well accepted by the population.	Mexico	Peso per litre excise tax on any non-alcoholic beverage with added sugar (powder, concentrates or ready-to-drinks)	2014	9% decline in sales of sweetened beverages during 2014, and up to a 17% decrease by December
					8% ad valorem tax on the purchase price for a list of non-essential energy-dense foods (snacks)	2014	2014 compared with pre-tax trends.
Hungary	Public health product tax (PHPT) -taxing non-staple food products that carry proven health risks when consumed. (€ 0.037 tax on foods with high fat, sugar and salt content, in addition to a 10 % increase in the tax on liquor and soft drinks.	2011		Thailand	Tax on beverages without sugar is US\$ 0.025/440 ml, while the tax on beverages with sugar is US\$ 0.012/440 ml.	/	Insufficient monitoring and enforcement capacity and limited preparedness to administer tax policies.

Table continues

*Table 11: Fiscal policies targeted at reducing diabetes risk factors in developed and developing countries (cont.)*

<b>USA</b>	Policies to regulate sales of soda and other sugar sweetened beverages (SSBs) on school campuses .	2014	The ongoing market trend shows a significant reduction in SSB consumption". In California decreased consumption of sugary drinks by 21% .	<b>Philippines</b>	Excise tax on sugar-sweetened beverages	2009	The impact on the sale of soft drinks has not been assessed.
	California - excise tax on SSBs -tax of 1% per ounce of sugar	2014					
<b>Denmark</b>	Duty on foods containing more than 2.3 % saturated fat (meat, dairy products, snacks etc; cooking oil)(at the rate of 16 kroner [~USD2.79] per kilogram of saturated fat)	2011	It was repealed after in 2013, as the tax had no strong proponents and many influential adversaries. Research indicates that the tax was effective in changing consumer behaviour. Between 2011 and 2012, consumers preferred buying meat with 6-8% fat instead of meat with 8-12% fat; the sale of butter, oil and margarine fell 10-20% .	<b>Brazil</b>	SSBs are subject to the Tax on Manufactured Products (IPI in Portuguese acronym). The IPI rate varies from 0 to 30% based on the degree of essentiality of the item and whether production took place domestically or in another country. IPI tax rate on soft drinks in 2013, set at a rate of 27% for juice drinks, nectars, and other SSBs	2013-2016	The impact on the sale of soft drinks has not been assessed.
					Decrease of the IPI rate on many SSBs (IPI tax rate for carbonated and non-carbonated sodas was set at 4%)	2016-2018	
					Increased the IPI rate on many SSBs to 12%	2019	
<b>UK</b>	Soft drinks industry levy (SDIL) The rates companies will need to pay are as follows: 24p per litre of drink if it contains 8 grams of sugar per 100 millilitres, 18p per litre of drink if it contains between 5 – 8 grams of sugar per 100 millilitres.	2018	Over 50% of manufacturers reducing the sugar content of drinks. Statistical models based on available data estimated that a 20% tax (which would raise the cost of a 70p can to 84p) would decrease sugary drink consumption by about 15%; 1.3% reduction in the number of obese and 0.9% reduction in the number of overweight and obese adults. Greatest effect expected in 16-29 age	<b>Barbados</b>	The Government of Barbados implemented a 10% ad valorem (value-based) tax on SSBs. It has been hypothesized that this tax structure may inadvertently encourage consumers to switch to cheap sugar drinks	2015	average weekly sales of SSBs decreased by 4.3% compared to expected sales without a tax, primarily driven by a decreased in carbonated SSBs increased by 5.2% with bottled water sales increasing by an average of 7.5%. Sensitivity analyses were consistent with the uncontrolled results. After stratifying by price, we found evidence of substitution to cheaper SSBs.

*Source: World Health Organization (2015).*

The key dilemma when designing fiscal policies to influence the dietary habits of the population is always the choice of the type of tax to be applied. As seen from Table 11 in the majority of the cases the governments opt for additional (excise) tax on either a group of products or on targeted products containing a higher level of certain substance e.g., sugar either as a sole measure or in combination with subsidizing the less harmful alternatives. There are also cases that countries have experimented with ad valorem taxes (Barbados).

As argued above, not all of the results are measurable or measured, so it is difficult to identify an individual approach that would provide optimal results in all countries.

The lessons learned from the case of tobacco suggest that excise taxes levied based on the quantity of given nutrient, would most likely provide the best results. In addition, this is confirmed with the results of the policies applied in the UK, where (a set amount of tax is charged on a given quantity of the product or specific ingredient) are likely to be most effective. The Barbados case on the other hand, points out toward a conclusion that an ad valorem tax, although contributing to reduction of SSBs at the beginning, in fact on the long run provides incentives to switch to cheaper, but still very harmful SSBs.

The UK case also shows that taxation of volume of product per package could lead to overall decrease of sales due to decreased amount of beverage per container.

The sensitivity analysis conducted in some of the cases has shown that most of the SSBs are relatively sensitive to price increase showing a satisfactory level of elasticity, when prices are increased for 20% or more. The cheaper SSBs tend to be more elastic while the “big brands” like Coca Cola or Pepsi are in fact almost inelastic in cases of insignificant (less than 20%) retail price increase.

This calls for a greater degree of caution when designing the fiscal policies. The solution of the problem, as per the reviews of the policies (World Health Organization , 2015) is that the highest probability of positive impact could be expected when combining taxation of SSBs with incentives for switching to healthier substitutes.

The overall health effects of food and beverage taxes depend on the price elasticities of demand, which are composed of the income and substitution effects (World Health Organization , 2015). Substitutions are not always available, at least not at a level that would allow for a noticeable difference. On the other hand, some of the substitutes might be still beyond the threshold of affordability for the vast majority of population, so the state needs to take action that on parallel track with introducing additional taxes to SSBs, provide fiscal incentives (subsidies) for the consumption of water, milk, unsweetened 100% fruit juice and beverages with non-caloric sweeteners.

However, these are only theoretic predictions which do not factorize the willingness of the population to change the behaviour and the dietary habits. Lack of behavioural change might imply that consumers feel burdened by the tax and have less money to buy either unhealthy or healthy foods (World Health Organization , 2015).

On the positive side, the added value of fiscal policy interventions, highlighted in the literature, is revenue generation and the potential to designate these funds for health promoting purposes such as awareness increase campaigns, education of stakeholders and training of concerned personnel to promote prevention rather than curative approach.

Finally, the entire action is expected to result in relieving part of the burden to the central budget, in particular the health one related to covering the direct and indirect costs of diabetes itself, as well as the complications arising as a consequence of it.

RNM until this moment has yet not implemented any policies that might have an effect on unhealthy dietary habits of the population, hence reducing the increase of the prevalence of the risk factors for developing diabetes, and decrease the incidence and prevalence of diabetes. It is often implied in the responses of the interviewees in broad and unspecified terms that “the state is obliged to do something to make healthier food more affordable and awareness of the effects of the unhealthy food should be increased”. SHSA, when asked about her opinion on possible policies which will help in reduction of the diabetes risk factors, says “Adopting EU regulation on banning trans-fats, front of package labelling, fiscal measures at least on sugar-sweetened non-alcoholic beverages or more comprehensively on all products with high content of sugar, salt and fats, incentivise physical activity (improving infrastructure, payment-fee PA), regulate food marketing to children” could be an adequate way to address this issue.

