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Diploma Thesis

Food Security and Obesity in Developing Countries

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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DIPLOMA THESIS ASSIGNMENT

Martina Ďuranová

European Agrarian Diplomacy

Thesis title

Food Security and Obesity in developing countries

Objectives of thesis

The main objective of this work is to describe the correlation between food security and obesity. The strongest inverse correlation is mainly in developing countries because they mostly fight with food insecurity. The interesting part is that at the same time they may suffer with a high percentage of obesity. It is important to find out how much food security influences the current growth of obesity worldwide. Furthermore the thesis aims to investigate the reasons of increasing obesity in particular countries with low food security in south America, North Africa and Middle East belonging to already mentioned developing countries coming from diverse regional backgrounds.

Methodology

The diploma thesis is composed into two parts. The first part is theoretical, describing and defining the basic concepts regarding to food security, obesity and their relationship in particular developing countries.

The following practical part is devoted to the analysis of acquired data using methods of analysis, comparison and synthesis. For the analysis, acquired statistical data extracted from FAO, World Bank, WHO, GFSI and OECD organization and other international databases will be used. Consequently, the obesity risk factors such as education level, income level and prices of food influencing the decision-making of people buying the food will be analysed. Finally, using the outcomes of the analysis, projections of the future obesity trends will be carried out.

The proposed extent of the thesis

60-80 pages

Keywords

Food security, Obesity, Developing country, Analysis, Mexico, Egypt, Jordan

Recommended information sources

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Declaration

I declare that I have worked on my diploma thesis titled "Food Security and Obesity in Developing Countries" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 30th of November, 2016

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I would like to thank Ing. Zuzana Smeets Křístková, Ph.D. for her guidance and expert advices those were very important for drafting of my diploma thesis.

Potravinová bezpečnost a obezita v rozvojových zemích

Souhrn

Hlavním cílem této práce je analyzovat paradox, zda existuje souvislost mezi nízkou potravinovou bezpečností a zároveň vysokým výskytem obezity v rozvojových zemích, jako Jordánsko, což představuje Střední východ, a Mexiko, což představuje Latinskou Ameriku, obě splňující podmínky s relativně nízkou potravinovou bezpečností a vysokou mírou obezity. Práce je rozdělena do dvou částí. Teoretická část se nejprve věnuje vysvětlování bezpečnosti potravin a její determinanty. Následně se opisuje obezita, její stručná historie, příčiny, důsledky a její měření. Teoretický přehled pokračuje opisem vztahu nedostatečnému zabezpečení potravin a následné obezity dodatečně vysvětlující makro-faktory, jako je příjem, ceny potravin a urbanizace. Tyto faktory, zobrazeny pomocí grafů a tabulek v praktické části poskytují detailní informace a měření týkající se Jordánské a Mexické bezpečnosti potravin a výskytu obezity. Poté jsou klasifikovány a navzájem porovnány, aby se potvrdila korelace bezpečnosti potravin, výskyt obezity a jejich makro-faktorů. Výsledky jsou také uvedeny v závěrečné diskusi potvrzující, že bezpečnost potravin a obezita jsou vzájemně propojeny. Pokud jde o konkrétní analýzu bezpečnosti potravin a výskytu obezity v Jordánsku a Mexiku, Jordánsko prokazuje, že je v horších podmínkách bezpečnosti potravin a zároveň výskytu obezity.

Klíčová slova: bezpečnost potravin, výskyt obezity, Jordánsko, Mexiko, analýza, korelace

Food Security and Obesity in Developing Countries

Summary

The main focus of this thesis is to analyse the paradox, whether there is any correlation between the low food security and at the same time high prevalence of obesity using the particular developing countries examples, such as Jordan, representing Middle-East and Mexico, representing Latin America, both meeting the conditions of relatively low food security and high obesity rate. The work is divided into two parts. The theoretical part is firstly devoted to explaining the food security and insecurity, its determinants and pillars. Secondary, the overweight, obesity, its brief history, causes, consequences and measurements are described. Furthermore, the theoretical overview continues with the relationship of food insecurity and prevalence of obesity additionally explained by macro-factors such as income, prices of food, and urbanization. These factors, displayed through the graphs and tables in the practical part provide the detailed information and measures regarding Jordan`s and Mexico`s food security and their prevalence of obesity. Afterwards they are classified and additionally compared to each other in order to confirm the correlations of food security, prevalence of obesity and their macro-level factors. The results are also provided in the final discussion confirming that the food security and the prevalence of obesity are certainly correlated, which is also proved within the mentioned countries, in which some macro-level factors are more and some less correlated. Regarding particular analysis of Jordan`s and Mexico`s food security and the prevalence of obesity, Jordan proves to be in the worse conditions of food security and simultaneously of prevalence of obesity.

Keywords: Food Security, Prevalence of Obesity, Jordan, Mexico, analysis, correlation

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1 Introduction

The higher the food security the higher the prevalence of obesity. This statement is said to be true mostly in the developed countries. As generally known, countries like United States of America, Australia and European Union countries have been suffering from obesity recently. The reason are, for instance, the unlimited availability, affordability, stability and proper utilization of food. These four pillars determines the level of food security the best. Obesity is mostly the consequence of such a good conditions for food demand. There are also few micro-factors influencing obesity issues of individuals like habits, age, gender, education - lack of information, genes, and hormones.

On the other hand, there are developing countries that suffer from the food insecurity but paradoxically at the same time they also suffer from increasing rate of overweight and obesity. Statistically, Mexico and Jordan belong among them. How is it possible that although the food security of the countries is low, the prevalence of obesity reaches very high numbers? Therefore, the main hypothesis is: *how does the low food security correlate with the high prevalence of obesity in developing countries of modern civilization?* The analysis includes the measures of food security and prevalence of obesity in chosen countries - Mexico and Jordan. Additional hypothesis is: *how much, if at all, do the macro-factors like income, prices of food, urbanization, fat and protein supply in the food, may influence the food security and the continuous increase of prevalence of obesity in particular countries?*

To approach these answers, it is necessary to understand what the food security, insecurity and obesity mean. These relations are explained in theoretical part. To get more specific picture, the countries, Mexico and Jordan, statistically ranked as the ones with the highest obesity prevalence and lower food security, are the best countries determining the paradox of relationship between low food security and high prevalence obesity in developing countries.

In the first chapter of the literature review, the meaning of food security is explained by few economists and governmental institutions. Food security`s determinants - acquirement and utilization of food - are identified in the subchapter. The second subchapter describes four main pillars of food security - availability, access, utilization and stability. To approach the first hypothesis, the second chapter, explaining the food insecurity and its causes, needs to be specified as well.

Obesity definitions and its brief history are the content of the third chapter, further explaining the causes of obesity. Further, the micro-level factors like age, hormones, education, genetics, physical activity and environment are described. The next subchapter explains the kinds of measurements of obesity, such as: Body Mass Index and Global Food Security Index, important to be able to classify normal, overweight and obese people. Obesity's consequences are the last subchapter more explaining health and practical living issues of individuals.

The last chapter describes the theory of mutual correlation between the food security and obesity. The allocated macro-level factors of this chapter are income, prices of food, urbanization, fat and protein supply are theoretically confirming this correlation. Additionally, the differences between prevalence of obesity in developed and developing are also specified.

The practical part continues by introduction of countries Jordan and Mexico to get familiar with their backgrounds of culture, politics, economy and history in order to be able to link the level of food security and prevalence of obesity. Following this, the state of food security for both countries is examined and subsequently compared to prove the paradox of possibility of having low food security and at the same time high prevalence of obesity. The same approach is used with prevalence of obesity in both countries and again compared. Using the macro-level factors – income, prices of food, urbanization, fat and proteins supply in food - already explained in the literature review, both countries are then classified.

2 Objectives and Methodology

2.1 Objectives

The aim of the literature review of this thesis is to link the theoretical and quantitative statements of world organizations` or individual health specialist researchers. The aim of the practical part of this thesis is to explain the most significant determinants of Jordan`s and Mexico`s food security and prevalence of obesity and afterwards to analyse whether there is a correlation between their low food security and high prevalence of obesity. The methods used are analytical, graphical, statistical and comparative.

The reasons why these particular countries are analysed and compared are that they both belong among developing countries with relatively low food security and paradoxically high rate of obesity. However, they are from different regions so they are not geographically or culturally influenced by each other. Also the geographical and demographical sizes of the countries are very different. These similarities and difference are the reasons why they are the best to be analysed and compared regarding the food security and prevalence of obesity.

2.2 Methodology

1. Food security analysis:

Firstly, it is necessary to point at the general facts and figures of each country obtained from the Central Intelligence Agency (CIA, 2015) and World Health Organization (WHO, 2015). Afterwards, using Global Food Security Index (GFSI, period 2012 - 2016) the food security dimensions – affordability, availability, quality and safety, and human development index (HDI) - of Jordan and Mexico are analysed, ranked and compared. Also, their strengths, weaknesses are explained and scored (1-100points).

GFSI considers the core issues of affordability, availability, quality and safety across a set of 113 countries. The index is a dynamic quantitative and qualitative benchmarking model, constructed from 28 unique indicators, that measures these drivers of food security across both developing and developed countries.

2. Prevalence of Obesity analysis:

The figures regarding prevalence of obesity`s groups - gender and age - are taken mostly from WHO (period 2010 - 2014), World Obesity Federation (year 2011) and CIA (period 2000 - 2008). The most significant determinants causing the increase of obesity are graphically quantified and compared among the countries.

3. Macro-level Factors analysis:

The macro-level factors, listed below, are used to confirm their correlation with food security and obesity in general and also within particular countries.

- Gross National Income (GNI) measures the correlation by GFSI (2015) and the growth by World Development Indicator (WDI) (period 2000 - 2012).
- Prices of Food uses WDI to measure the growth (period 2000 – 2014).
- Urbanization`s measures of growth are provided from World Bank, (period 2000 – 2014) and proportion of urban and rural population Food and Agriculture Organization of United States (FAOSTAT, 2010).
- Fat and Protein Supply figures of ratio are obtained from FAOSTAT, (periods 2000 – 2011), and GFSI (2015).

3 Literature Review

The theoretical part of this work defines the food security, food insecurity and its relationship with obesity in order to be able to further investigate their correlation within particular developing countries addressed later in the practical part.

3.1 Concept of Food Security

Primarily, it is necessary to explain what food security means from more points of views defined by few economists and organizations.

A special committee of the United Nations defines the food security as: *“A household is food secured when it has access to the food needed for a healthy life for all its members (adequate in terms of quality, quantity and culturally acceptable), and when it is not at undue risk of losing such access”* (ACC/SCN 1991, p. 6).

The FAOSTAT (2016): *“Food security exists when all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.”*

GFSI (2016) defines food security as *“the state in which people at all times have physical, social and economic access to sufficient and nutritious food that meets their dietary needs for a healthy and active life”*. It also claims that food security is concerned with structural issues – corruption, food supply and infrastructure – causing difficulties in tracking the impact on food security of individual.

According to J Am Diet Assoc. (2007), food security is *“an access by all people at all times to enough food for an active, healthy life, including, at a minimum: (a) the ready availability of nutritionally adequate and safe foods, and (b) an assured ability to acquire acceptable foods in socially acceptable ways (eg. without resorting to emergency food supplies, scavenging, stealing, or other coping strategies)”*.

Even when the law characterizes the food security as something that every person has a right to get, we still wonder why there is anybody not able to carry through. It is very important if the government obliged to secure the food for the people is really performing (Southgate – Graham – Tweeten, 2011).

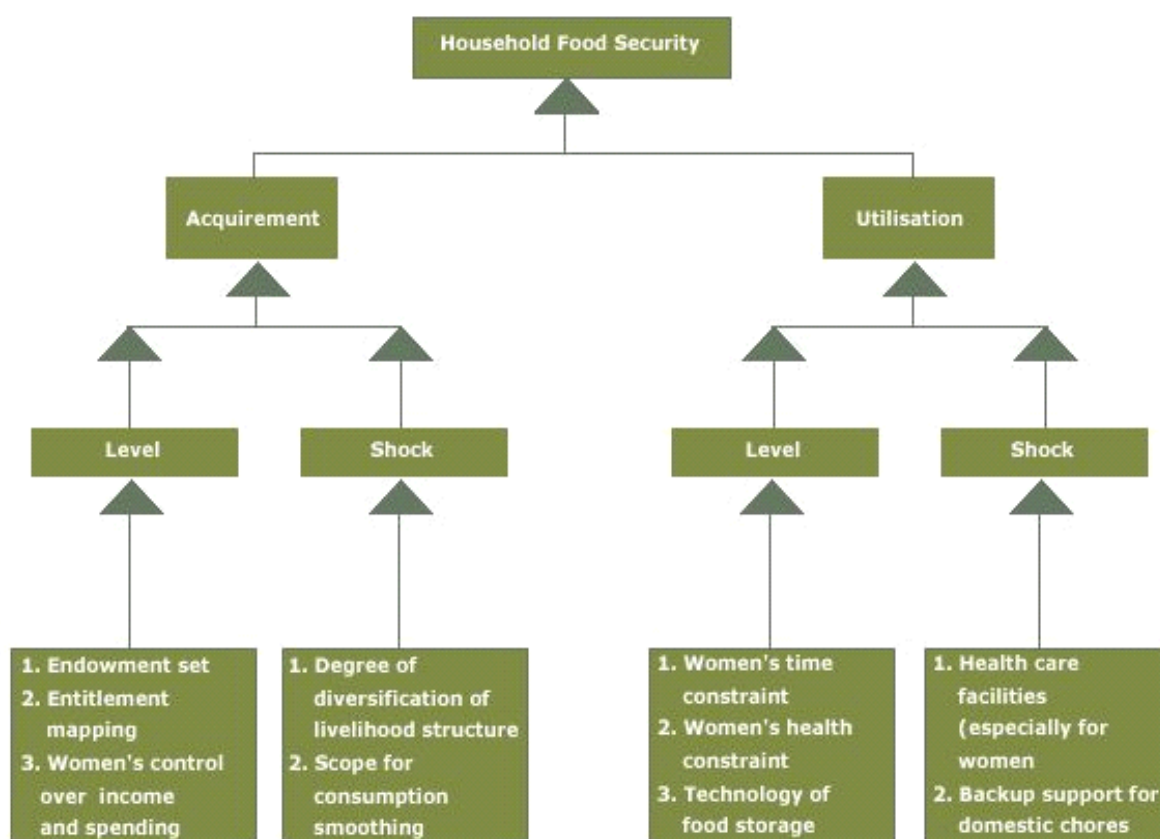
The next chapter defines the food security determinants affecting the decision making of consumers.