There is a lack of knowledge and experience about the available fiscal instruments and in particular the feasibility of their application. Following this line of reasoning, the targeted interviewees were chosen in a way to insure they have a hands-on experience in the daily issues faced by the diabetics, as well as professionals who are directly involved in recommending and creating strategic policies. On the other hand, given the fact that no such policy has been introduced so far in RNM and no public discussion on the issue has been organized, the low level of knowledge about the potentials of strategic policy making among the general public was predictable.

In the case of the developing countries such as RNM, yet another factor has to be taken in consideration. Namely, the decrease of demand for SSBs could translate into a problem of financial viability and sustainability of some of the producers, which in turn can lead to loss of jobs. Taking in consideration the unemployment rates in the country that, as described in chapter 4.3 Figure 34 are among the highest in Europe, the elaboration of the fiscal strategy for prevention of diabetes would need to carefully calculate the impact on the employment of the adopted measures. Therefore, again the producers of SSBs should be stimulated to decrease the amount of sugar in their beverages, by introducing excise tax on the level of nutrient or the volume of beverage per container, while not jeopardizing the market position of the producer.

#### 4.3.2 Assessment of the instruments for monitoring healthy food production and import

Once the policies are designed and implemented, it is of crucial importance to monitor their implementation in terms of respecting the set actions and avoid potential incidental or deliberate non-compliance with the regulations. The assessment of the monitoring and evaluation instruments in this case is entirely based on the experiences of other countries and theoretical assumptions, since due to the lack of any previous national experience in implementing fiscal policies, there is a noticeable gap of knowledge and capacities to monitor and evaluate them. This is confirmed by the responses of the interviews in which

not a single responder mentioned the need and/or the possibility to monitor and measure the impact of the potentially implemented measures.

On the other hand, the state needs to define mechanisms to quantify and measure the impact of the applied policies, in order to determine their respective efficiency. The set of key performance indicators (hereinafter KPI) that should be defined should consist, but not be limited to, measuring the sales/consumption of the targeted products and their substitutes and control of the nutritional information of these products. However, this must be introduced as a multidisciplinary and systematic approach that will not only measure the consequences of the introduced policies in terms of follow-up of the sales figures, but at the same time a reliable mechanism to measure the impact of the introduced policies in the actual reduction of the incidence and prevalence of diabetes and most importantly the impact on the reduction of the risk factors that lead to it would need to be designed and implemented. Given the fact all the options discussed in the previous chapter 4.3.1 do not provide absolute certainty of achieving the desired results, a diligent monitoring and evaluation of the implementation would do a great degree assist in reviewing and adopting the measures to suit to the particular circumstances and conditions of the country. Therefore, the state needs also to show maximal degree of flexibility to adjust the fiscal approach for prevention of NCD in accordance with the results of the above monitoring.



## CONCLUSION

The last decades show a dramatic increase of prevalence of diabetes globally, exceeding even the most pessimistic projections by several hundreds of percentile points. This is further aggravated by the growth of the total population and in particular its aging, which in turn increases the number of more mature people.

The above conclusion is confirmed also by the Centre for Disease Control (CDC) of the USA, suggesting that even if diabetes incidence rates level off, the prevalence of diabetes will double in the next 20 years, in part, due to aging (Kirkman et al., 2012). Consequently, it is to be expected that the complications related to diabetes will follow the same pattern of increase, given the proportional causal relation between the two phenomena.

RNM shows very similar trends of population development compared to the global ones. According to the last census of the, State Statistical Office of the Republic of Macedonia (2022) the number of populations in RNM has shrunk to approximately 1.8 million, as compared to over 2 million in the previous census. In addition, the population growth rate is at its historic minimum leading to an age distribution in which the number of the elderly (over 65 years) has increased for 50% in the period 1990-2003 while at the same time the percentage of the young population 0-14 years decreased to 21.1% according to the State Statistical Office of the Republic of Macedonia (2011). Notwithstanding the increase in the proportion of the elderly population, the population is still relatively young in comparison with the averages for the EU and for Central and Eastern European countries. As argued in Chapter 3.2.1 the elderly age group of 65+ has increased its contribution to total population in RNM from 11.6% to 14.4%, mainly due to two factors: increased life expectancy and negative population growth rate trends. When this indicator is complemented with the fact that this age group shows the highest increase of prevalence of T2D while the other age groups' contribution to the total number of diabetics is relatively constant, it can be assumed with a very high degree of probability that aging as a risk factor for T2D will continue to be one of the main problems that the country's health system will have to deal with.

The projections show that, should the prevalence of diabetes and especially the risk factors contributing to it, continue to follow the current trends, the developing world and in particular RNM will in the foreseeable future not be able to cope with the economic burden resulting from the direct and indirect costs of diabetes and the related complications (World Health Organization , 2015).

The burden of diabetes is far too big to be borne by the low- and middle-income countries, especially having in mind that its incidence and prevalence is considerably higher among the socially vulnerable categories of populations. The predominantly urban impact of type 2 diabetes and other forms of impaired glucose tolerance, coupled with high prevalence of overweight, obesity and changes in lifestyle, present not only a health concern but it threatens to undermine countries overall socioeconomic development.

Taking in consideration that the above-explained uncertainties will continue to exist and perhaps even increase, the main challenge in the future will be to put under control the related economic burden.

Focusing on the example of RNM, facts show that in 2021 the per capita GDP (PPP) is at the level of around USD 16.000, while the expenditures for treatment of diabetes are at a level of over 6% of the per capita GDP as compared with 2007 when this ratio was merely 1.3 %. This indicates a drastic increase of almost 5 times in relative terms, which if the trends continue would pose a considerable threat to the stability of the health insurance system.

Having identified this as a great risk with a high probability of occurrence, an effective risk mitigating strategy should be designed to flatten the curve of prevalence of diabetes and its respective risk factors. The health systems in cooperation with a well targeted fiscal policy has a considerable potential to impact their prevention. Taking in consideration that RNM is doing very little to address the issue of preventing diabetes, it is very likely that there is a considerable potential to influence the risks factors contributing to the high prevalence of diabetes utilizing the available instruments of a well targeted fiscal policy in combination with a policy of subsidizing the substitutes of the “unhealthy” products.

Different approaches and different strategies are pointed out by the interviewees SHSA and TGJH:

- Cost-effective and sustainable strategies are urgently required to curb the obesity and diabetes epidemic
- School and Education sector policies should promote a healthy, active and sustainable lifestyle.
- Urban sector policies should include a number of initiatives (free bicycle schemes)
- Agriculture sector should encourage rural development and agriculture as Macedonia is a net food importer.
- Food policies should: provide incentives to the production, distribution and marketing of healthy foods and encourage local small-scale production.
- Adopting EU regulation on banning trans-fats.
- Front of package labelling.
- Fiscal measures at least on sugar-sweetened non-alcoholic beverages, more comprehensive, on all products with high content of sugar, salt and fats, the better
- Incentivise physical activity (improving infrastructure, payment-free PA).
- Regulate food marketing to children.