3.1.1 Determinants of Food Security

In Figure 1 are two areas of classification of food security, the *level area* and the *shock area*. Four dimensional characteristics of food security subdivided into problems of acquirement and utilization are:

- the ability to improve and maintain the *level of acquirement*
- the ability to cope with *shocks to acquirement*
- the ability to improve and maintain the *level of utilization*
- the ability to cope with *shocks to utilization*

Figure 1 Division of Determinants of Food Security



Source: International Fund for Agricultural Development (IFAD), 2014

Determinants of the Level of Acquirement

According to Amartya Sen's analysis the first acquirement determinant is the *endowment set*. It comprises household's resources with its usufructuary rights. They can be tangible, such as land, animals, machinery and intangible are labour power and a membership rights. Using of these resources allow the households require the food either directly - through production, or indirectly - through exchange or transfer. *Entitlement mapping* is the rate of endowment resources converted into food. One of the components of entitlement mapping is a production – input, output ratios. A good example may be a technology available and quality of land determine the way of food acquired from the land (IFAD, 2014).

Determinants of Ability to Cope with Shocks to Acquirement

Crop failure, unemployment or higher costs for food are examples of causes of shocks of acquirement. Every household is able to cope with these shocks differently. One of the determinants from this category is the *degree of diversification* – household's essential livelihood strategy or allocating a time in order to purchase a various means to earn a living. IFAD, (2014) states: "*The greater the degree of diversification the greater the ability to cope with temporary shocks to acquirement.*" The *scope for consumption-smoothing* is second determinant. It is ability to maintain the normal level of food consumption occurring in income shock, where the household asset base is the basic element of this category.

Determinants of the Level of Food Utilization

A household's food security depends on the utilization of the food. This utilization includes preparation and storage of the food. If the quality of preparation or storage is different, than the level of food security is different as well. The most important determinant of food utilization is a *time constraints* of members of household. For example, if a woman doesn't have enough time to prepare a good quality and healthy food for her family, the level of security of food is lower. Also the poorer the *health*, the lower the quality of food security and so quality of life, because the food cannot be prepared in the best manner. The facilities of *storage of food* is another issue of food utilization security. Mostly poor households save the food also for the leaner seasons which lowers its quality and quantity (IFAD, 2014).

Determinants of the ability to cope with shocks to utilization

The raise of shock of utilization is caused mainly by the members of household's ability of ensuring secure utilization of food. There are two factors of utilization ability to cope with these shocks: the members' *health care* quality of facilities and their *support in performing* domestic chores. The first factor is about the internal interests of members' needs. If the self-interest is satisfied, then ability to cope with such a shock is more effective. The second factor can take advantage of an extended family for example. The higher the number of the members of family, the higher the support provided for the performance of domestic chores and protecting household's food security (IFAD, 2014).

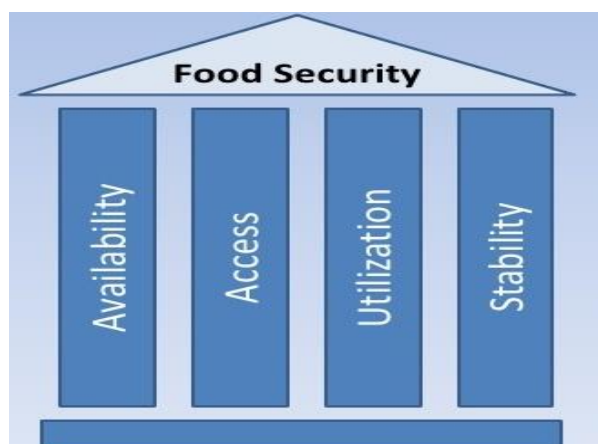
To summarize the chapter, it is important to not only to deal with any food security shocks occurred, but also to keep its optimal level of utilization of food within the household. The next chapter explains four pillars supporting the ability of being properly food secure.

3.1.2 Pillars of Food Security

According to Agricultural Research for Development (CIRAD, 2014), food security is regarded as a balance of supply and demand. It is based on four pillars:

- *Access/Affordability* to food refers to the ability to produce or buy one's own food, which implies having the purchasing power to do so.
- *Availability* of food means a sufficient quantities of food available on a consistent basis. It is still a problem in areas where food production does not meet population needs.
- *Food utilization* is affected by the preparation, processing, and cooking of food in the community and household.
- *Food stability* is an ability to obtain food over time, in terms of availability, accessibility and quality. This fourth pillar incorporates issues of price stability and secure incomes for vulnerable populations.

Figure 2 Four Pillars of Food Security



Source: Agriwaterpedia, 2015

Figure 2 shows equality of importance of all of the pillars of food security. To keep a household fully food secure, it is necessary to meet all of these four criteria supported by a suitable environment created by the state itself. Otherwise the households becomes food insecure as described in the next chapter.

3.2 Concept of Food Insecurity

In this chapter, the definition of food insecurity and its classifications provides further understanding of the differences among hunger, malnutrition, undernourishment and their causes.

According to American Dietetic Association (1998), *food insecurity* is defined as “a limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways”.

According to the U.S. Department of Agriculture Economic Research Service (2015), the *food insecurity* is divided into two groups:

- *Low food security* is caused by reduced quality, quantity of food intake, or desirability of diet.
- *Very low food security* means multiple disrupted eating patterns and also reduced food intake.

The US Department of Agriculture (2007) states: “*Food insecurity is when people do not have adequate physical, social, or economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life*”.

According to J Am Diet Assoc. (2007), food insecurity is more complex, and the paradox is that it not only might lead to undernutrition and recurring hunger, but also to over-nutrition, which can lead to overweight and obesity. *Poverty* results in food insecurity and often hunger, which can lead to malnutrition. Furthermore, the absence of a diversified, nutrient-dense diet can lead to over-nutrition, subsequent obesity, and failure to meet micronutrient requirements.

There is an experience of food insecurity with or without *hunger* according to the severity of the food scarcity situation. *Food insecurity* consists mainly of concerns about having enough food or running out of money to purchase more. The most of food insecure adults believe they may try to avoid hunger by cutting the size of meals or even skipping meals. However, in case of extremely limited food, the avoiding hunger is ineffective and causes severe personal or even family hunger (Klein 1996).

Hunger is defined as “*The uneasy or painful sensation caused by a lack of food. The recurrent and involuntary lack of access to food. Hunger, over time may produce malnutrition*” (Hamilton 1997).

According to World Food Programme (2015) a *hunger* means a dietary intake not providing enough of food needed for growth, physical activity and the good health. *Starvation* is an absence of dietary intake of famines and is connected with *undernutrition*, which is the chronic or seasonal absence of needed food proteins and caloric energy. The dominants of *micronutrient deficiencies* are the dietary shortages of iron, iodine and Vitamin A.

When hunger is recurrent, it results in undernutrition. Socially, the term *hunger* describes individuals who occasionally cannot obtain an adequate quantity or quality of food and nourishment, and hunger can be present even when no clinical symptoms or health problems associated with food deprivation exist. Thus, hunger can signify the existence of a social problem and not necessarily a medical condition. Individuals living in poverty are likely to be malnourished, fitting the clinical and social definitions of hunger (J Am Diet Assoc. 2007).

Hidden hunger is when an individual suffers from subclinical nutrient deficiencies (eg, iron, folic acid, and vitamin A), but does not have overt clinical signs of undernutrition (US Department of Agriculture, 2007).

Internationally, *hidden hunger* is a major issue, and is not always associated with the world's poorest people. The most common examples of hidden hunger in the world are poor iron status among women and vitamin A deficiency in preschool children. Historically, use of the term *malnourished* has been associated with a state of *undernutrition*. *Malnutrition* is usually associated with poverty and food insecurity, and *malnourished* is defined as poorly or wrongly fed and having a poor or inadequate diet.

Table 1 Undernourishment around the World, (1990 – 2016)

	Number of undernourished (millions) and prevalence (%) of undernourishment									
	1990-92		2000-02		2005-07		2010-12		2014-16*	
	No.	%	No.	%	No.	%	No.	%	No.	%
WORLD	1 010.6	18.6	929.6	14.9	942.3	14.3	820.7	11.8	794.6	10.9
DEVELOPED REGIONS	20.0	<5.0	21.2	<5.0	15.4	<5.0	15.7	<5.0	14.7	<5.0
DEVELOPING REGIONS	990.7	23.3	908.4	18.2	926.9	17.3	805.0	14.1	779.9	12.9
Africa	181.7	27.6	210.2	25.4	213.0	22.7	218.5	20.7	232.5	20.0
Northern Africa	6.0	<5.0	6.6	<5.0	7.0	<5.0	5.1	<5.0	4.3	<5.0
Sub-Saharan Africa	175.7	33.2	203.6	30.0	206.0	26.5	205.7	24.1	220.0	23.2
Eastern Africa	103.9	47.2	121.6	43.1	122.5	37.8	118.7	33.7	124.2	31.5
Middle Africa	24.2	33.5	42.4	44.2	47.7	43.0	53.0	41.5	58.9	41.3
Southern Africa	3.1	7.2	3.7	7.1	3.5	6.2	3.6	6.1	3.2	5.2
Western Africa	44.6	24.2	35.9	15.0	32.3	11.8	30.4	9.7	33.7	9.6
Asia	741.9	23.6	636.5	17.6	665.5	17.3	546.9	13.5	511.7	12.1
Caucasus and Central Asia	9.6	14.1	10.9	15.3	8.4	11.3	7.1	8.9	5.8	7.0
Eastern Asia	295.4	23.2	221.7	16.0	217.6	15.2	174.7	11.8	145.1	9.6
South-Eastern Asia	137.5	30.6	117.6	22.3	103.2	18.3	72.5	12.1	60.5	9.6
Southern Asia	291.2	23.9	272.3	18.5	319.1	20.1	274.2	16.1	281.4	15.7
Western Asia	8.2	6.4	14.0	8.6	17.2	9.3	18.4	8.8	18.9	8.4
Latin America and the Caribbean	66.1	14.7	60.4	11.4	47.1	8.4	38.3	6.4	34.3	5.5
Caribbean	8.1	27.0	8.2	24.4	8.3	23.5	7.3	19.8	7.5	19.8
Latin America	58.0	13.9	52.1	10.5	38.8	7.3	31.0	5.5	26.8	<5.0
Central America	12.6	10.7	11.8	8.3	11.6	7.6	11.3	6.9	11.4	6.6
South America	45.4	15.1	40.3	11.4	27.2	7.2	ns	<5.0	ns	<5.0
Oceania	1.0	15.7	1.3	16.5	1.3	15.4	1.3	13.5	1.4	14.2

*Data for 2014-16 refer to provisional estimates.

Source: International Fund for Agricultural Development, 2015

According to data from Table 1 provided by International Fund for Agricultural Development (2015), there is about 795 million undernourished people globally in 2014, which was decreased by 167 million over the last decade, and by 216 million less than in 1990-92. So the share of undernourished people has decreased from 18.6 percent in 1990-92

to 10.9 percent in 2014–16. Although since 1990–92 the population has increased by 1.9 billion in total, the number of undernourished people has declined by 21.4 percent, over the same period. Despite of significant growth of population, the decline is mostly recorded in developing regions. In recent years, progress has been obstructed by slower economic growth and political instability in some of developing regions, such as Central Africa and Western Asia. However, changes in large populous countries, such as China and India, explain the reduction of the overall hunger in the developing regions. Economic growth is basically a key of success for reducing undernourishment, but it has to provide opportunities to improve the livelihoods of the poor people. Also enhancing of productivity and incomes of smallholder family farmers is a key to progress.

Causes of Food Insecurity

- *Natural disasters* such as floods, tropical storms and long periods of drought are responsible for the food insecurity in the countries.
- *War* takes millions of people their homes, causing the world's worst hunger emergencies and so food insecurity.
- In developing countries, farmers usually cannot afford seeds to plant the crops that would secure a food for their families. Others have no land, water or education to secure their future.
- *A lack of agricultural infrastructure* in many developing countries are not enough of roads, warehouses and irrigation. It leads to high transport costs, lack of storage facilities and unreliable water supplies.
- *Poor farming practices*, deforestation, over cropping and overgrazing are exhausting the Earth's fertility and also causing a hunger.

Even the most of developing countries depend on agriculture, their governments economic planning often emphasize urban development. Not getting enough food or not getting the right kind of food causes a *malnutrition*. Even if people get enough to eat, they are still malnourished if the food does not provide the proper amounts of micronutrients, vitamins and minerals for the daily nutritional requirements (WFP, 2014).

In order to further explain the relationship between food security and obesity, the next chapter continues with defining of obesity, its history and its determinants.

3.3 Concept of Obesity

Farflex, Inc - a medical dictionary (2015) - describes obesity as *'an abnormal accumulation of body fat, usually 20% or more over an individual's ideal body weight. Obesity is associated with increased risk of illness, disability, and death'*.

According to WHO (2015), the main cause of obesity is an imbalance of energy between calories consumed and expended. It means that the intake of energy-dense food high in fat has increased and physical activity has decreased. Such changes of dietary and physical inactivity lifestyle lead to social and environmental changes associated with lack of supportive development of health, agriculture and education policies.

An academic Charvat (1967) states that obesity is a luxury which we cannot afford not only from the medical point of view but also because of about one billion of hunger fighting people and another billion of undernourished. Therefore the obesity is as economic as social issue.

According to prof. R. Dolecek (2013), an obesity is an inadequate adaptation to the environment with plenty of food. This definition excels a co-responsibility of an individual for negligent state of his weight.

WHO (2015) states that the obesity since 1980 has almost doubled. In 2013, 42 million of children under 5 years old were overweight or obese. Obesity is not problem of only high-income countries but recently has become increasing problem of low- and middle-income countries, particularly in urban areas. Furthermore more of deaths worldwide are caused by overweight and obesity than underweight.

Overweight and mainly obesity lead to negative metabolic effects on blood pressure, cholesterol, and insulin resistance. In 2014, 39% of adults from WHO countries, aged 18 and more, were overweight ($BMI \geq 25 \text{ kg/m}^2$), from which 39% are men and 40% are women and 13% were obese ($BMI \geq 30 \text{ kg/m}^2$), from which 11% of men and 15% of women. This means that almost 2 billion of adults worldwide are overweight and more than half of billion are obese. The most of overweight and obese population were in the WHO Regions of the America (61% for overweight and 27% for obesity) and least in the WHO Region for South

East Asia calculated 22% of overweight and 5% of obesity. In all of WHO regions were women more likely to be obese than men. In the WHO African and South-East Asia, women had almost double of obesity prevalence than men (WHO, 2015).

The prevalence of raised BMI increases with the income level of countries. The prevalence of overweight in high income countries is about double compared to the low income countries. For obesity in high income countries, the prevalence is four times higher than in low income countries. Women's obesity was significantly higher than men's in low and middle income countries, however obesity of women and men in high income countries was similar (WHO, 2015).

After general defining of obesity and mentioning the facts and trends regarding obesity, its historical bases and data from the past will be further reviewed.

3.3.1 History of Obesity

The existence of obesity was proven already in the past. One of the proofs could be Venus of Vestonice, also shown in figure 3. A marionette of this kind was found within an extensive territories of Europe. Their meaning was probably a fertility cult. It presents an obese figure of woman created by an artist, which must have existed also in the past. Even the big antique medical doctors Hippocrates and Galen mention obesity and its treatments. Before more than 200 years, English doctors claimed that obesity is not only caused by overeating but also due to genetic predisposition. During the historical period baroque, the obesity was an artistic ideal. During the whole centuries, the obesity was not reputed as an illness but only as a cosmetic defect. A new view at this serious illness, which brings a lot of complications and shortens life has lasted only for a few decades. After the teeth illnesses, the obesity is the most often chronical illness in the developed countries (Svacina, 2008).

Figure 3 Venus of Vestonice



Source: Witicon Museum ltd., 2015

3.3.2 Causes of Obesity

According to Harvard School of Public Health (2016), obesity is when someone takes in more calories than needed. These excess calories are stored in the body as body fat and continuously the extra pounds add up. Eating fewer calories than the body burns leads to weight loss. However this equation can be misleading, because it does not account for the number of factors that affect our eating, exercising, and how our body process all the energy.

According to The Economist (2014), obesity is an energy imbalance caused by higher caloric consumption than its usage by the body. To solve this problem, it might not be certainly said to just reduce caloric intake or increase physical activity. It is more complex problem. Obesity doesn't simply mean being overfed. Micronutrient deficiencies of iron and vitamin A-helping to consume an excess of food, may also lead to obesity. Obesity can be also influenced by factors such as diet, lifestyle, culture, level of physical activity, genetics, access to food, and income level.

Concerning the causes of obesity, in the past it was considered that a ratio of *internal* (genetic) and *external* (environmental) factors were 2:1 and later on even 1:1. Nowadays it is considered as an external influence causing the obesity. Most of population overeats and the average person almost does not do any sport actively. The genetic basis practically remains the same. Its enforcement can be started for instance by an inappropriate diet. A science concerning this is called the nutrigenomics. Diet, especially a fat diet, influences genes which role would not reflect otherwise. Usually it is not possible to get fat without genetic predispositions. A tendency to obesity is inherited. In the past, when people did not overeat and moved more, the tendency could not reflect. Nowadays it is happening for more than half of population. The most ideal study differentiating the influence of inheritance and environment was made on identical twins adopted to two different families. In this case, the result was that only genetics were acknowledged and 'inherited cookbook' was rejected (Bretsnajdrova, 2008). To better understand internal and external influences on obesity, the definitions are:

Internal – occurrence of obesity, diabetes and hypertension in family, so called hereditary basis.

External – occurs at lower educated people, lower physical activity, work or family problems (stress, overeating, some kinds of medicines, and inappropriate diet in family).

Mixed – genes influenced by inappropriate diet and low physical activity.

So-called concept of ‘thrifty gene’ assumes that the individuals endowed by genetics of obesity overcame bad periods like war and famine better than the others. Also many other organisms, mammals etc. would not survive if they would not have a saving mechanism in their body, which enabled them to starve for long periods. In the situations, when there was a lack of food, their slow metabolism and big stores of energy in body-fat were an advantage for them. This is a disadvantage for diabetes and obese people when trying to lose some weight. An old saying ‘when the war comes, the fat people will be skinny and skinny will be chilly’ confirms this genetic advantage which has been accumulated up to today. So we are the descendants of the ones who survived wars and famines and therefore we cannot adjust and overcome to today’s overeating. The ones that did not inherit the thrifty genes, did not survive the wars and famines and so there is less of their descendants. Therefore the obesity is so often nowadays. *Metabolism* – a cloth exchange of the body - was very adjustable to a regular period of lack of food in the past. The change came in the 20th century influenced by mainly oncoming supermarkets when people started to overeat more and more and so the balance of intake of energy and its expenditure became unequal. These quantities of unhealthy, cheap junk food gradually replaced doing of sport so the energy expenditure keeps decreasing. These facts make the obesity the most serious and often illness of our population (Cajthamlova, 2008).

It is also important to determine the factors of obesity initially from the micro-perspective to get a picture from an individual point of view, described in the following chapter.

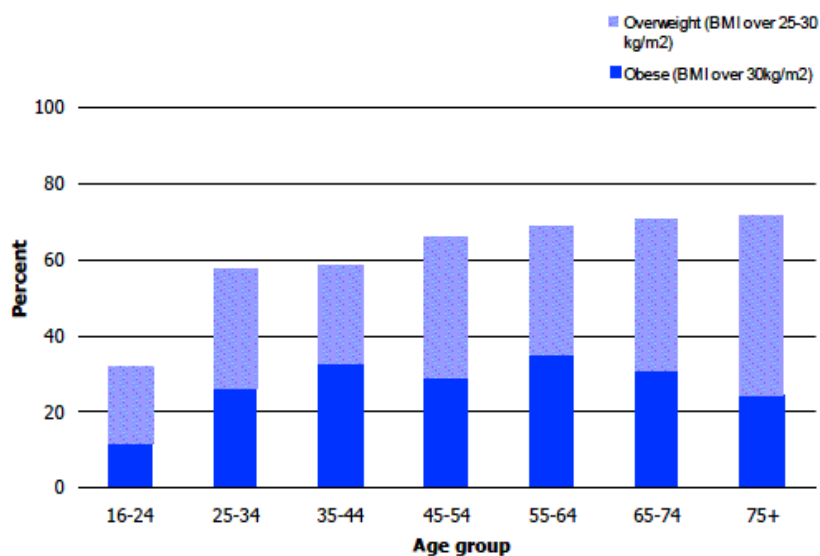
3.3.3 Micro-level Factors of Obesity

The occurrence of obesity in the worldwide scale fluctuates and is influenced by many factors. From the micro-point of view, the factors are:

Age

The number of obese people increases by aging and the occurrence of obesity culminates between 50 and 60 year of life. Obesity shortens life and therefore its occurrence decreases in higher age. This phenomena is proved also by the Scottish study from 2008. The obese people die sooner (Svacina, 2008).

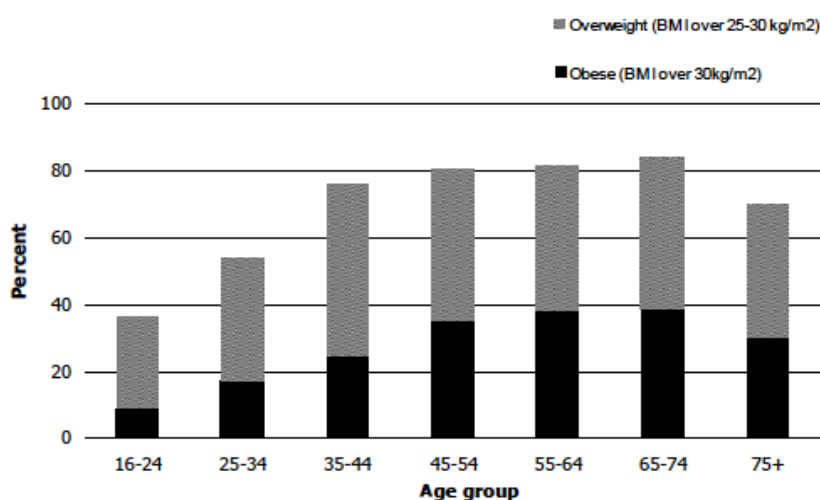
Figure 4 Prevalence of Overweight and Obese Women (2008)



Source: Scottish Health Survey, 2008

The figures 4 and 5 in the Scottish Health Survey in 2008, shows a decreasing trend of number of obese people for both genders after age of 60. At the same time the number of overweight people relatively stagnates. This proves that obesity might be the reason of premature dying.

Figure 5 Prevalence of Overweight and Obese Men (2008)



Source: Scottish Health Survey, 2008

A physical performance of metabolism naturally decreases by increasing of age. The organism manages a lower supply of energy because its physical activity is lower economical and accustomed. Therefore there might be a higher occurrence of overweight and obesity (Streda, 2013). This statement explains the increase of obese people till 60 years old.

Gender

The women are statistically more obese than men in every country. It is mostly caused by hormones during pregnancy and menopause. It is also usually assumed that every pregnancy leaves a few extra kilograms to woman. So this can also influence a slightly increase of weight. Up to 10% of obesity within female population occurs only in Sweden, more than 20% occurs in Poland, Germany, Finland and Greece, and 30% and more of obese women are in Czech Republic, Romania, and south Italy. Malta and Russia are the countries with more than 40% of obese women. Recently, the obesity has increased by 10 - 40% with every decade of which it can be concluded that the increase will continue eventually (Bretsnajdrova, 2008).

Obesity of men can be mainly blamed on marriage, explained by a very good known saying 'a love goes through the stomach'. There is a lot more reasons to get obese for women than for men. The most common reasons for female obesity are puberty (hormonal changes), marriage, pregnancy, after-birth period, menopause, and birth-control pills. Another very common cause of obesity is emotional troubles leading to overeating of sweets to calm down depression and anxiety (Cajthamlova, 2013).

A lack of sleep

The lowest consumption of energy – burning of fat - is during the sleep. This might be also a cause of obesity. Adults should not sleep more than 8 hours per night. However a laboratory finding paradoxically proves that the ones that continuously sleep about 5 hours are more often obese than the sleepers. The reason is that they had a lower leptin hormone level, signalling brain the state of fat stores and so can block the extra energy intake and at the same time higher ghrelin 'hungry hormone' level, increasing appetite (Dolecek, 2013).

Hormones

Almost every obese blames the hormones, while it has never been proved that the ordinary obesity is a hormonal illness. A regular obese person has usually no hormonal problems. It is very rare to be obese because of hormonal dysfunctions. However, the obese

people have some hormonal areas disturbed, for instance resistance to insulin and increases secretion of the stress hormones cortisol and adrenaline. A weight increases due to taking a kind of medicine called steroids that used to be taken mainly for healing of lung diseases, joints and blood. Today, they are either taken only for a short period or substituted by another drugs (Svacina, 2008).

Education

The US study in second half of 20th century shows that the most of obese people are the less educated ones. The reason was that they overeat the cheap carbohydrates like sweets and starches. Also many people don't care about their appearance or health. This can be cause either by the ignorance or by the lack of information and knowledge how to lose a weight and keep healthy. Also, a greater dietary variety and higher consumption of healthy food such as vegetables and fruits were associated with higher education level (Kendall 1996).

The relationship of education and overweight could be attributable to knowledge about maintaining an optimal body weight and health awareness. This hypothesis states that the effect of socioeconomic variables on diet quality and health behaviours can be connected to a higher educational level or a greater awareness of healthy behaviour among higher-income respondents (Burns, 2014).

Genetic Impacts and Dietary Habits

According to Harvard School of Public Health (2016), *'early life is important, too. Pregnant mothers who smoke or who are overweight may have children who are more likely to grow up to be obese adults. Excessive weight gain during infancy also raises the risk of adult obesity, while being breastfed may lower the risk.'*

The occurrence of obesity within family influences another family habits, for instance, heritage of cookbook, meaning unhealthy way of cooking and unhealthy lifestyle relaying from one generation to another. Marriage might lead to increase of obesity due to newly created wrong habits of a couple as well. The national cuisines have also considerable influence, especially concerning a fat intake. An increased alcohol intake leads to increase of weight, considering from the whole population point of view. On the contrary, the heavy alcoholics have usually lower weight. Their socially complicated situation leads to lack of quality food and to malnutrition. Also, smoking causes a slightly decrease the occurrence of obesity (Svacina, 2008).

Some people have better working metabolism than others. It is just more efficient and economical and by using of less energy it reaches higher physical performance. Many obese people eat greedily with no pause. It can be caused by an insufficient diligence of hormones leptin and ghrelin, which are supposed to stimulate a feel of hunger (Dolecek, 2013).

People nowadays eat and drink too much of sweet food and drinks. Sugar is everywhere. Even the school meals do not always provide a proper and rational food habits (Streda, 2013).

Heredity plays a part of the role in obesity but to a much lower degree than many people might think. Rather than believing that obesity is the main cause, genes seem to only increase the risk of weight gain and are connected to other environmental risk factors, such as unhealthy diet and inactive lifestyle. So the healthy lifestyle can counteract these genetic effects (Harvard School of Public Health, 2016).

Surprisingly, mental *anorexia and bulimia* are also connected to obesity in a long term. Many obese women, used to be slim in their youth. A reaction such as restriction of amount of food, forced vomiting and taking of laxatives, can be an exaggerative reaction of young woman with genetic origin of metabolic syndrome. This can later on lead to an uncontrollable overeating at least twice a week but with no compensative behaviour, common for obese people (Bretsnajdrova, 2008).

Physical Activity and Environment

Reduction of physical activity brings an increase in obesity. A scientific – technical revolution has removed the most of departments of physically demanding work. At the same time, our energetic consumption has increased. Such a degree of offset has a growing contrary result (Cajthamlova, 2013).

The physical and social environment plays a huge role in decision-making of the food and activity choices. Unfortunately, today`s environment has become globally toxic to healthy living:

- The ceaseless, unavoidable marketing of unhealthy foods and drinks,
- The lack of areas for exercising,
- The junk food sold at schools, at work places.

To add it up, it is hard for individuals to make the healthy choices, important to a good quality of life and a healthy weight (Harvard School of Public Health, 2016).

Furthermore, few measurements of obesity and their differences of usage are described in the following chapter.

3.3.4 Measurements of Obesity

A healthy, not obese young man has approximately 14% of adipose (fat) tissue, a young woman has 25%, older man 26% and older woman 38% (Keys, 1955) or according Ganong (2001) 15% for men and 21% for women.

The share of fat can be determined by many procedures. For instance, measuring of skinfolds pincers also called calliper, measuring of weight under the water or the examination by the computed tomography, ultrasound, or densitometry – also used for the osteoporosis. The principle of these measurements is determination of total body fat (Svacina, 2008).

There are two phases of obesity. The first one is a phase of weight increase, during which the unbalance of intake and outtake of energy is significant. Stationary phase comes later, when the fully obesity persists. In this phase, the intake of energy do not have to be higher necessarily. It can be even lower and the weight does not decrease. It seems like some of the organisms get used to lower intake energy and don't lose weight anymore. (Dolecek, 2013).

Body Mass Index measurement of Obesity

The severity of obesity can be recognized by simple examination of height and weight. There was one called Broc Index: $weight\ in\ kg / (height\ in\ cm - 100)$, which was forgotten about a hundred years ago. The reason was that it was inappropriate to tall and small people concurrently. It indicates that an adult should weigh as many kilograms as many centimetres is his height over one meter. So 170cm high woman should weigh 70kg, which would be too much for younger woman. Therefore so called Quetelet Index or more known as the Body Mass Index (BMI) became more popular and lasts up to this day. It is measured as a $weight\ in\ kg / (height\ in\ cm)^2$ (Cajthamlova, 2013).

According to The Economist (2014), the body mass index is “*the most commonly used metric to measure obesity, given that it is easy to understand and measure and is readily comparable. It is calculated as a simple ratio of an individual's height and weight. The resultant ratio is compared against a standardised scale, common to men and women of all ages, to determine an individual's weight category.*”

However, BMI is unreliable measurement and may lead to wrong results. The reasons are:

- It doesn't treat age and gender of adults differently, providing only one uniform scale.
- It doesn't distinguish among bones, muscles and fat weight (muscles weight more than fat).