Drawing from the experiences and lessons learned from other countries as presented in Table 11 it can be concluded that a well targeted and consistently applied fiscal policy could have a considerable impact on the consumption of substances that a high threat for the increase of the prevalence of diabetes and its risk factors. As presented in the quoted table, the potential for reduction of the prevalence of diabetes and its risk factors through targeted policies has

been recognized by different countries in the past and as in the case of Finland, specific measures have been introduced as early as 1948. In summary what can be concluded from this table is that the measures have been introduced to establish control over the consumption of products containing particular ingredients, via different fiscal tools. The table provides a comparative analysis of the instruments used vs the results achieved. In the majority of the cases there is no conclusive evidence on the impact of the introduced measures, mainly due to lack of the monitoring and evaluation component. On the other hand, where this impact has been measured in vast majority of the cases, positive results have been reported. In addition, the state should establish clear and transparent mechanisms for monitoring the impact of the implemented measures and show a high degree of flexibility to adjust the approach in accordance with the results of this monitoring.

The most appropriate approach towards achieving the above goal needs to be carefully studied. This study needs to be elaborated in a way that will provide a comparison of the different fiscal interventions as explained in chapter 4.3.1., which analyses the potential that the fiscal policies could have on mitigation of risk factors related to diabetes and its consequences. In summary the performed analyses and in particular the ones related to the responses of the interviewees have shown that the poor dietary habits influenced by the deteriorating standard of life of the population are seen as the most important risk factor for the high increase of diabetes and its related health complications. Furthermore, the interviewees provide their opinion about the necessity for the introduction of a systemic and systematic approach of the state that via the means of its fiscal policies could influence the dietary habits of its population.

Depending on the outcomes of this study the financial authorities of RNM should be able to come to a decision whether to impose additional taxation burden (excise or ad valorem) also taking into consideration the price elasticity of the products that will be targeted with those measures. Alternatively, the conclusions of the study could also point out that the best approach would be to subsidise the production and sales of healthier alternatives. Having in mind that the purpose of this thesis is to determine the possible fiscal interventions that could potentially minimize the prevalence of diabetes and its risk factors and in particular taking into consideration that all of the responders of the in-depth interviews underline the dietary pattern as a major problem, in conclusion it can be deduced that closing the price gap between the cheaper less healthy products and their respective healthy alternatives could be a potent instrument in controlling the growth rate of prevalence of diabetes and its risk factors and consequently relieve a part of the economic burden related to treatment of diabetes and the comorbidities caused by it.

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## **APPENDICES**

## **Appendix 1: Povzetek (Summary in Slovene language)**

Zadnja desetletja zaznamujeta hitra gospodarska rast in razvoj, ki sta povzročila tudi številne pozitivne spremembe v zdravju prebivalstva v primerjavi s prejšnjimi stoletji. Gospodarski razvoj je pripeljal do okrepitve izobraževanja, izboljšane zdravstvene oskrbe in boljšega obvladovanja številnih dejavnikov tveganja različnih bolezni, kar je prispevalo k izboljšanem zdravstvenem stanju prebivalstva. Po drugi strani pa je prišlo tudi do sprememb v življenjskem slogu in okrepitve določenih dejavnikov tveganja bolezni, vse večji pa so tudi izzivi pri ohranjanju dostopnosti do zdravstvene oskrbe in zdravil ter zdrave hrane. Globalizacija je namreč povzročila velike spremembe v prehrani, najprej v industrijskih regijah in nedavno v državah v razvoju. S t.i. »prehranjevalnim prehodom« so tradicionalne, večinoma rastlinske diete nadomestile energijsko bogate diete živalskega izvora, povečal se je delež predelane hrane z visoko vsebnostjo nasičenih in transmaščob, narastlo pa je tudi število obrokov, zaužitih zunaj doma.

Prehranjevalne navade poleg drugih dejavnikov tveganja, kot so spol, starost, genetika ipd., pomembno prispevajo k povečevanju razširjenosti sladkorne bolezni po vsem svetu. Slednja povzroča veliko veliko družbeno breme, in sicer tako zaradi neposrednih stroškov, povezanih z zdravljenjem tako sladkorne bolezni kot njenih zapletov, kot zaradi posrednih stroškov, ki nastajajo zaradi izgub produktivnosti zaradi te bolezni. Z vidika obvladovanja tega bremena tako z vidika pacientov in njihovih družinskih članov kot z vidika družbe kot celote je pomembno izpostaviti, da je sladkorno bolezen in zlasti njene zaplete možno v veliki meri preprečiti, pri čemer ima zdrav življenjski slog, ki vključuje zdravo prehrano in vzdrževanje normalne telesne teže, ključno vlogo. Obstajajo namreč dokazi v več državah, da ciljni javnozdravstveni preventivni programi za sladkorno bolezen zmanjšujejo razširjenost sladkorne bolezni tipa 2. Kljub temu pa je težko doseči, da pacienti dolgoročno ohranjajo ta sorazmerno preprost pristop k izboljšanju življenjskega sloga, katerega cilj je doseči kalorični primanjkljaj (z uživanjem manj kalorij, s telesno aktivnostjo ali kombiniranjem obojega).

Glede na stalno naraščajoče breme sladkorne bolezni po vsem svetu ter veliko vrzel v znanju in razumevanju njenih glavnih dejavnikov, zlasti v državah v razvoju, je namen tega magistrskega dela raziskati možnosti za uvedbo fiskalnih politik ali drugih ekonomskih ukrepov, ki bi vplivali na tiste dejavnike tveganja, ki jih je mogoče obvladovati, zlasti torej dejavnike življenjskega sloga, kar bi preprečilo nastanek določenih zdravstvenih izdatkov in s tem razbremenitev zdravstvenega proračuna. Primerjava relativnega bremena sladkorne bolezni in z njo povezanih zapletov med RNM in preostalim svetom ter zlasti z evropskimi državami je pokazala, da je RNM država z najvišjo stopnjo bremena te bolezni. Vzroke za tako visoko obremenitev je mogoče iskati v hitrem naraščanju prevalence sladkorne bolezni, pa tudi v relativno nizki stopnji rasti BDP. Stopnja obremenitve kaže, da je RNM država, ki se sooča s težavami pri zadovoljevanju hitro naraščajočega povpraševanja po zdravstvenih

storitvah za zdravljenje sladkorne bolezni. Če se bo trend nadaljeval, bo breme sladane bolezni pomembno prispevalo k finančni nevezdržnosti zdravstva, zaradi izgub produktivnosti pa bo ta bolezen negativno vplivala tudi na gospodarsko rast.

## **Appendix 2: In depth Interview with a representative of Macedonian association of people with diabetes (Mr. Viktor Lukarski)**

Q1. In your opinion would you say that the diabetic patients receive enough education about diabetes management from healthcare professionals (in terms of nutrition, adequate and precise treatment use, measuring glucose levels)?

Q1. (Translation in Macedonian) Дали сметате дека дијабетичарите добиват доволно едукација за начинот на менаџирање на болеста од медицински персонал во однос на исхрана, правилен начин на користење на препишаната терапија како и насоки на мерење на нивото на гликоза во крв во домашни услови?

(Answer in Macedonian) Генерално нивото на едукација во земјава е многу ниско. Не само поради

Малиот број на професионалци туку и поради незаинтересираноста на самите пациенти. Здруженијата обично еднаш во месецот имаат такви работилници, но посетеноста е очајно мала.

(Translation of the answer) In general, the level of education in the country is very low. Not only because

The small number of professionals but also due to the lack of interest of the patients themselves. Associations usually have such workshops once a month, but the attendance is extremely low.

Q2. Would you say that the members of your association consult their doctors to discuss possible diabetes complications such as retinopathy, cardiovascular complications, diabetic foot... etc?