Despite these disadvantages, this index is today commonly used all over the world, not only within the medicine but also in many health educational, dietetic and fashion magazines. If somebody measures 180cm and weights 100kg, his BMI $100/1.8^2 = 100/3.24 = 30.8 \text{ kg/m}^2$. According to the table 2, this means that he has an obesity of 1st stage - *Obese*. A healthy weight is indicated as BMI 18.5 – 25 kg/m². Lower limits than 18.5 are classified as underweighted. This value is obviously connected with health risks. It is important to highlight that these data do not concern children. It is interesting, that BMI decreases after a birth and a child has the lowest BMI at the end of a pre-school age (Bretsnajdrova, 2008).

Table 2 BMI Chart

Weight Categories	BMI (kg/m ²)
Underweight	< 18.5
Healthy Weight	18.5-24.9
Overweight	25-29.9
Obese	30-34.9
Severely Obese	35-39.9
Morbidly Obese	≥40

Source: Medpace, 2015

Mortality rate increases with increasing degree of overweight measured by BMI. To achieve optimal health, the median BMI for an adult population should be between 21 to 23 kg/m², while the goal of individuals should be in the range 18.5 to 24.9 kg/m². There is an increased risk of co-morbidities for BMI from 25.0 to 29.9 (WHO, 2015).

Morbid (heavy) obesity, is a serious illness and people with this problem mostly do not survive 60 years of life. Recently had been invented also new terms like super-obese people with BMI more than 50 and super-super-obese with BMI more than 60. Their health prognosis is usually bad (Svacina, 2008).

Global Food Security Index measurement of Obesity

The relationship between Global Food Security Index (GFSI) and obesity is not in general strong. Food security's affordability, quality and safety have the strongest relationship with obesity. Usually, the countries with the highest poverty have a very low prevalence of obesity. Other countries with not such a high poverty have other factors like lifestyle and culture influencing obesity level. In the GFSI, obesity is considered only as background indicator of food security, not included into availability, affordability and quality & safety framework. The GFSI indicates the prevalence of obesity through the percentage of population over 20 years old with a BMI greater than thirty. From the data list of countries across the globe, the lowest rates are in South-east Asia and Sub-Saharan Africa (mainly Bangladesh 1.1%, Ethiopia 1.2%, Nepal 1.5% and Vietnam 1.6%). Kuwait 42.8%. Saudi Arabia 35.2% have the highest obesity prevalence of the 113 countries in GFSI (Hurst et al., 2014).

After describing the measurements of obesity, the negative effects caused by the obesity will be mentioned in the next chapter.

3.3.5 Obesity and its Consequences

Obesity has two types of complications - mechanical and metabolic. Mechanical complications are basically caused by the obesity, i.e. by the large body weight, for example a back pain, joint diseases, and shortness of breath during sleep - apnoea. Even among the young obese people there is a ten times higher death rate than the slim ones caused by for instance complications during the surgery or pregnancy. Metabolic complications, for instance, a high blood pressure and diabetes, are not caused by obesity but they have the same cause, which is genetics, overeating and lack of physical activity. A nomenclature - metabolic syndrome - has been used since 80's years as a synonym for metabolic complications of obesity. Some scientists do not accept this syndrome as a real, but some of them claims that it is the most common illness in the world (Bretsnajdrova, 2008).

Diseases connected with Obesity

Obesity causes a large number of health conditions, such as heart disease, diabetes, high blood pressure and cholesterol, asthma, kidney stones, infertility, and many types of cancers, such as breast and colon cancer. There are also the social and emotional effects of

obesity like discrimination, lower quality of life and depression (Harvard School of Public Health, 2016).

Malignancy, a fatal tumour, can be also connected to obesity. A cancer was not used to be connected with diabetes in the past, but recent studies prove that obese people and diabetics today are more susceptible to a malignancy than before. More typical occurrence of tumour for men is colon and prostate cancer. For women is more typical to get gynaecological and gallbladder tumour. The increasing risk of cancer depends on the weight. The interventional studies prove that slight weight loss helps to decrease the risk of tumorigenesis. It is interesting that a risk of breast cancer of obese women before menopause is low and conversely after menopause the risk increases (Svacina, 2008).

Regarding child obesity, the World Bank (2013) states, that emerging economy countries have 30% higher increasing child obesity than those of developed countries. According to WHO (2015), childhood obesity can eventually lead to premature death in adulthood. In addition, obese children usually experience breathing difficulties, increased risk of fractures, hypertension, cardiovascular disease, insulin resistance and psychological effects.

Children in developing countries are often more vulnerable to inadequate infant and young child nutrition food. Also, they are exposed to high-fat, high-sugar, high-salt, energy-dense, micronutrient-poor foods, which is lower in cost but at the same time lower in nutrient quality. This dietary pattern in combination with lower level of physical activity, results in sharp increase in childhood obesity while problems of undernutrition remain unsolved (WHO, 2015).

Many low and middle-income countries are currently facing a "double burden" of diseases. While they continue to deal with the infectious disease and undernutrition, they are experiencing an obesity and overweight, particularly in urban areas. Recently, it is very common to find undernutrition and obesity dwelling together within the same country, community and even the same household (WHO, 2015).

Obesity Problems in Practise

For some people is the obesity only an aesthetic problem. For others, it can be social or working problem. A higher level of obesity lowers amount of job opportunities, it is harder to find a partner and easier to lose him, and might be discriminated from others. From the

economic point of view, obesity is not only an individual problem but also public and state`s. It is common for obese people to have a problems in a work place which might lead to early retirement or invalidity pension. Canadian studies in 2012, found out that car accidents are also more often caused by obese people, for instance, because they more often get a drowsiness. They usually go over more injuries because the seatbelts and airbags are set up for lower weight people. It is also very common that obese people have the issues with finding a right clothing confection. Therefore they have to pay an extra money for clothes tailored (Streda, 2013).

Obesity has harmful societal effect on the economy, national productivity and defence. The health care costs of obesity in many developed countries is expected to rise, along with obesity rates, over the coming decades. This includes spending on medical care related to obesity. Obesity has also other costs associated with it, such as the cost of lost days of work and higher employee insurance. Altogether, it is clear that obesity is a global issue that touches everyone in some manner (Harvard School of Public Health, 2016).

Bad and Good Fat effects

A death from obesity can be caused by too much of bad fat. It means that an adipose (external) tissue excretes various substances into the body inducing a hormone leptin, a body infection and a resistance to insulin causing diabetes. When there is no more space for the fat in the adipose tissue, the extra fat goes to the liver, muscles, and many others and harms and devalues them. On the other hand, each body should contain a certain amount of fat, so called a good fat. The reasons are energy reserves for bad times, heat insulator against the cold and mechanic protection of organs and bones. The difference between bad and good fat is that a good fat is necessary for body to work properly and protect the organs and a bad fat is unwanted extra fat that causes many diseases and eventually early death (Svacina, 2008).

Fit-Fat People

Obese people do not necessarily have to be unhealthy. The ones that regularly exercise can keep their body healthy even they overeat. These people are called fit-fat (firm-obese). From the medical point of view, these people have better prognosis than unfit-unfat ones. Exercising protects them against many diseases (Bretsnajdrova, 2008).

The recent studies in Spain, Sweden and USA follow the motto ‘Fit and Fat’ – to be healthy and obese at the same time. According to M. Roberts, (2012), health editor BBC study proves that a group of obese but exercising people are doing well physically, has no metabolic, cardio vascular or hypertonic problems.

After devotion to obesity history, causes, measurements and consequences, the next chapter concerns with relationship of obesity and food security respectively insecurity within a households and countries.

3.4 Food Insecurity and Obesity Correlation

There are many researches investigating whether food insecurity and obesity have any correlation. Some researches confirm some reject the association and there are also some researches that neither confirm nor reject the relationship. In this chapter, some of the conclusions will be provided.

According to Food Research and Action Center (FRAC) (2011), there are many research studies in the United States providing results of co-existence of food insecurity and obesity. Other studies have found no association between food insecurity and obesity or even lower risk of obesity within the countries with high food insecurity. Overall, the most compliant evidence for a higher risk of obesity is among food insecure women. Also several other studies prove relationship among children as well.

The Report from The Economist Intelligence Unit (2014) states that *“Obesity and food security can co-exist, but their relationship is complicated, with poverty and other factors potentially impacting both. The prevalence of obesity is moderately correlated with overall GFSI scores, reflecting the complex relationship between both issues at the national level.”*

Hunger and food insecurity could be called ‘hidden crisis’. At the same time and paradoxically obesity is on the epidemic increase. National data indicates that obesity is most prevalent among those at highest risk of food insecurity. The co-existence of obesity and food insecurity may sound contradictory. While links between food insecurity and low diet quality might be expected, the association between food insecurity and overweight is a paradox. This paradox has only recently started to be investigated (Burns, 2004).

Statistically nearly one third of the population in developing countries like Syria, Mexico and Jordan is obese and continuous to increase. Over the past 30 years, the obesity level has almost doubled. In 2008, the number of obese people reached a half of billion. Although both, obesity and food security were always studied, today might be these two issues studied in linkage (The Economist, 2014).

Although according to Doc. Schwartz (2014) from Yale Rudd Centre, there is an overlap between food security and obesity, it need not mean a direct relationship between these two issues. They can both co-exist within the same country, household or even individual. However, they do not have to be connected. Many of the studies in developed countries, prove no relationship between food insecurity and obesity among children or adult males. However there are many positive results among adult female and adolescents in the presence of maternal stressor found in Europe, United States and Australia. The results are more varied considering also socioeconomic and ethnic groups.

The paradox within the intertwined social and economic relationships is that poverty causes food insecurity, yet one of the overwhelming outcomes of food insecurity is obesity. When food insecurity exists in a community, sufficient or even excessive energy may be provided by the limited foods available, but the nutritional quality and diversity of the foods in the diet may not support a healthy nutritional status due in part to inadequate micronutrients. The least severe level of food insecurity is a household that runs out of food, is uncertain about the ability to obtain sufficient food, and begins to compromise the quality of the family diet. Compromising diet quality often leads to a higher intake of energy from foods that are higher in fat and carbohydrate, but lower in nutrient density. These energy-dense foods are often less expensive than foods of lower energy density or higher nutrient density, such as fruits, vegetables, and whole-grains. Despite the link between poverty, food insecurity, and malnutrition, it should come as no surprise that households characterized as food insecure also have the highest body mass index (BMI; calculated as kg/m²) and prevalence of obesity (BMI>30). This paradox between poverty and obesity occurs throughout the world. Globally, 28% of the world's people lived in extreme poverty in 1990, and by 2002 this percentage had decreased to 19%. Measures to correct poverty among women are important because women are often the main providers of health care and education for their children, and they are critical to the political and economic success of their communities (J Am Diet Assoc. 2007).

Although there were less of research papers made in developing countries, the results are more complex than in developed countries. The studies have shown the inverse association between food insecurity and obesity in rural areas of Ghana, Malaysia and Colombia. The food insecurity there is rather correlated with underweight than obesity. On the other hand, there was found a relationship of this two issues among females, not males, in Tehran, Iran and Uganda. However considering certain environmental factors, this effect disappears (Schwartz, 2014).

In 2002, Martin C. Gulliford et al. (2003) made a study of evaluation whether food insecurity and obesity were associated in a population sample of 15 households in Trinidad. Analyses were adjusted for age, sex, and ethnic group. Food insecurity was frequent at all levels of BMI and was associated with lower consumption of fruit and vegetables. Food insecurity was associated with underweight but not with present obesity.

Professor of agricultural strategy Gundersen (2014) states that *“in a lot of developing countries, being overweight is considered a good thing. It shows you have wealth.”* Because of some positive results of correlation between food insecurity and obesity, this might lead to spurious assumptions.

Based on socioeconomic factors like education and poverty and demographic factors like age, gender and race, the studies in developed countries of America show that the correlation between food insecurity and obesity is high. The first box of sample studies proves the high correlation between insecure women and older adults and obesity:

- A national study of 4, 500 food secure and insecure women together showed the higher rate of the obesity among the group of food insecure.
- A sample of 5, 200 women has found that those from food insufficient households were more vulnerable to obesity compared to those from food sufficient households.
- Another U.S. sample of more than 9, 700 adults found out that women of intermediate level of food insecurity were more prone to gain a weight in the recent years than those living in food security. Similar but smaller results were seen for men.
- Based on a study of 810 pregnant women experiencing food insecure households, were positively associated with strong obesity before pregnancy and also experiencing greater weight gain during pregnancy.
- In another study of 8, 200 women, a greater risk of obesity was associated with food insecure women of non-white race.
- Food insecurity study of 200 adults in Connecticut, showed these people were a twice as likely to suffer from obesity than those food secure.
- In Georgia study of 620 older adults, was obesity and its related physical disability associated with food insecurity (FRAC, 2011).

American studies of food insecure children mostly found an indirect association with postponed obesity in adulthood, more described in the following box:

- A study using national sample of almost 6, 500 children found an indirect food insecurity association with obesity among 12 to 18-years age.
- Another study of 1, 020 adolescents was associated with a combination of maternal stress and adolescent food insecurity which significantly increased a probability of obesity of adolescents.
- In a sample using national data from 8, 700 toddlers and infants was found an indirect association between food insecurity and overweight operated through feeding and parenting practices of infants.
- Among almost 7, 000 food insecure children were associated with overweight.
- In Massachusetts, a national sample of 2 to 5-year old girls, found that those living in food insecure households with hunger had 47 percent higher probability of being obese than those living of food secure households (FRAC, 2011).

Academy of Nutrition and Dietetics (2012) has studied the correlation between food insecurity and obesity among children of 2-5 aged. The study compared food secure households with those of food insecure and found out that household with persistent food insecurity but without hunger is highly associated with preschool child overweight and obesity, with greater odds 22% than children in food secure households. This association is also related with maternal weight status of children.

According to Malik V.S. et al., (2012), *'the worldwide prevalence of childhood overweight and obesity increased from 4.3% to 6.7% between 1990 and 2010. This increase means that an estimated 43 million children were overweight or had obesity in 2010, of whom 35 million live in lower and middle-income countries (LMCs)'*.

According to National Center for Biotechnology Information (NCBI) (2013), most of the food insecure households are those with a lower income, ethnic minority and female-headed households. These households are also mostly affected with these diet-related diseases. Therefore, the researches explored the factors influencing food insecurity and their impacts on weight increase among youth, adults and elderly people. Among 65 research papers since 2005, 19 of them were selected for review. This review has confirmed that food insecurity and obesity are strongly associated, mostly among woman gender.

The question of direction of influence remains. Most of the studies assume that food insecurity influences obesity, but in fact, it can be also assumed inversely. They both can be

the risks factors of each other simultaneously. Obesity, for instance, may cause food insecurity by lowering ability to work due to individual's high weight a so shortening if income and so budget to gain more food. Obese people also require higher quantity of food which also leads to cutting the budget more (Hurst et al., 2014).

Some of the mentioned researches found many similarities but also differences in their conclusions. There were conclusions as direct and/or indirect influence of food insecurity on obesity, but also vice versa. The strongest association was also found in obesity and food insecurity among women, elders and children. The following chapter will discuss about the obesity occurrence among people in developed and developing countries.

3.4.1 Difference of Obesity in Developed and Developing Countries

According to Barry M Popkin et al. (2011), decades ago, a global pandemic of obesity was thought of as misbelief. However in the 1970s, diets began to shift towards increased reliance upon processed foods, increased food intake and use of edible oils and sugar-sweetened beverages. Reductions in physical activity and increases in sedentary behaviour began to be proceed more often as well. The negative effects of these new habits began to be recognized in the early 1990s, particularly in low- and middle-income population, but still not clearly acknowledged until diabetes, hypertension, and obesity began to dominate globally. Now, rapid increase in the rate of obesity and overweight is widely documented, from urban and rural areas from the poorest to countries with higher income levels.

According to Global Health Institute (2014), economic growth is certainly increasing obesity in developing countries. The individuals who become richer and move to middle class often change traditional food for more Westernized cuisine including more fats and oil.

A key difference of obesity in developed and developing countries is that obesity in developed countries occurs more among the poorest individuals and in developing countries it is opposite and so obese people are prevalently the richest. This means that obesity in low-income countries associates with wealth and obesity in high-income countries associates with lower socioeconomic status (Hurst et al., 2014).

Obesity in developing countries is a big problem rather for wealthier and more food secure people with a westernised lifestyle. However, the food insecurity remains an issue for

the poor ones. On the other hand, obesity in developed countries occurs mostly among poor and food insecure people (The Economist, 2014).

According to Harvard School of Public Health (2016), in low-income countries, wealthier and well-educated people are mostly more likely to be overweight or obese than people with lower incomes and less schooling. The opposite is in higher income countries, where wealthier people have lower rates of overweight or obesity than the poor ones.

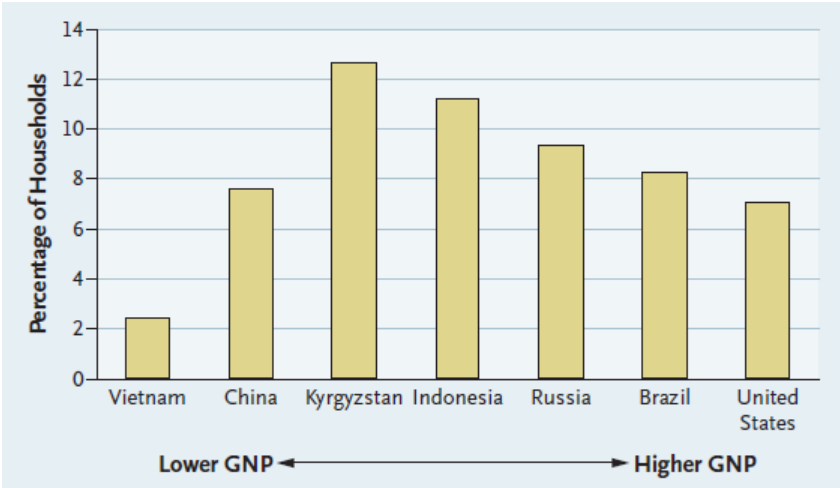
Obesity in developing countries has traditionally been linked with wealth, and it was expected that as developing countries improved their economic status, undernutrition would decrease and obesity would begin to appear among members of the upper socioeconomic classes. But the relationship between economic status and overweight is more complex. Although being poor in the poorest countries prevents against obesity, being poor in a middle-income country is actually associated with a higher risk of obesity than being richer in the same country. The reasons are not completely clear, but obviously, in poor countries, the dietary energy intake of the poorest people may be limited by the scarcity of food. Also the high energy demands of manual labour make it difficult to achieve a net positive energy balance and therefore to gain weight. In more urbanized developing countries with a middle income food scarcity may not be necessarily the driving factor behind energy intake. Instead, the availability of cheap, energy-dense foods makes it easier to consume more calories (Caballero, 2005).

According to Anoop Misra and Lokesh Khurana (2008) the prevalence of obesity and the metabolic syndrome is rapidly increasing in developing countries, leading to increased morbidity and mortality. With improvement in economic situation in developing countries, increasing prevalence of obesity and the metabolic syndrome is seen in adults and particularly in children. The main causes are increasing urbanization, nutrition transition, and reduced physical activity. Furthermore, aggressive community nutrition intervention programs for undernourished children may increase obesity. Some evidence suggests that widely prevalent perinatal undernutrition and childhood catch-up obesity may play a role in adult-onset metabolic syndrome and diabetes 2. The economic cost of obesity and related diseases in developing countries, having poor health budgets is enormous.

According to Benjamin Caballero (2005), the combination of underweight in children and overweight in adults, frequently coexisting in the same family, is in developing

countries a relatively new phenomenon connected nutrition transition — the changes in diet, food availability, and lifestyle in countries experiencing a socioeconomic or demographic transition. In these countries, about 60% of households include underweight family member and at the same time an overweight one. This situation is called the ‘*dual burden household*’.

Figure 6 Households concerned by Undernourishment and Obesity (2005)



Source: Global Health, 2005

Figure 6 represents the percentage of households having both underweight and overweight members in seven countries above. The countries are arranged according to their per capita gross national product (GNP), with data adjusted for household size, from the lowest average on the left (Vietnam, \$1,100) to the highest average on the right (United States, \$26,250).

Despite of many studies confirming positive or negative relationship between food insecurity and obesity, generally it is still considered as unclear and complex issue. It is necessary to take into considerations all the basic drivers of obesity related to food security:

- Access to nutritious and quality food

Particularly in developing countries there is a lack of healthy food available for the poorest due to high prices. The substitute is therefore cheaper food with lower amount of nutritious and higher caloric food leading to obesity.

- Opportunities for physical activity

A similar arguments for correlation of food insecurity and obesity is made for access to physical activity. Lower income households have less of opportunities for physical activity due to lack of money potentially leading to obesity.

- Sacrifice theory

Regarding to sacrifice theory connected with a distribution of food within the household, adults, especially women, are more likely to consume cheaper and less nutritious food in order to supply healthier food for their children. This way they increase the likelihood of obesity.

- Feast-famine cycle

Another explanation of food insecurity and obesity correlation is oscillation between overeating and restrictions of food. This continuous process might lead to change of metabolism and so to increase of accumulation of fat in the body.

- Public feeding programmes

The Supplemental Nutrition Assistance Programme (SNAP) in US, may be another driver of obesity among the food insecurity. This programme of massive supply of food is coherent with feast-famine cycle in a long-term leading to obesity.

- Childhood food insecurity

Early deprivation of proper diet of infants can develop obesity later in adultery. Such a malnutrition experience can create a long-term relationships of obesity and food security.

- Poverty

“Poverty is where people have unreasonably low living standards compared with others; cannot afford to buy necessities, such as a refrigerator for example; and experience real deprivation and hardship in everyday life” (McClelland 2000).

Poverty is a factor driving obesity and food security simultaneously. However, as the Institute of Medicine (2011) emphasis, *“Obesity and poverty are associated, and food insecurity and poverty often coexist.”* This implies to only indirect relation of obesity and food insecurity.

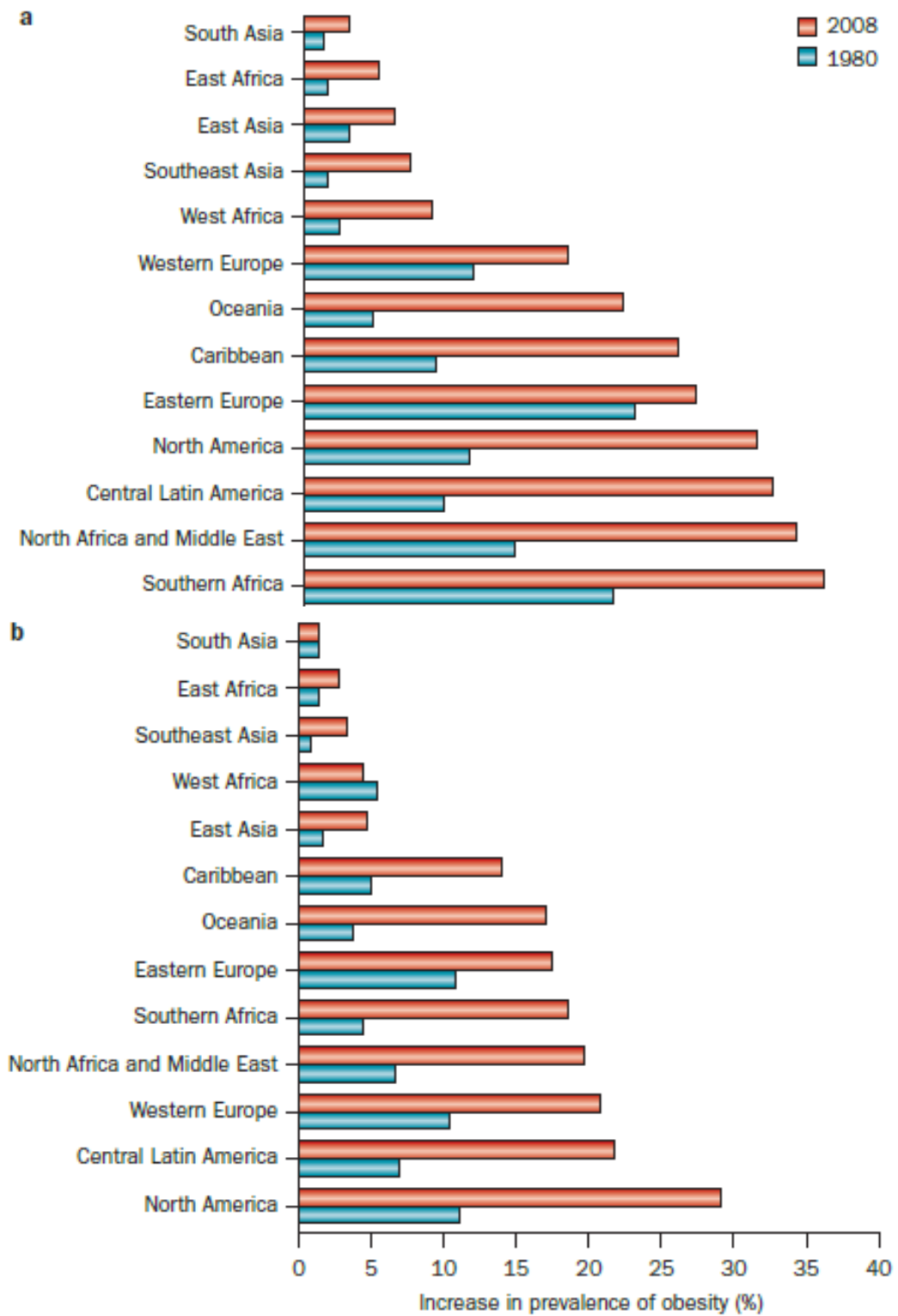
Although most of people living in poverty have a high risk of food insecurity, it doesn't directly mean they are food insecure. In addition many people living above a poverty line might not be assumed as food secure. Food insecurity and poverty are not one-to-one correspondent but their relationship is more complex (Burns, 2004).

Several studies have investigated the link between poverty and food insecurity of families and obesity ((Townsend et al., 2001), (Dietz, 1995), (Olson, 1999), (Alaimo et al., 2001). The coherent finding is that white women in families that are food-constrained measured by poverty and food insecurity – are more likely to be obese. Some of these studies confirm that although moderate food insecurity is associated with a higher risk of obesity, severe food insecurity associates with a lower risk. Poverty and food insecurity were not proved to be associated with obesity in men.

There are also other potential drivers of obesity such as genetics and biology, culture and lifestyle, stress, urbanization, and changing diets. However, these are not directly connected with food insecurity (Swartz, 2014).

For a period from 1980 and 2008, a large evidence was documented in increase of the prevalence of obesity across the globe (Figure 7). These figures showing an estimated 500 million obese adults in 2008, represent 10–14% of the world's population. From these data, the sex-specific prevalence of obesity was highest in North America (men 29.2%) and in southern Africa (women 36.5%). Obesity prevalence higher than 30% was observed in women living in North America, Latin America, North Africa and the Middle East. Over the next 20 years, the largest increase in overweight and obesity of adults is expected to occur in LMCs, estimating range from 62-205% for overweight and from 71-263% for obesity (Malik V.S. et al., 2012).

Figure 7 Prevalence of Obesity among Women (a) and Men (b)



Source: Nature Reviews, Endocrinology, 2012

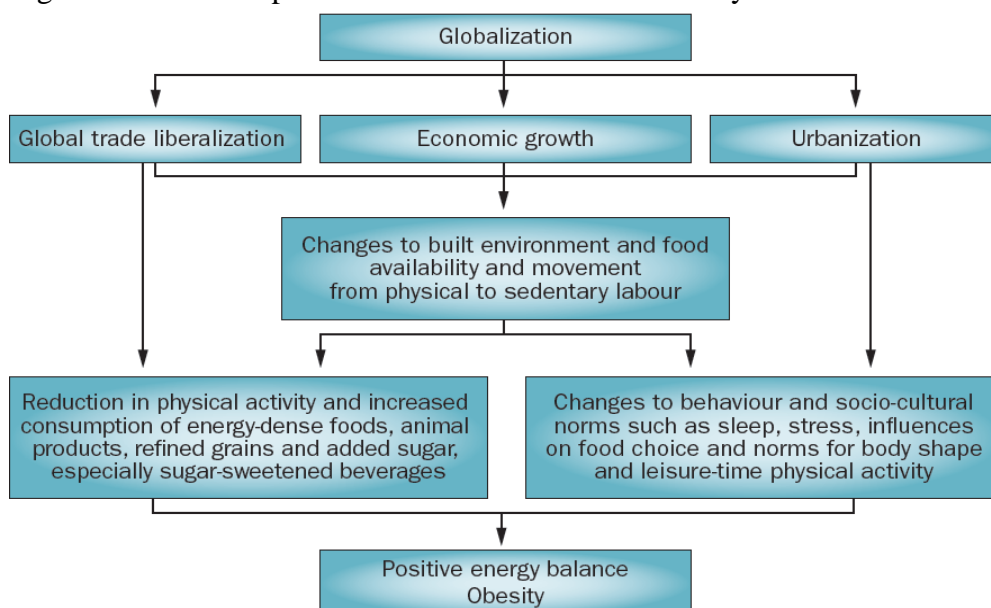
As assumed by many researchers, it can be theoretically concluded that the highest rate of obesity in developed countries is among the poorest people with food insecurity and vice versa, in most of developing countries, the highest rate of obesity is among the higher-class people. However there are still many people fighting with food insecurity and high obesity rate in developing countries. Undoubtedly, the relationship between food insecurity and obesity is complex, and still not fully understood and confirmed. Therefore following chapter is devoted to macro-factors of obesity and food insecurity.