Q2 (Translation in Macedonian) Дали би рекле дека пациентите што се дел на вашето здружение се консултираат со својот доктор за потенцијални компликации кои можат да произлезат од дијабетот како ретинопатија, кардиоваскуларни проблеми, проблеми со дијабетично стапало?

(Answer in Macedonian) За среќа нашето здружение се фокусира на млади луѓе кои имаат Т1Д, па досега сепак нивното здравје е добро за да ги прават овие тестови на редовна база, но едукацијата за овие компликации е постојана во координација со лекарите од клиниката за ендокринологија.

(Translation of the answer) Fortunately our association focuses on young people who have T1D, so far, their health is still good enough to do these tests on a regular basis, but education about these complications is constant in coordination with the doctors from the endocrinology clinic.

Q3. In your opinion how often do patients visit the doctor's office for their BMI measurements, measuring glucose levels as well as optimizing their therapies?

Q3(Translation in Macedonian) Според вашето мислење дали пациентите редовно го посетуваат својот доктор за мерење на гликоза и инсулин, исто како и мерења на нивното БМИ (индекс на телесна маса), од кои што би добиле понатамошни насоки за начинот на користење на нивната терапија?

(Answer in Macedonian) За жал БМИ кај нас не е нешто што се практикува често, а би требало. Но од друга страна нашите членови редовно си го проверуваат ХБА1Ц гликолизираниот хемоглобин и на тој начин одржуваат контрола.

(Translation of the answer) Unfortunately, BMI is not something that is practiced often in our country, but it should be. But on the other hand, our members regularly check their HBA1C glycosylated hemoglobin and thus maintain control.

Q4. Would you say that the people in your association are familiar with the benefits of consumption of fruits, vegetables, nuts and seeds and that are compliant to the measures in terms of nutrition that their doctor has recommended? If not, please explain why?

Q4. (Translation in Macedonian) Дали луѓето во вашето здружение се запознати со бенефитите на конзумирање на овошје, зеленчук, житарици и јаткасти плодови и дали се придржуваат на мерките за исхрана кои се препорачани од нивниот доктор? Доколку не, зошто?

(Answer in Macedonian) Апсолутно да, нашите членови знаат да бројат и јаглени хидрати и лебни единици.

(Translation of the answer) Absolutely yes, our members know how to count carbohydrates and bread units.

Q5. In your opinion what makes the medication and diet as prescribed by their doctors difficult to adhere to?

Q5. (Translation in Macedonian) Што сметате дека им претставува потешкотија на пациентите кога станува збор за правилна употреба на лекастрвата и придржување до правилната исхрана?

(Answer in Macedonian) Кај повеќето проблем е брзиот и нередовен живот кој е најчесто е поврзан со работните обврски и прилагодување кон истите.

(Translation of the answer) For most, the problem is the fast and irregular life that is most often associated with it with work obligations and adaptation to them.



Q6. In your opinion do you think that the medical teams need to be supported to be able to manage the disease better?

Q6. (Translation in Macedonian) Дали сметате дека медицинските лица имаат потреба од поддршка како би имале можност за подобар менаџмент на болеста?

(Answer in Macedonian) Секако. Добрата соработка меѓу ендокринологот и пациентот е императив за добар менаџмент на дијабетесот.

(Translation of the answer) Of course. Good cooperation between the endocrinologist and the patient is imperative for good diabetes management.

Q7. From the experience gathered in your association how does having diabetes impact daily life?

Q7. (Translation in Macedonian) Според вашите досегашни искуства, како би рекле дека дијабетесот влијае врз секојдневниот живот на пациентите?

(Answer in Macedonian) Кај повеќето членови како што кажав работните обврски го диктираат темпото во секојдневниот живот. Сакам да мислам дека сите се трудиме да то најдеме средниот пат за едното и другото за добар менаџмент на дијабетесот но не секогаш тоа е возможно.

(Translation of the answer) For most members, as I said, work responsibilities dictate it the pace of everyday life. I like to think that we all try to we find the middle way for one and the other for a good management of diabetes, but it is not always possible.

Q8. If you as an association could change something about the service received by healthcare professionals, what would it be?

Q8. (Translation in Macedonian) Доколку вие како здружение би имале можност да промените дел од услугите што ги добивате од медицинскиот персонал, што би било тоа?

(Answer in Macedonian) Повеќе ендокринолози и едукатори се секогаш потребни. Најнови технологии како пумпи и сензори за мониторирање на гликемиите исто така.

(Translation of the answer) More endocrinologists and educators are always needed. The latest technologies such as pumps and sensors for monitoring glycemia as well.

Q9. In your opinion based on discussions in your association what are the main barriers in achieving target weight and/or healthier eating habits?

Q9. (Translation in Macedonian) Според дискусиите во вашето здружение, каков заклучок би извлекле кога станува збор за најолемата препрека која пациентите ја дектираат во постигнување на посакуваната тежина и/или здрави навики во исхранта?

(Answer in Macedonian) За ова ќе кажам само дека ние сме Македонци (како географска одредница не национална) и сите сакаме да каснеме лебче, мевце и останати работи. Нашата земја има одлична храна и тоа не е секогаш лесно да се заобиколи кога станува збор за менаџирање на телесна тежина, не само кај T1 луѓе туку и воопшто кај здравите луѓе затоа се почесто се соочуваме со проблем на обезност и кај младите здрави деца.

(Translation of the answer) I will only say about this that we are Macedonians (as a geographical marker, not a national one) and we all like to have a bite of bread, meat and other things. Our country has great food and that's not always easy to get around when it comes to weight management, not just in T1 people, but also in healthy people in general, that's why we are more and more often faced with problem of obesity even in young healthy children.

Q10. In your opinion what drives people's choices when choosing food? Would you say that their diet is driven by culture, or price driven?

Q10. (Translation in Macedonian) Според вас дали изборот на храна на луѓето во вашето здружение е базирано врз културни навики или повеќе би рекле дека се базира врз куповната моќ?

(Answer in Macedonian) Ова е многу индивидуално прашање. Како што кажав погоре културата има големо влијание, но пост пандемски и сега со целата Украинска ситуација, куповната моќ на населението е драстично опадната.

(Translation of the answer) This is a very individual question. As I said above, culture has a great influence, but post-pandemic and now with the whole Ukrainian situation, the purchasing power of the population has drastically decreased.

Q11. To what extent would you say that individuals from your association feel supported and encouraged by healthcare professionals to improve their diet or increase physical activity level?

Q11. (Translation in Macedonian) Дали сметате дека членовите на вашето здружение се осеќаат поддржани во подобрување на нивниот начин на исхрана и зголемување на нивната физичка активност од страна на медицинскиот персонал ?

(Answer in Macedonian) Нашето здружение со години учествува на спортски настани како ДиаЕуро, Скопски маратон, Велосипедски тури итн. Пандемијата на Ковид,

Го прекина сето тоа ненадејно и се соочуваме со реален и голем проблем во повторното активирање во однос на физичките активности. Медицинскиот персонал е секогаш тука за поддршка, но сепак не е нивна обврска да не мотивираат за физичка активност туку да укажат колку е важна истата.

(Translation of the answer) For years, our association has been participating in sports events such as DiaEuro, Skopje Marathon, Bicycle tours, etc. The covid pandemic It stopped all of that suddenly and we are facing a real and big problem in reactivation in terms of physical activities. The medical staff is always there for support, but it is not their responsibility to motivate us for physical activity, but to show how important it is.