3.4.2 Macro-level Factors of Food Security and Obesity

According to Malik V.S. et al. (2012), “*Although globalization has resulted in substantial improvements in quality of life and food security, as well as reductions in poverty, unintended consequences of globalization are also driving the obesity epidemic*”. These changes are mediated through macro-level drivers as liberalization of global trade, economic growth and urbanization (Figure 8).

“*Global trade liberalization, increases in income and urbanization have created obesogenic environments that promote nutritional transitions and reductions in physical activity, resulting in positive energy balance*” (Malik V.S. et al., 2012).

Figure 8 Relationship between Globalization and Obesity



Source: Nature Reviews, Endocrinology, 2012

3.4.2.1 Economic Growth – GNI

The obesity prevalence correlates with the initial stages of economic growth and development; as populations of rapidly developing LMCs experience nutritional and lifestyle transitions. An analysis of economic development in 100 countries showed that BMI increases rapidly in relation to increased national income. This association declines as countries achieve upper-middle-income or high-income status, as a result of improved access to education, health care and behavioural changes. However, with increasing average income, habits associated with obesity, such as watching television, purchasing highly processed foods at supermarkets, are adopted. (Malik V.S. et al., 2012).

Paul Amuna et al. (2008) states that the trends in overweight and obesity among children and adolescents have been reported for Europe and high-income Asian countries, as well as for developing countries in which income levels are rising, including China, Chile and Kuwait. The evidence suggests that as income level rises, the obesity and its comorbidities become more prevalent among children and young adults in developing countries.

Contrary, Basiotis (1992) hypothesized and confirmed a behavioural model of household members faced to diminishing incomes at first consumed less expensive food to maintain energy intakes at a lower cost. In this study at a certain income level participants stated that they had enough but not the kind of food they pleased to eat. Only when incomes diminished more the households reduced dietary energy to below daily requirements. This resulted in overt deprivation. The association between poverty and obesity is in part by the low cost of energy dense food which may eventually promote overconsumption. The explanation is that energy density (MJ/kg) and energy costs (\$/MJ) are inversely linked, such that the decision of selecting of energy-dense food by consumers that are food insecure or low-income represents an intentional strategy to save money (Drewnowski 2004).

In an in-depth analysis of income, education, and poverty, as income increased and people became more educated, prevalence of obesity decreased. As income increased, calorie needs were met or exceeded before food security was achieved. Adequate or excessive calories were available, but not necessarily from nutritionally dense foods (ie,

vegetables and fruits, whole-grains, low-fat dairy products, and lean meats) (J Am Diet Assoc. 2007).

According to Burns (2004), the association of food insecurity and obesity does not have to be directly linked to each other. They both can be consequences of low income and connected to lack of nutritious food. Therefore low-income and food insecure people are more likely to be obese due to higher poverty risk factors including:

Limited Resources and Access to Healthy and Affordable Food

- No reliable transportation to the neighbourhood residence with potentially healthier food.
- Lack of money to pay healthier but more expensive food.
- Greater availability of cheap fast food restaurant associated with a high calories and low nutrients diet (Burns, 2004).

Less Opportunities for Physical Activities

- The neighbourhood with lower income has less of physical activity resources such as parks, bike paths and other recreational facilities.
- Lower attractiveness of existing physical activity resources due to poorer treatment of neighbourhood.
- Higher risk of indoor sedentary activities such as watching television and overeating (Burns, 2004).

Food Deprivation and Overeating Cycle

- People often skipping meals usually overeat when food is available again, which leads to unhealthy metabolic changes and promote fat storage.
- Occurs especially among low-income parents, particularly mothers scarifying their nutrition in order to satisfy children (Burns, 2004).

High Level of Stress

- Stress caused by emotional and financial pressure of food insecurity leads to weight gain, hormonal and metabolic changes, which can trigger anxiety and depression (Burns, 2004).

Obesity-Promoting Marketing

- More advertising for obesity-promoting products such as fast food, television shows, video games, encourages the consumption of unhealthy food and discourages physical activity (Burns, 2004).

Limited Access to Health Care

- Low-income people often experience low quality of health care if available at all, resulting in lack of treatments of health problems like obesity (Burns, 2004).

To summarize the income factor, there are two opposite results. Some of the researches assume that by increasing income, the prevalence of obesity increases as well. The reasons might be adopted sedentary habits associated with obesity (e.g. watching television). Also some analysis prove increased BMI together with increased income of households. On the other hand, there are assumptions claiming opposite correlation due to mostly limited resources of healthy and more expensive food, low access to health care and reduced dietary energy to below daily requirements due to diminishing income of household. Also another analysis proves that as income increased and people became more educated, prevalence of obesity decreased.

3.4.2.2 Liberalization of Global Trade – Prices of Food

According to Malik V.S. et al., (2012), *“trade liberalization can affect the availability of certain foods by enabling the trade of greater amounts and varieties of food, by removing barriers to foreign investment in food distribution, and through expansion of multinational food companies and fast-food chains”*. Dietary changes are driven by the increasing availability of low-cost food and drinks, which are basically low in nutritional value and high in energy/sugar.

Cutler *et al.* (2003) predicted 12 years ago that the declining cost of food and movement towards mass preparation has contributed to the obesity epidemic in USA, which can be extended to other countries experiencing same changes in food availability. These factors might be contributors, however this explanation for the obesity epidemic is not sufficient because, otherwise people with more money would tend to be more obese, which is not necessarily the case.

Over the past forty years, the price of beef has dropped by enormous 80%, thanks mainly to global trade liberalization. In low and middle-income countries, it became easier to trade crops across the most of the world. In 1994, the General Agreement on Tariffs and Trade included agricultural products for the first time, which lead to globally more open agricultural market and also to cheaper food. The food price changes were linked to changes in how much people eat, and in successively, their risk of obesity. However, that is not the only way the free trade contributes to this problem. Trade liberalization allow people to access different types of food and so high-calorie processed foods. It also eliminates barriers to foreign food distribution and gives an access for international food companies and fast-food chains to expand and dwell into new countries (Harvard School of Public Health (2016).

The neighbourhood of socio-economic environment and individual educational status may be associated with poor health behaviours. It has been found that those living on a low income or in a socially disadvantaged area may face higher food prices. It is the environmental providing snacks, soft drinks and fast foods widely available. Reidpath et al. (2001) found that particularly the low-income areas have 3 times the density of fast food outlets per head. Furthermore, the phenomenon of ‘supersizing’ i.e. offering larger food portions provides inexpensive extra energy at lower unit cost (Cameron-Smith, Bilsborough and Crowe 2002).

Because food costs consume a much larger proportion of family income in developing countries than in developed countries (more than 50%), prices have a strong effect on the selection of particular foods. The globalization of food markets has resulted in the introduction of mass-produced, low-cost foods (e.g. vegetable oils) to the domestic food supply in many developing countries. These changes, including advertising campaigns, have a powerful effect on the food choices and dietary patterns of low-income households. Although many of these low-cost commercial foods are energy dense, they may be nutrient-poor (Caballero, 2005).

It can be assumed that the prices of foods do have an influence of growth of obesity in both, developed and developing countries. Mass-production and low-cost food production lead to higher availability and so higher consumption. Trade liberalization

allow people to access different types of food and so high-calorie processed foods, especially in fast foods surprisingly mostly in developing countries.

3.4.2.3 Urbanization

The consequences of urban living on the development of obesity are numerous. They occur as a result of changes in the living environment of more food options available as well as through lifestyle alterations related to technological advancement. So, these changes have a direct effect on quality of diet and energy expenditure. As urbanization is going to continue, these trends of positive energy balance are expected to continue simultaneously (Malik V.S. et al., 2012).

Urban food, built environments, and the new technologies that link with city living might lead to poorer diets and sedentary lifestyle. Urbanization makes easier access to health care, occupation and education, from which can help rein obesity rates. However in many low and middle-income countries, new urban areas are simply not able to develop the health care and education infrastructure so quickly (Harvard School of Public Health (2016).

While obesity prevalence certainly appears to be rising across all low and middle-income countries, it is not quite clear what urban-rural difference may exist. Therefore there are the data from repeated nationally representative cross-sectional surveys of 441,916 rural and 364,267 urban (806,183 total) adult women (18–49 years old) from 42 countries in Asia, the Middle East, Africa (East West), and Latin America. The combined prevalence of overweight and obesity (overweight = BMI >25, obesity = BMI >30), grew for all 42 countries at about 0.7 percentage points per year on average. Using population weights, it is estimated that 19% of rural women and 37.2% of urban women are overweight or obese (Barry M Popkin et al., 2011).

The clustering of populations in urban centres affects dietary patterns by changing the way that people interact with their environments in ways that transform food production and distribution systems. For example, urban living is associated with less compatible home food production and consumption, and also with limited land availability for cultivation. Urbanization brings infrastructure and resources such as improved transportation and refrigeration systems. Furthermore, growing foreign investment has

contributed to the rise of fast food restaurants and western-style supermarkets, also influencing consumer food choices by offering greater variety, quality, convenience and competitive prices. These changes in the food environment are occurring at a rapid pace. As developing countries become more urbanized, the changes are expanding beyond large urban centres and into smaller cities and towns (Reardon et al., 2003).

Widespread access to television would only support an indoor, sedentary lifestyle, reducing the average daily energy expenditure. Among the wealthier regions of a given population, these influences may be counterbalanced by access to better education about health and nutrition, sufficient income to purchase healthier foods, which are usually more expensive, greater leisure time for physical activity, and better access to health care. The contribution of the urban environment to the underweight–overweight paradox will probably continue to increase, since it is predicted that most of the population growth in the next 30 years will occur in urban areas, and almost all these new urban areas will be located in developing countries (Caballero, 2005).

According to the report of Food Insecurity Atlas of Urban India (2002), the underfed still outnumber the overfed. But recent studies in India show that neither the rich nor the poor are eating well. Nearly 30% of India's one billion people live in cities and towns today. Urban incomes are higher than rural incomes, but expenditure on food is lower in urban areas compared to rural areas. According to the report, poor, unskilled workers are migrating to urban areas in search of work and ending up as casual labour or self-employed vendors, which is the lowest rung on the economic ladder. Workers find that wages are higher than in rural areas and settle there. In urban India, the traditional diet of coarse grains and millets has given way to refined wheat and rice as the staple cereal, leading to a substantial reduction in the fibre content and possibly micronutrients in the diet. This shift has resulted in the Indian urban affluent consuming more fats, oils, sugars, and western-style fast foods. Add to that a more sedentary lifestyle and lack of physical activity, which eventually leads to overweight and obesity.

The study of Mohd Shariff et al. in 2005, examined 140 Malay and 60 Indian rural women, interviewed and measured for demographic, socioeconomic, dietary and physical activity information using their BMI and waist circumference (WC). There were 58% of the women reported some degree of food insecurity. In general, food-insecure women had

lower years of education, household income, and more children. More than 50% of food-insecure women were overweight and obese than women from food-secure households (38%). Similarly, more food-insecure women (32–47%) had at-risk WC (88 cm) than food-secure women (29%). Food-insecure women spent significantly more time in domestic and leisure activities than food-secure women.

The main point of this chapter is that the trend of continuous urbanization in developing countries is most likely going to increase the positive energy balance of consumption. Although the urbanization makes easier access to health care, occupation and education, from which can help rein obesity rates, the most of developing countries are not able to develop so quickly. Furthermore it brings improved infrastructure and transportation and growing foreign investment which contributes to the rise of western-style supermarkets, also influencing consumer food choices by offering greater variety, quality and competitive prices which actually leads to increased obesity. Another force of increasing obesity is that urban incomes are higher than rural incomes, but expenditure on food is lower in urban areas compared to rural areas. Therefore, many surveys prove higher percentage of obese food-insecure urban women than the rural ones. These food-insecure obese women had also lower years of education, household income, and more children.

4 Practical Part

As already mention in literature review, professor of agricultural strategy Gundersen (2014) states that *“in a lot of developing countries, being overweight is considered a good thing. It shows you have wealth.”* Because of some positive results of correlation between food insecurity and obesity, this might lead to spurious assumptions. Based on socioeconomic factors like education and poverty and demographic factors like age, gender and race, the studies in developed countries of America show that the correlation between food insecurity and obesity is high (FRAC, 2011). These two statements based on national studies might be only confusing. They claim that the prevalence of obesity in developed countries is mainly caused by poor people and vice versa, the prevalence of obesity in developing countries is mainly caused by rich people. This thesis is dedicated to developing countries because of interesting paradox of low food security and high prevalence of obesity.

The practical part continues by introduction of countries Jordan and Mexico to familiar with their culture, politics, economy and history in order to be able to link the level of food security and prevalence of obesity. Following this, the state of food security for both countries is examined and subsequently compared to prove the paradox of possibility of having low food security and at the same time high prevalence of obesity. The same approach is used with prevalence of obesity in both countries and again compared. Using the macro-level factors – income, prices of food, urbanization, fat and proteins supply in food - already explained in the theoretical part, both countries are afterwards classified.

The reasons why these particular countries are compared are that they both belong among developing countries with relatively low food security and paradoxically high rate of obesity. However, they are from different regions so they are not geographically or culturally influenced by each other. Also the sizes and number of population of the countries are very different. These similarities and difference are the reasons why they are the best to be compared regarding the food security and prevalence of obesity.

4.1 Jordan – General Information

Central Intelligence Agency (CIA, 2015), library publicises that in 1999, King of Jordan, Abdallah II implemented modest political and economic reforms, but in the wake of the "Arab Revolution" across the Middle East, Jordanians continue to press for further political liberalization, government reforms, and economic improvements.

Jordan's economy is among the smallest in the Middle East, with insufficient supplies of water, oil, and other natural resources underlying the government's heavy reliance on foreign assistance. Other economic challenges for the government include chronic high rates of poverty, unemployment and underemployment, inflation, chronic budget, current account deficits, and government debt (CIA, 2015).

King Abdallah, during the first decade of the 2000s, implemented significant economic reforms, such as opening the foreign trade and privatizing state-owned companies that attracted foreign investment and contributed to average annual economic growth of 8% for 2004 through 2008. The global economic slowdown and regional turmoil contributed to slower growth from 2010 to 2014 - with growth averaging 2.8% per year - and hurt export-oriented sectors, construction, and tourism (CIA, 2015).

In August 2015, Jordan completed a \$2.1 billion, three year International Monetary Fund (IMF) Arrangement, which the Government had entered to help correct budgetary and balance of payments imbalances. Jordan plans to expand on its fiscal reform measures enacted over the previous few years with a follow-on IMF agreement in 2016 to boost government revenues, reduce the budget deficit, and manage its debt, brought on partially by an influx of over 630,000 Syrian refugees since 2011, which put additional pressure on expenditures (CIA, 2015).

4.2 Mexico – General Information

Mexico, administered as the Viceroyalty of New Spain for three centuries, achieved independence early in the 19th century. Elections held in 2000 marked the first time since the 1910 Mexican Revolution. The global financial crisis in late 2008 caused a massive economic downturn in Mexico the following year, although growth returned quickly in 2010. Ongoing economic and social concerns include low real wages, high underemployment and inequitable income distribution. Since 2007, Mexico's powerful

drug-trafficking organizations have engaged in bloody feuding, resulting in tens of thousands of drug-related homicides (CIA, 2015).

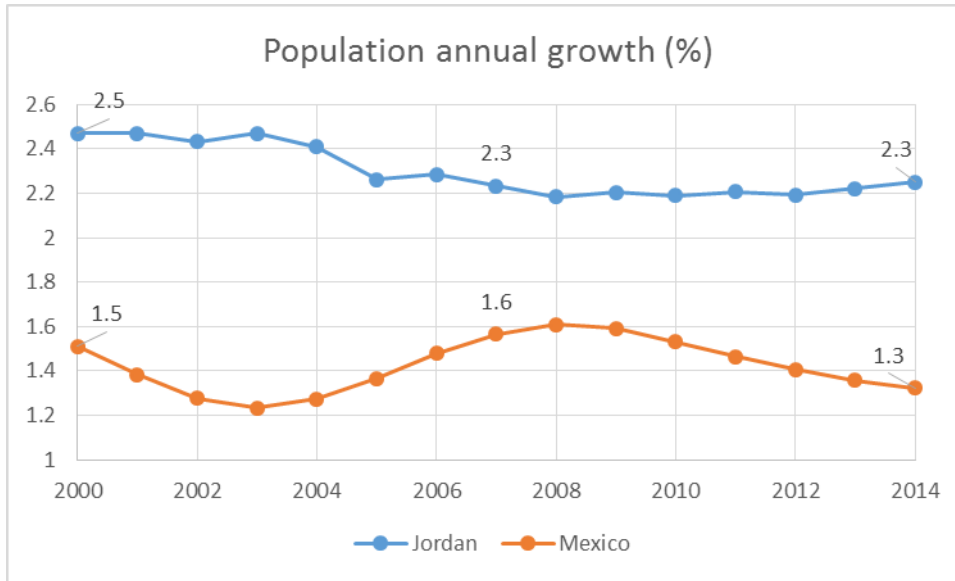
Economy of Mexico has become increasingly oriented toward manufacturing in the 22 years since the North American Free Trade Agreement (NAFTA) entered into force. It has become the United States' second-largest export market and third-largest source of imports. Mexico has free trade agreements with 46 countries, putting more than 90% of trade under free trade agreements. In 2012, Mexico formally joined the Trans-Pacific Partnership negotiations and formed the Pacific Alliance with Peru, Colombia and Chile (CIA, 2015).

Mexico's current government, led by President Enrique Pena Nieto, emphasized economic reforms during its first two years in office and implementing sweeping education, energy, financial, fiscal and telecommunications reform legislation, with the long-term aim to improve competitiveness and economic growth across the Mexican economy (CIA, 2015).

Although the economy experienced stronger growth in 2014-15 as a result of increased investment and stronger demand for Mexican exports, growth is predicted to remain below potential given falling oil production, weak oil prices, structural issues such as low productivity, high inequality, weak rule of law, and corruption. The increasing integration of supply chains, development of energy sectors, and government-to-government focus on trade facilitation will continue to make the North American region increasingly competitive and contribute to Mexican economic development and strength (CIA, 2015).

Jordan and Mexico have many similarities and at the same time many differences. For instance, the population density in Mexico is sixteen times higher than Jordan's. However, as shown in the graph 1, the population annual increase has been recently higher for Jordan. Literacy rate is on a very good level in the both countries and their prevalence of obesity is quite alarming. There are many threats from natural hazards like tsunamis, droughts and earthquakes in both countries influencing their food security (CIA, 2015). Therefore it is necessary to investigate food security and prevalence of obesity in these countries more deeply.

Graph 1 Population annual growth (2000-2014)



Source: author`s elaboration from data extracted from The World Bank, 2015

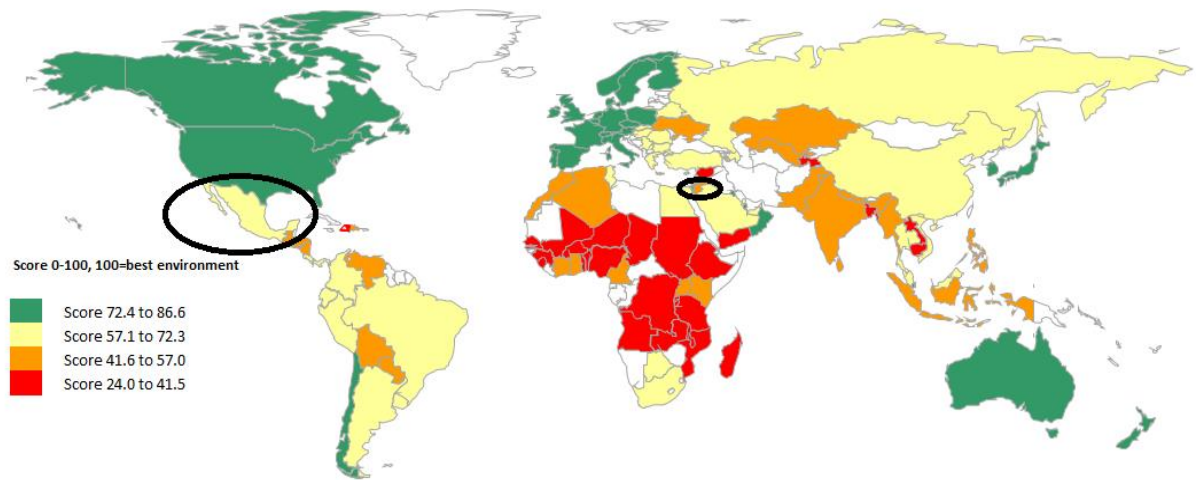
4.3 Analysis of Food Security of Jordan and Mexico

The overall goal of this chapter is to assess and compare two developing countries, Mexico – representing North America or Latin America and Jordan – representing the Middle East and North Africa.

The Report from The Economist Intelligence Unit (2014) states that *“Obesity and food security can co-exist, but their relationship is complicated, with poverty and other factors potentially impacting both. The prevalence of obesity is moderately correlated with overall GFSI scores, reflecting the complex relationship between both issues at the national level.”*

Figure 9 represents a world map with colours of four food security levels ranking 113 countries measured by GFSI, where 100 scores = the best environment. Among them, Mexico belongs to the second level (yellow <58.5 to 74.1>) of the countries with score of 68.1. It can be considered that Mexico`s food security is an average. Jordan with its score of 56.9, reaches exactly the upper border of third level (orange <41.6 to 57.0>).

Figure 9 World Map of Food Security (2016)



Source: Economist Intelligence Unit, 2016

As already mentioned in the literature overview, the food insecurity is more complex, and the paradox is that it not only might lead to undernutrition and recurring hunger, but also to over-nutrition, which can lead to overweight and obesity. *Poverty* results in food insecurity and often hunger, which can lead to malnutrition. Furthermore, the absence of a diversified, nutrient-dense diet can lead to over-nutrition, subsequent obesity, and failure to meet micronutrient requirements (J Am Diet Assoc. (2007)). Therefore, the food security of Jordan and Mexico needs to be more analysed in order to approach the hypothesis of correlation between lower food security and higher prevalence of obesity in these countries.

4.3.1 Food Security of Jordan

Food security of Jordan can be considered as an average among 113 GFSI countries. Table 3 shows a recent increase of scores and of this country. Affordability dimension score has been stagnating for the recent four years. The second dimension, availability, has had a rapid increase in 2015 and therefore it has overtaken the best score out of all dimensions. The weakest dimension of Jordan's food security has been quality and safety. Even though the scores for the last four years have been relatively increasing, the country's third dimension keeps quite low values and so should be the most concerned.

Table 3 Food Security Dimensions Index for Jordan (2012-2016)

	Score / 100				
	2012	2013	2014	2015	2016
OVERALL SCORE	55.6	54.8	54.9	56.9	56.9
Affordability	57.5	57.5	57.7	57.6	57.3
Availability	55.5	53.5	53.4	58.1	58.4
Quality and safety	50.8	51.6	52.3	52.1	52.1

Source: Economist Intelligence Unit, 2016

Jordan's current biggest strengths (scores > 75) are proportion of population under global poverty line (97.8), food loss (81.8) and presence of food safety net programmes (75.0), which are all the indicators of availability and affordability dimension (highlighted green). On the other hand, the challenges are political stability risk (22.2) and GDP per capita (6.6). The reason why the affordability has decreased its score might be due to its current weaknesses, political stability risk and GDP per capita (Table 4). The quality and safety dimension issue might be caused because of such a popular occurrence of fast foods in Jordan potentially leading to obesity.

Table 4 Strengths and Weaknesses of Jordan's Food Security (2016)

STRENGTHS (Scores 75 or more)		WEAKNESSES (Scores less than 25)	
Proportion of population under global poverty line	97.8	Political stability risk	22.2
Food safety	84.9	Gross domestic product per capita (US\$ PPP)	6.6
Food loss	81.8		
Presence of food safety net programmes	75.0		

Source: Economist Intelligence Unit, 2016

As already mentioned in Literature review, Reidpath et al. (2001) found that particularly the low-income areas have 3 times the density of fast food outlets per head.

4.3.2 Food Security of Mexico

Mexico's food security is placed in the first half among 113 GFSI countries. Table 5 shows a continuous increase of overall score. Affordability dimension score rapidly increased in 2015, however, its current score is the lowest out of all dimensions. The availability dimension has lost its status of worst dimension from 2015 and currently is in the middle. The scores of quality and safety has always been the highest out of all dimensions.

Table 5 Food Security Dimensions Index for Mexico (2012-2016)

	Score / 100				
	2012	2013	2014	2015	2016
OVERALL SCORE	66.8	65.9	65.7	67.2	68.1
Affordability	62.5	62.6	62.7	66.5	66.5
Availability	67.6	66.0	65.5	65.5	67.5
Quality and safety	75.2	74.1	73.9	73.9	73.9

Source: Economist Intelligence Unit, 2016

Mexico's current strengths measured by GFSI are shown in Table 6, where the nutritional standards (100) and food safety (96.7), highlighted green, are the indicators of quality and safety dimension. On the other hand, GDP per capita (11.8), is the weakness and highest challenge for Mexico. It also may be the main reason of the lowest score for affordability dimension.

Table 6 Strengths and Weaknesses of Mexico's Food Security (2016)

STRENGTHS (Scores 75 or more)		WEAKNESSES (Scores less than 25)	
Presence of food safety net programmes	100.0	Gross domestic product per capita (US\$ PPP)	11.8
Nutritional standards	100.0		
Food safety	96.7		
Volatility of agricultural production	92.4		

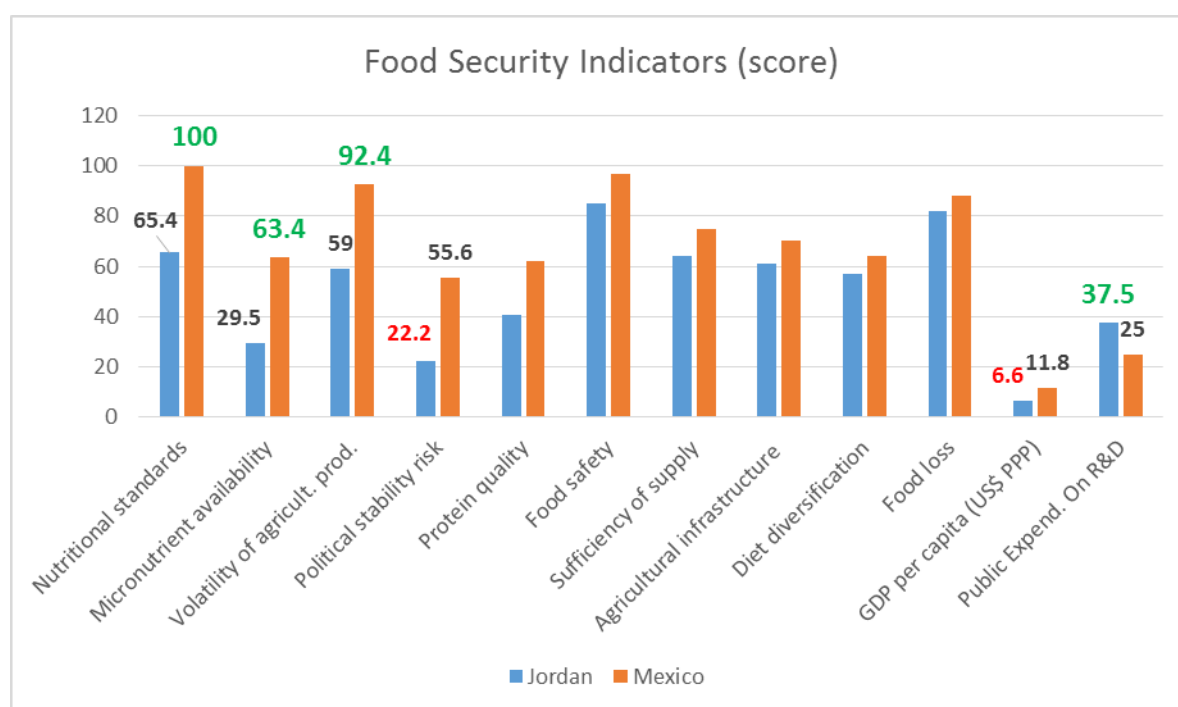
Source: Economist Intelligence Unit, 2016

After the investigating of Jordan's and Mexico's food security separately, they can be now compared in the next chapter.

4.3.3 Comparison of Current Food Security of Jordan and Mexico

It is quite obvious that overall Mexico's food security scores are better than Jordan's. The reasons are shown in Graph 2, where the most of the indicators, chosen from 28 overall, measured by GFSI have higher score for Mexico. The worse position for Jordan might be caused by its weaknesses, political instability and GDP per capita (Table 4), which are even lower than in Mexico and might have a big influence on the public and governmental decision-making.