Q12. Would you say that the members of your association would consider healthier options, if the prices of those products were lower?

Q12. (Translation in Macedonian) Според вас дали членовите на вашето здружение би конзумирале повеќе здрава храна доколку цената на тие продукти е помала?

(Answer in Macedonian) Апсолутно.

(Translation of the answer) Absolutely.

Q13. Would you say that the increase prices of unhealthy foods (fast-food, ready-made meals, take aways, etc.) would discourage the members of your association from consuming them?

Q13. (Translation in Macedonian) Дали ви рекле дека зголемувањето на цените брзата храна би придонеле до намалена конзумација на тој вид на храна од страна на членовите на вашето здружение?

(Answer in Macedonian) Не, зголемувањето на цената на брзата храна како нешто што не се препорачува во нашите животи, само ќе ја поттикне желбата да го направиме спротивното и повеќе да ја конзумираме, особено кај помладите генерации.

(Translation of the answer) No, increasing the price of fast food as something that is not recommended in our lives will only encourage the desire to do the opposite and consume more of it, especially among the younger generations.

Q14. Is there anything else that you feel is relevant regarding diabetes prevention and improved management?

Q14. (Translation in Macedonian) Дали би додале нешто друго што сметате дека е релевантно за превенирање и подобар менаџмент на дијабетесот?

(Answer in Macedonian) Благодарам на вниманието и во однос на ова прашање мислам дека можеме да напишеме уште неколку трудови на оваа тема бидејќи е неисцрпна.

(Translation of the answer) Thanks for your attention and regarding this issue I think we can write several more papers on this topic because it is inexhaustible.

### **Appendix 3: In depth Interview with a doctor, specialist in endocrinology at Acibaden Sistina Hospital (Dr. Nadica Bozinovska)**

Q1. In your opinion what is the main factor for the rising trend of diabetes in RNM?

Q1. (Translation in Macedonian) Според вас кој е главниот фактор за растечкиот тренд на дијабет во Република Северна Македонија?

(Answer in Macedonian) Несоодветна исхрана, недостаток на физичка активност.

(Translation of the answer) Inadequate diet, lack of physical activity

Q2. In your opinion what factors affect the poor eating habits in RNM?

Q2. (Translation in Macedonian) Според вас кои фактори влијаат на нездравите навики во исхраната на ниво на Република Северна Македонија?

(Answer in Macedonian) Недоволно свесност кај населението за опасноста од метаболните болести, финансиска недостапност на здрава храна

(Translation of the answer) Insufficient awareness among the population about the danger of metabolic diseases, financial inaccessibility of healthy food

Q3. Why do you think that the obesity percentage in RNM is high?

Q3. (Translation in Macedonian) Зошто сметате дека Република Северна Македонија има висок процент на луѓе со прекумерна тежина?

(Answer in Macedonian) Брзата храна полна со масти и јаглехидрати е полесно достапна, дополнително не постои т.н. спортска култура со редовно практикување на спортски активности

(Translation of the answer) Fast food full of fats and carbohydrates is more easily available, in addition, there is no so-called sports culture with regular practice of sports activities

Q4. To what extent are eating habits in RNM are a result of personal choice or are driven by food affordability?

Q4. (Translation in Macedonian) Според вас дали изборот на храна на пациентите е базирано врз културни навики или повеќе би рекле дека се базира врз куповната моќ?

(Answer in Macedonian) Две третини е резултат на куповната моќ, меѓутоа децениските навики на внес на храна со потекло од Р. Турција имаат исто така големо влијание

(Translation of the answer) Two-thirds is the result of purchasing power, but decades of food intake habits originating from Turkey also has a great influence

Q5. In your opinion, are the GP practices (doctors and nurses) doing enough to increase awareness regarding behavioral risk factors of diabetes, such as poor diet?

Q5. (Translation in Macedonian) Според вас, дали лекарите и медицинските сестри прават доволно за да ја зголемат свеста за ризик факторите на дијабетес, како што е лошата исхрана?

(Answer in Macedonian) Медицинскиот персонал не е доволен за зголемување на свеста, медицинскиот персонал воглавно допира само до пациентите кои доаѓаат да се лекуваат.

(Translation of the answer) The medical staff is not enough to raise awareness, the medical staff mainly only reaches the patients who come for treatment.

Q6. Can you say that doctors in RNM guide their patients towards prevention of the disease, rather than afterwards treating the disease?

Q6. (Translation in Macedonian) Можете ли да кажете дека лекарите во РСМ ги насочуваат своите пациенти кон превенција на болеста, наместо лекување на болеста?

(Answer in Macedonian) Во последните десетина години, да.

(Translation of the answer) In the last ten years, yes.

Q7. Do you think that doctors in RNM have the right resources and opportunities to help and support the patients in making “smarter” lifestyle decisions to prevent the development of the disease?

Q7. (Translation in Macedonian) Дали сметате дека лекарите во РСМ ги имаат потребните ресурси и можности да им помогнат и да ги поддржат пациентите во донесувањето „попаметни“ одлуки за да се спречи развојот на болеста?

(Answer in Macedonian) Да

(Translation of the answer) Yes

Q8. From your perspective what can be done to move to prevention-oriented country rather than treating diabetes in RNM?

Q8. (Translation in Macedonian) Од ваша перспектива, кои мерки би можеле да се преземат за РСМ да се ориентирана кон превенција наместо кон лекување на дијабетесот?

(Answer in Macedonian) Акции на ниво на целата држава, зголемена достапност на подтоци по информативните медиуми

(Translation of the answer) Actions at the level of the entire country, increased availability of sub-streams in the news media

Q9. Do you think that RNM lacks policies that will help healthcare professionals regulate eating habits and to optimize use of medication?

Q9. (Translation in Macedonian) Дали сметате дека во РСМ недостасуваат политики кои ќе им помогнат на здравствените работници да ги регулираат навиките за исхрана и да ја оптимизираат употребата на лекови?

(Answer in Macedonian) Да.

(Translation of the answer) Yes.

Q10. In your opinion what do you think can be done to improve the treatment of those who already have diabetes?

Q10. (Translation in Macedonian) Според вас, што може да се направи за да се подобри третманот на пациентите кои што веќе имаат дијабет?

(Answer in Macedonian) Поголема достапност на лекови преку фондот.

(Translation of the answer) Greater availability of medicines through the fund.

Q11. Is there anything else that you feel is relevant regarding diabetes prevention and management?

Q11. (Translation in Macedonian) Дали би додале нешто друго што сметате дека е релевантно за превенирање и подобар менаџмент на дијабетесот?

(Answer in Macedonian) Подобрување на целосната здравствена култура во нашата држава

(Translation of the answer) Improvement of the complete health culture in our country

**Appendix 4: In depth interview with a nurse providing diabetes care in Acibadem Sistina hospital (Ms. Gordana Komljenovic)**

Q1. In your opinion what is the main factor for the rising trend of diabetes in RNM?

Q1. (Translation in Macedonian) Според вас кој е главниот фактор за растечкиот тренд на дијабет во Република Северна Македонија?

(Answer in Macedonian) Најчесто се смета дека стилот на живеење е причина за зголемување на дијабетот, нездрава исхрана (гојазност) и слаба физичка активност.

(Translation of the answer) Most often it is considered that the lifestyle is the cause of the increase of diabetes, unhealthy diet (obesity) and poor physical activity

Q2. In your opinion what factors affect the poor eating habits in RNM?

Q2. (Translation in Macedonian) Според вас кои фактори влијаат на нездравите навики во исхраната на ниво на Република Северна Македонија?

(Answer in Macedonian) Моето мислење на оваа тема е дека животниот стандард има големо значење кога станува збор за навиките на луѓето, исто така брзото темпо на живеење го детектирам како проблем заради кој што луѓето се соочуваат со бариери да си ги постигнат нивните здрави навики.

(Translation of the answer) My opinion on this topic is that the standard of living has a great importance when it comes to people's habits, I also detect the fast pace of living as a problem because of which people face barriers to achieve their healthy habits.

Q3. Why do you think that the obesity percentage in RNM is high?

Q3. (Translation in Macedonian) Зошто сметате дека Република Северна Македонија има висок процент на луѓе со прекумерна тежина?

(Answer in Macedonian) Сметам дека тоа се должи на лошите навики за исхрана и физичка неактивност. Исто така мислам дека нивото на едукација и анимација на нацеленито е сеуште на многу ниско ниво.

(Translation of the answer) I believe it is due to poor eating habits and physical inactivity. I also think that the level of education and animation of the population is still at a very low level.

Q4. To what extent are eating habits in RNM are a result of personal choice or are driven by food affordability?

Q4. (Translation in Macedonian) Според вас дали изборот на храна на пациентите е базирано врз култуни навики или повеќе би рекле дека се базира врз куповната моќ?



(Answer in Macedonian) Мислам дека куповната моќ е клучна, не секој има доволно средства да обезбеди намирници кои се здрави, еколошки или органски. Секако се негуваат и културните навики ,но се прифаќа и новиот тренд на користење непроцесирана храна и свежи намирници.

(Translation of the answer) I think that purchasing power is key, not everyone has enough funds to provide food that is healthy, ecological or organic. Of course, cultural habits are cultivated, but the new trend of using unprocessed food and fresh food is also accepted.

Q5. In your opinion, are the GP practices (doctors and nurses) doing enough to increase awareness regarding behavioral risk factors of diabetes, such as poor diet?

Q5. (Translation in Macedonian) Според вас, дали лекарите и медицинските сестри прават доволно за да ја зголемат свеста за ризик факторите на дијабетес, како што е лошата исхрана?

(Answer in Macedonian) Убаво што го поставивте ова прашање, според моето досегашно искуство степенот на примање на информации како слушатели од страна на пациентите со многу слаб одзив и покрај тоа што се прават напори од страна на медицинскиот персонал да ја зголемат свеста кај пациентот.

(Translation of the answer) It's nice that you asked this question, according to my experience so far, the level of receiving information as listeners by patients is very low response despite the efforts made by the medical staff to increase the awareness of the patient.

Q6. Can you say that doctors in RNM guide their patients towards prevention of the disease, rather than afterwards treating the disease?

Q6. (Translation in Macedonian) Можете ли да кажете дека лекарите во РСМ ги насочуваат своите пациенти кон превенција на болеста, наместо лекување на болеста?

(Answer in Macedonian) Да, од моето искуство, сметам дека се прават напори но за жал тоа во моментот е повеќе сконцентрирано во приватните институции, но финансискиот момент е клучен за изборот на пациентите околу превентивните прегледи.

(Translation of the answer) Yes, from my experience, I believe that efforts are being made, but unfortunately it is currently more concentrated in private institutions, but the financial moment is key to the choice of patients regarding preventive examinations.

Q7. From your perspective what can be done to move to prevention-oriented country rather than treating diabetes in RNM?

Q7. (Translation in Macedonian) Од ваша перспектива, кои мерки би можеле да се преземат за РСМ да се ориентира кон превенција наместо кон лекување на дијабетесот?

(Answer in Macedonian) Па... сметам дека треба да се придонесе за зголемување на свеста преку финансиски достапни можности за физичкаактивност (теретани, базени, велосипеди) како и промовирање на медитеранската исхрана, кои би имале позитивен ефект врз здравјето на луѓето и секако би придоење во превенција на дијабет тип 2.

(Translation of the answer) Well... I think that it is necessary to contribute to increasing awareness through financially available opportunities for physical activity (gyms, swimming pools, bicycles) as well as promoting the Mediterranean diet, which would have a positive effect on people's health and would certainly contribute to prevention of type 2 diabetes.

Q8. Do you think that RNM lacks policies that will help healthcare professionals regulate eating habits and to optimize use of medication?

Q8. (Translation in Macedonian) Дали сметате дека во РСМ недостасуваат политики кои ќе им помогнат на здравствените работници да ги регулираат навиките за исхрана и да ја оптимизираат употребата на лекови?

(Answer in Macedonian) Во право сте, сметам дека недостасуваат политики, мерки кои здравствените работниработници би ги користели во секојдневната пракса со пациентите.

(Translation of the answer) You are right, I think that there is a lack of policies, measures that healthcare workers would use in their daily practice with patients.

Q9. In your opinion what do you think can be done to improve the treatment of those who already have diabetes?

Q9. (Translation in Macedonian) Според вас, што може да се направи за да се подобри третманот на пациентите кои што веќе имаат дијабет?

(Answer in Macedonian) Јас сметам дека треба да се промовира поголема физичка активност како и да се исклучат белите отрови (ШЕКЕРИ, БРАШНО) што се конзумираат на секојдневна база на зашите простори.

(Translation of the answer) I think that it is necessary to promote more physical activity as well as to exclude white poisons (SUGARS, FLOUR) that are consumed on a daily basis in these areas.

Q10. Is there anything else that you feel is relevant regarding diabetes prevention and management?

Q10. (Translation in Macedonian) Дали би додале нешто друго што сметате дека е релевантно за превенирање и подобар менаџмент на дијабетесот?

(Answer in Macedonian) Мислам дека се што зборувавме во текот на ова интервју е сосема доволно доколку истото се спроведе и реализира.

(Translation of the answer) I think that everything we talked about during this interview is quite enough if it is implemented and implemented.

## **Appendix 5: In depth interview with a public health nutrition lecturer and evidence based researcher in the field of T2D (Dr. Teuta Gjulin Hellon)**

1. In your opinion what is the main reason of increasing prevalence trend of diabetes on a national level?

A: On population level, increasing prevalence of type 2 diabetes can be attributed to a wide range of potential factors. At the first place, increased overweight and obesity levels in RNM are seen as the main contributor. Weight and obesity problems initially seem easy to cure, by encourage people to eat less and exercise more. However, this would be oversimplifying the issue now known as “the wicked problem in public health”. Diabetes is a chronic is the result of complex lifestyle factors determined by physical, emotional, environmental and social determinants. It is difficult is to determine the conditions that drive individual choice on food and physical activity and how this is influenced by society and modern living conditions.

2. To what extent is a lifestyle medicine a part of the undergraduate and postgraduate curricula?

A: This is a crucial and very important question to address, I am very glad you raised this point. Nutrition and dietetics are somehow missing from the medical curricula. In order to understand the importance of Lifestyle Medicine, we need to go back to its definition, provided by the British Society of Lifestyle Medicine: “Lifestyle Medicine is evidence-based clinical care that supports behavior change through person-centered techniques to improve mental wellbeing, social connection, healthy eating, physical activity, sleep and minimization of harmful substances and behaviors.” While Lifestyle Medicine is not the ultimate solution and substitute for traditional population-level public health interventions, Lifestyle Medicine is an important part of the solution, that should be increasingly integrated in the population-level interventions of preventive approaches to health and well-being. And while the developed countries are rapidly introducing Lifestyle Medicine in the undergraduate and postgraduate curricula, developing countries like the RNM are lagging far behind. Even more upsetting is the fact that Nutrition and dietetics are hardly integrated in undergraduate medical education, let alone studied as separate modules. Embedding Lifestyle Medicine as a set of skill would provide an opportunity to improve people’s health and to protect nation’s workforce ahead of uncertain future.

3. In your opinion what factors affect the poor eating habits in RNM?

A: Knowledge and awareness about the food choices we make is important in shaping people’s diet. However, economic instability and increased food insecurity also influence us to a great extent what people chose to buy. The high economic insecurity and increasing food prices indicate that more and more people struggle to meet their daily calorific demand

and opt for cheap energy dense foods to satiate their hunger, with little consideration of the nutritional value of foods. Urbanisation and fast-food culture is also one of the contributing elements. Cultural influences and traditional cooking high in fat, salt and sugar and portion sizes certainly add to the increased risk of obesity and diabetes. On the other hand, the globalised food systems have made it possible to consume exotic and processed foods that have never been known before. In parallel with this, physical activity levels are very low, and my research showed that none of the age groups are meeting the necessary level of physical activity as suggested by the WHO. This shortly should provide you with some broad understanding about the reason of the increasing trends in overweight, obesity and diabetes in the RNM.

4. In your opinion is the education system doing enough to guide young people towards a healthier lifestyle?

A: The recent large-scale survey focused on eating habits of primary school children in RNM (published in 2021 and funded by the European Food Safety Authority) found that childhood obesity grows into a concerning public health issue. Analysis showed that 38.5% of children in the second grade in RNM were overweight or obese. Daily soft drinks consumption was among highest when compared to other countries in the WHO European region, consumption of both sweet and savoury snacks was above European average, obesity among girls is gradually closing the gap and approach the prevalence present among boys which was not the case previously, while improvements should be done in terms of fruit and vegetable consumption. This shows that education system is not doing enough to promote healthy diets and adoption of healthy practices in the early stages of life, to prevent childhood and adolescent obesity and consequently lower diabetes risk.

5. In your opinion is research in this area sufficient and sufficiently supported?

A: Evidence suggests that political and economic instability is negatively related to individual health via its link with the quality of the health care sector and this is exactly the case with RNM. The government of RNM does not have the capacity, I dare say also has not shown interest to make research behind the raising trend of not only diabetes, but all other non-communicable diseases, such as heart and musculoskeletal disease, cancer and mental health diseases a priority. Diabetes prevention is particularly an under researched area.

This is really upsetting for researchers, especially as much of the research should be informed by routinely collected data to increase the national evidence-base and structure modelling studies to simulate and test the impact of policies before they are implemented in the 'real world'. Sadly, such information is scarce, sporadic and difficult to obtain from governmental websites or organisations which creates even more unfavourable environment. Mainly, research and its publication is self-funded and driven by the enthusiasm of researchers and academics in the field. Thus, large scale and long-term assessment of the

state of people's health and wellbeing or modelling studies to assess any potential policy to prevent and mitigate diabetes based on national data cannot be found.

6. In your opinion, does the health sector have the capacity to mitigate risk factors of diabetes, such as poor diet?

A: In urban areas, clinical staff such as GPs, specialists and nurses cannot cope with the increasing demand for their services, considering the population demographics (increased inward migration towards major cities characteristic for the last 30-40 years, population aging and recently high immigration out of the country among the younger people) in RNM. On the other hand, rural areas are often left abandoned, without trained clinical staff that can manage and increase awareness of the benefits of self-management of diabetes through lifestyle changes. This situation put people's life in danger and further exacerbates the situation, you know, it has become a vicious circle. And we know that T2D to a larger extent is a preventable metabolic disorder and intensive lifestyle interventions have shown a reduction in the overall risk of developing the disease. Unfortunately, in RNM, the first 10 years of diabetes natural history, namely the prediabetic stages, is not the focus of most interventions and research, when the disorder is easiest to treat. Further, my own research as public health nutritionist has shown that regardless of the type of intervention, adherence to any form of diet is decreasing after 6 months with a tendency to return to baseline dietary habits after one year. Thus, a joint multidisciplinary team that includes clinical staff, psychologists, nutritionist / dietitian or lifestyle medicine specialist have the potential to improve compliance and promote long-term behavioural change. However, psychologists, nutritionists, dietitians and certainly lifestyle medicine specialists rarely or do not make part of the health care teams.

RNM does not even have national evidence-based guidelines and policies that would inform clinicians about different types of diets, physical activity and behavioural change based available for prediabetic and diabetic patients and in this way patients' preferences are being ignored which makes self-management and prevention of progression of the disease even harder. The guidelines in use at the moment are translated verbatim from the National Institute of Health and Care Excellence of the UK, however, these are not adopted to the specific Macedonia setting and are often inapplicable.

7. Should multifaceted government policies play significant role in reducing diabetes risk factors?

A: Government action alone is insufficient to solve the issue; the problem needs to be recognised and addressed across society, communities and individuals.

With the sociodemographic changes, population growing and aging, the RNM must act now, looking for multifaceted innovative solutions to tackle the most pressing issues of nations' health being in a joint approach. In my opinion, priority should be given to solutions that have the potential to improve people's health and wellbeing given the interconnections

between non-communicable diseases, climate change, food production and food security and the built urban environment in which people live and work.

As Austin Bradford Hill, the English epidemiologist who demonstrated the connection between cigarette smoking and lung cancer once said: “All scientific work is incomplete – whether it be observational or experimental. All scientific work is liable to be upset or modified by advancing knowledge. That does not confer upon us a freedom to ignore the knowledge we already have, or to postpone the action that it appears to demand at a given time.”

School and Education sector policies should promote a healthy, active and sustainable lifestyle by: ensuring school canteens offer nutritional and balanced diets to children, promoting ‘carbon efficient’ meals; introducing compulsory cooking classes, where children will learn in practice what a healthy meal means, not only in terms of human health, but in environmental terms; promoting organic school farms, where children and teachers can grow some of the food needed for cooking classes, learning about sustainable agriculture

Cost-effective and sustainable strategies are urgently required to curb the obesity and diabetes epidemic. Increased healthcare expenditures for people with diabetes (which are more than twice higher than for the ones without), high morbidity and mortality rates, economic loss due to increased absenteeism and presenteeism, should be a sufficient incentive for the government of the RNM to urgently implement multifaceted approach of mitigation diabetes and diabetes risk factors, considering the projected prevalence of the disease and stop the siloed single sector approach which does not yield any positive impact on prevention or management. This should include many governmental sectors (ministries) such as the health, food and agriculture, economic, environment and urban planning and education sectors.

Urban sector policies should include a number of initiatives, that if implemented will assist with promoting a healthy lifestyle such as a network of cycle paths, free bicycle schemes or subsidised public transport passes to promote active travel.

Agriculture sector should encourage rural development and agriculture as Macedonia is a net food importer. This would increase food security and lower the impact of global price volatility on the most vulnerable population.

Food policies should: provide incentives to the production, distribution and marketing of healthy foods and encourage local small-scale production; subsidise innovative production of alternatives/analogues to highly processed products especially of animal origin that taste similar, but are easier to cook, less expensive and healthier; enforce comprehensive nutritional information on food packaging such as the traffic light colour system understandable to the lay users. Here I would also add that restaurateurs should offer greater choices of healthy food meals in their menus and provide calorific value of meals in the menu.

Coordinated policies, responsibilities and actions should aim towards setting realistically achievable time-framed goals, including the most relevant sectors such as the health, education, transport, urban and agriculture sectors. This would ensure that information will reach the public and will potentially increase public awareness of health and environmental issues.

8. Are you aware of any economic measures that aim to prevent obesity and diabetes? This might include taxation on high sugar or high saturated fat food products, subsidies on fruit and vegetables, calorie tax, similar to the tobacco tax.

A: Oh yes, certainly. Knowing the complex interaction of a wide range of determinants that influence people's dietary choices, price policies applied to food can shape point-of-purchase decision-making by changing the price that the consumer pays. Price policies may be targeting a specific food product or a specific nutrient contained in the product. Evidence from a range of economic modelling and empirical studies shows that fiscal policies are well established economic measure that have the potential to contribute towards better health and wellbeing by influencing the choice of foods people buy and consume. Many developed countries (UK, Finland, France, Denmark) and increasingly developing countries (Brazil, Mexico, Equador etc.) have implemented such measures. For example, sugar tax, fat tax etc. Such economic measures in the RNM do not exist, despite their overall positive impact on health.

9. In your opinion do such economic measures, e.g., higher prices of unhealthy foods and lower prices of healthier alternatives have the potential to prevent and/or improve diabetes self-management in Macedonia?

A: The starting point for cost-effectiveness evaluations is to establish the evidence base for the effectiveness of the initiative. The quality of evidence behind the effectiveness of such policies from other countries is often low and evaluation of the effectiveness depends on the chosen indicators. So, quantifying the effect on people's health is often difficult as is influenced by other factors such as the demand for products, the design of the policy, the choice of target foods or nutrients, inflation, substitutes offered, differences in fiscal financing mechanism and ultimately other confounding factors that are related to the health indicator. In the RNM fiscal policies are likely to induce changes in consumption, the demand for less healthy items such as sugary soft drinks, processed foods and meat is likely to be more price sensitive or elastic than the demand for healthier foods such as fruit and vegetables. This in long term should result in delayed on-set and slower progression of diabetes and lower the risk factors for developing it.

Myself, I am not a health economist, and it is difficult to judge the willingness and the impact of such policies on food production companies and their revenue and this should also be part of the research in RNM.



Economic model simulation studies based on real national data to test the impact of such policies across all stakeholders are necessary.

10. Do you think that these types of economic measure would drive healthier choices among consumers?

A: Food affordability in developing countries seems as one of the major drivers of food choices. You would often see marketing of energy dense and nutrient poor food advertised as “buy 2 get 1 free”, “buy 1 and get 1 half price” etc. Often these foods are very palatable, but high in saturated and trans fats, high in sugar or salt with little consideration of the nutritional value. By making healthy alternatives cheaper and by increasing the prices of foods that pose health risk, people should be driven to make healthier choices. This would not only increase healthy food affordability and improve nutrition for all, but also has the potential to lower the gap for people from a lower socio-economic background, a stratum that is most affected by diabetes (unemployed, pensioners, people with low income and on benefits). Knowing the link between diet and diabetes, this should contribute towards prevention and slowing down the progression of the disease. However, in parallel with this, rising awareness of the benefits of healthier foods and the risk of the unhealthy foods is warranted. Hence, an increase in price of unhealthy foods should lead to a fall in demand and a shift by consumers to healthier untaxed substitutes.

11. Any other measure that could be implemented to prevent diabetes and/or improve diabetes management?

A: The Macedonian Government should initiate and invest in national campaigns promoting healthy lifestyle and should make use of strategies that have the potential to change people’s behavioural patterns. Lasting lifestyle change can be facilitated only through a combination of efforts that increase knowledge, and awareness, influence and motivate behavioural change and create supportive environments that trigger positive health choices and practices.

12. Is there anything else that you feel is relevant regarding diabetes prevention and management?

A: Low- and middle-income countries need development aid and technical assistance for prevention of diabetes and other lifestyle related diseases and assistance to lower poverty and inequity. Policies and initiatives may require substantial investments and the ‘buy in’ of the public, private sector and government (national and local) and RNM does not have the capacity to address this alone. This includes investing in the urban planning sector, healthcare, agri-food systems and food security and education. Considering another pressing and closely related issue, such as climate change, RNM should look at opportunities offering alternatives to overconsumption and environmental degradation, as an opportunity for the promotion of health and sustainable development. The relevant Macedonian policy and scientific bodies should show interest and encourage institutions and researchers to conduct assessment, longitudinal and population reports and studies that emphasise potential co-

beneficial mitigation of health and environmental issues, to observe and evaluate the outcome of implemented strategies and to draw conclusions that are country based.

## **Appendix 6: In depth interview with a professional from the institute of public health of RNM (Msc. Shenaj Skenderoska Adzija)**

1. In your opinion what is the main reason of increasing prevalence trend of diabetes on a national level?

The lifestyle of the population that includes high intake of foods with significant amounts of sugar, fat (saturated and trans) and salt. Low prevalence of health-enhancing physical activity on national level. This is accompanied but low health literacy and self-care.

But more important than population's lifestyle is the non-existence of public health policies that will establish health enhancing environment.

2. As an institute how often do you monitor the modifiable risk factors for diabetes?

We annually monitor nutritional status of school children (food intake in schools/kindergartens and prevalence of all sorts of malnutrition, including obesity)

Ad-hoc we conduct food consumption surveys on adults and children that includes physical activity levels and smoking (adults).

3. Do you have evidence based public health strategies for diabetes prevention?

No. There is annual program for diabetes management adopted by the Ministry of Health.

4. If yes, how do you measure and monitor their efficiency?

5. In your opinion, does the health sector have the capacity to mitigate risk factors of diabetes, such as poor diet?

Yes. But not much focus on that so far.

6. In your opinion what would be a relevant policy measure that plays a significant role in reducing diabetes risk factors?

Adopting EU regulation on banning trans-fats

Front of package labelling

Fiscal measures at least on sugar-sweetened non-alcoholic beverages, more comprehensive, on all products with high content of sugar, salt and fats, the better

Incentivise physical activity (improving infrastructure, payment-free PA)

Regulate food marketing to children

7. Are you aware of any economic measures that aim to prevent obesity and diabetes? This might include taxation on high sugar or high saturated fat food products, subsidies on fruit and vegetables, calorie tax, similar to the tobacco tax.

Yes. Fiscal measures mentioned above (Q6) mostly refer on taxation.

8. In your opinion do such economic measures, e.g., higher prices of unhealthy foods and lower prices of healthier alternatives have the potential to prevent and/or improve diabetes self-management in Macedonia?

Yes. Not only self-management since people with diabetes are very literate related to health and self-care but more important those may prevent the onset of diabetes and increase of the incidence in the population in Macedonia.

9. Do you think that these types of economic measure would drive healthier choices among consumers?

Yes, it will force the industry to reformulate and the authorities to monitor the situation.

10. Any other measure that in your opinion could be implemented to prevent diabetes and/or improve diabetes management?

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11. Is there anything else that you feel is relevant regarding diabetes prevention and management?

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