Graph 2 Food Security Indicators comparison for Jordan and Mexico (2016)

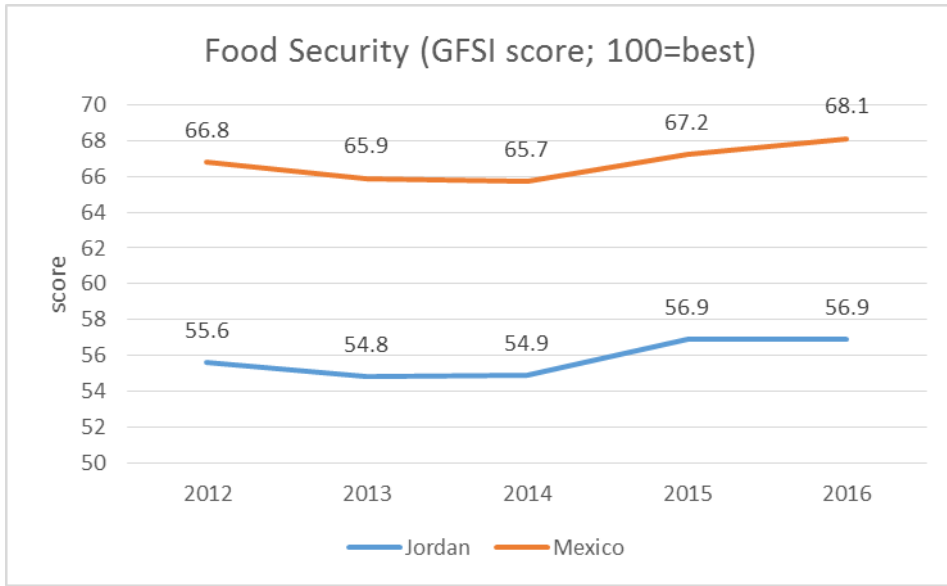


Source: author's elaboration from data extracted from GFSI, 2016

Although overall indicators' scores are mostly higher for Mexico, there is specific variables significantly better-off for Jordan and it is the public expenditures on agricultural research and development.

The most significant variables with the biggest difference that make Mexico better-off than Jordan are nutritional standards (34.6 score of difference), micronutrient availability (33.9 score of difference) and volatility of agricultural production (33.4 score of difference), which might be caused by poor climatic and environmental conditions, such as arid desert, deforestation, soil erosion, desertification (Supplement 1).

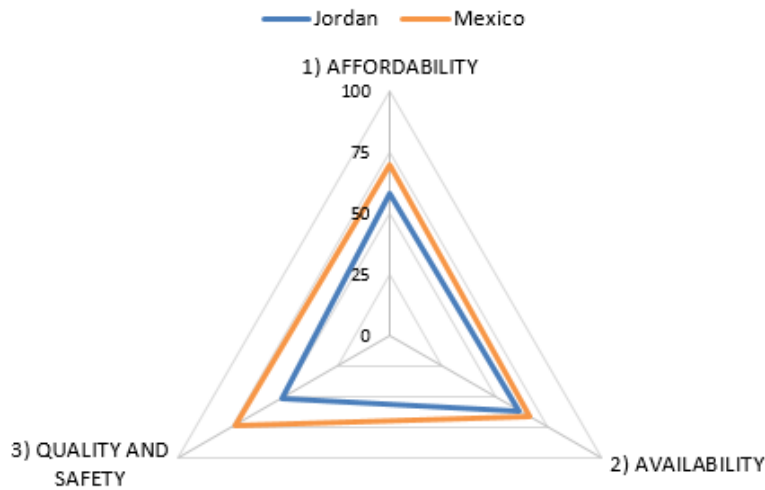
Graph 3 Food Security scores for Jordan and Mexico (2012-2016)



Source: author`s elaboration from data extracted from GFSI, 2016

Graph 3 shows the overall scores of food securities for Jordan and Mexico. According to GFSI (2016), it is obvious that Jordan (60th/113 countries) has always stood behind Mexico (39th/113 countries). The positive aspect is that there is at least a small increase for both countries from 2012 till today.

Figure 10 Comparison of Jordan and Mexico Food Security Index (2016)



Source: Economist Intelligence Unit, 2016

Figure 10 illustrates the positions of Jordan and Mexico regarding three dimensions. The highest difference of score, calculated from the Table 4 and 5, between these two countries is in quality and safety dimension (21.8). The lowest difference (9.1), is in availability and affordability difference is slightly higher (9.2).

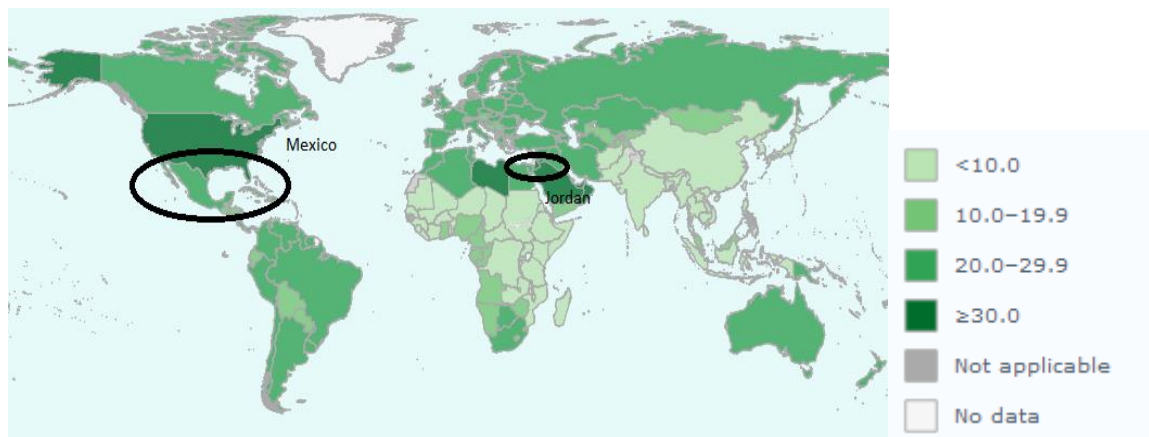
How is then possible that the prevalence of obesity in Jordan is higher than in Mexico? What are the reasons for such a high prevalence of obesity in both countries and among what kind of people does it occur the most? More details are explained in the next chapters.

4.4 Analysis of Prevalence of Obesity in Jordan and Mexico

The aim of this chapter is to determine Jordan`s and Mexico`s position in the world rank of prevalence of obesity. The results will be measured by CIA, GFSI, OECD, World Bank and WHO.

Obesity has become to be recognized as a global pandemic. The WHO (2015) recognizes obesity as a global health issue with one billion adults worldwide identified as overweight and an additional 300 million obese. Globally, it has affected not only developed but also developing countries. Figure 11 shows the prevalence of obesity in the world in 2014, measuring population of 18+ age. Obviously, Mexico belongs to the countries scaled from <20 to 29.9 %> of prevalence of obesity, particularly 28.1%. Among 194 of WHO countries, it is ranked as 34th country with the highest obesity prevalence. Jordan`s prevalence of obesity is 30.5% and it is ranked as 26th country. As the obesity is defined as having an age-standardized body mass index (BMI) greater than 30.0, both countries can be considered as suffering from relatively high obesity prevalence.

Figure 11 Prevalence of Obesity, World Map, both genders, aged 18+, (% , 2014)



Source: WHO, 2014

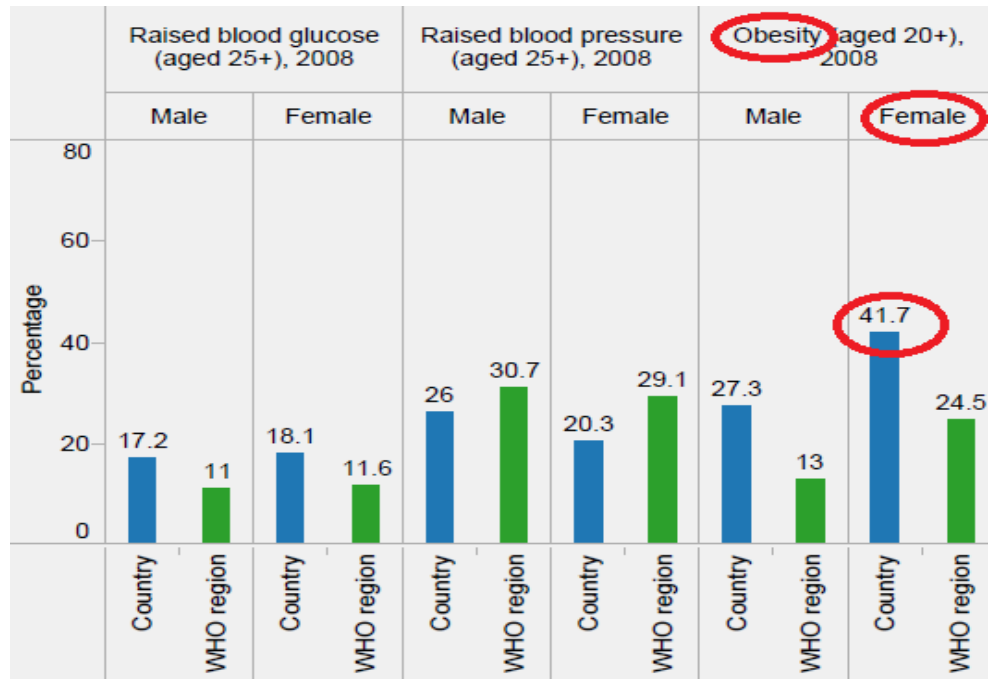
4.4.1 Prevalence of Obesity in Jordan

According to WHO, study in 2009, one-third of the Jordanian respondents were overweight, and 38.8% of respondents were obese, in line with other studies from the region and local studies. Results from the same earlier survey in 2007 showed that 27% of women of reproductive age (15–49) were overweight and 20% were obese. Another study on the national prevalence of behavioural risk factors for chronic diseases (2007) showed that 30.5% of respondents were overweight and 36.0% of them were obese. Jordan has experienced recent, rapid changes towards westernized lifestyles that are associated with greater risks of obesity. Sedentary lifestyles and high-fat diets are becoming common. Therefore, it seems reasonable to hypothesize that the prevalence of overweight and obesity in Jordan may have increased steeply in recent years.

In Jordan, study of Zindah et al. (2009), showed that obesity was significantly associated with diabetes, high blood pressure, high cholesterol and asthma compared with adults of normal weight among Jordanian people. The 2004 and 2007 Behavioural Risk Factor Surveys for Jordan showed a low intake of fruits and vegetables among people: only about 19% of survey respondents reported having consumed three or more cups of fruits, fresh juices or vegetables in average per day. Of obese Jordanians, 27.8% reported that they considered their weight to be normal, which reflects the poor awareness of what constituted a healthy weight among Jordanian population. In addition, results from the recent Behavioural Risk Factor Survey (2007) showed that only 37.8% of the Jordanian

population engaged in moderate physical activity. Lack of appropriate places for women to exercise is one of the major challenges. Moreover, negative social beliefs in some areas towards women who exercise is another concern (M. Al Nsour et al., 2009).

Figure 12 Adult Risk Factors on Health in Jordan, (2008)



Source: WHO, 2008

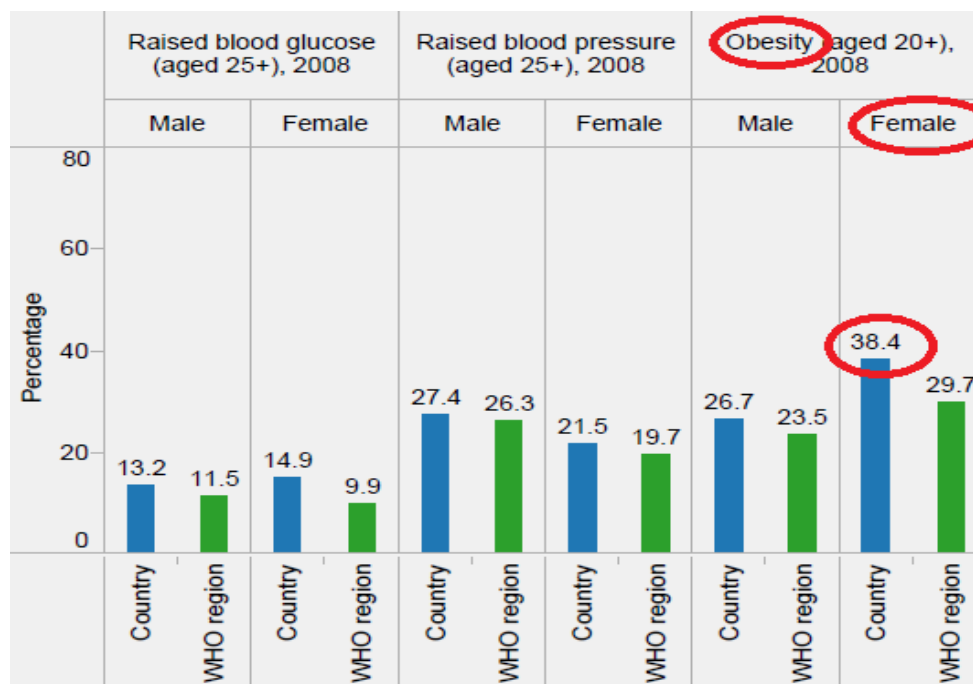
Raised BMI, causing overweight and obesity, is an important cause of chronic disease. Chronic diseases are the leading cause of mortality in Jordan. The Jordan MOH, with assistance from the Centres for Disease Control and Prevention and the WHO (2009), established a behavioural surveillance program to monitor the prevalence of risk factors associated with these diseases. The first Behavioural Risk Factor Survey in Jordan (Figure 12), which was conducted in 2008, revealed that among sample of adults aged 20 years or older, the self-reported diagnosed prevalence of obesity was for men 27.3% and women 41.7% - women obesity is a lot more significant than men obesity. This might be connected to already mention intolerant conditions for women to exercise due to cultural and religious attitude.

4.4.2 Prevalence of Obesity in Mexico

According to Harvard School of Public Health (2016), there's evidence that Mexico and other countries in Central and South America are already seeing the burden of obesity shift from the wealthy to the poor. In Mexico, for example, wealthier groups still have higher rates of obesity than lower socioeconomic groups. But the differences in average BMI between Mexico's more-developed regions in the north and less-developed areas in the south are small. In Brazil, meanwhile, from 1975 to 2003, obesity rates rose far more quickly among people with lower incomes than they did among the wealthiest Brazilians; by 2003, the difference in obesity rates between wealthy and lower-income men had narrowed, and the differences among women had nearly disappeared.

Mexico has the lowest life expectancy of all OECD (Organization for Economic Cooperation and Development) countries, which has increased much more slowly over the past ten years than in other OECD countries. The slow progress in life expectancy in Mexico is caused by harmful health-related behaviours including poor nutrition habits and very high obesity rates, increasing mortality rates from diabetes and no reduction in mortality from cardiovascular diseases, very high death rates from road traffic accidents and homicides, as well as persisting barriers to access to high-quality care (OECD, 2013).

Figure 13 Adult Risk Factors on Health in Mexico, (2008)



Source: WHO, 2008

Figure 13, designed by WHO (2008), illustrates the similar results in the prevalence of obesity in Mexico as in Jordan. Obesity prevalence is again higher among women (38.4%) than men (26.7%).

Health at a Glance 2013 says that *'the supply of health services in Mexico remains very low by OECD standards. This creates substantial barriers to effective access to care. Despite a large increase in the number of doctors since 1990, Mexico had 2.2 doctors per 1 000 population in 2011, one fewer than the OECD average of 3.2. Reducing inequalities in access to care across the country will require targeting resources more precisely on where they are most needed'*.

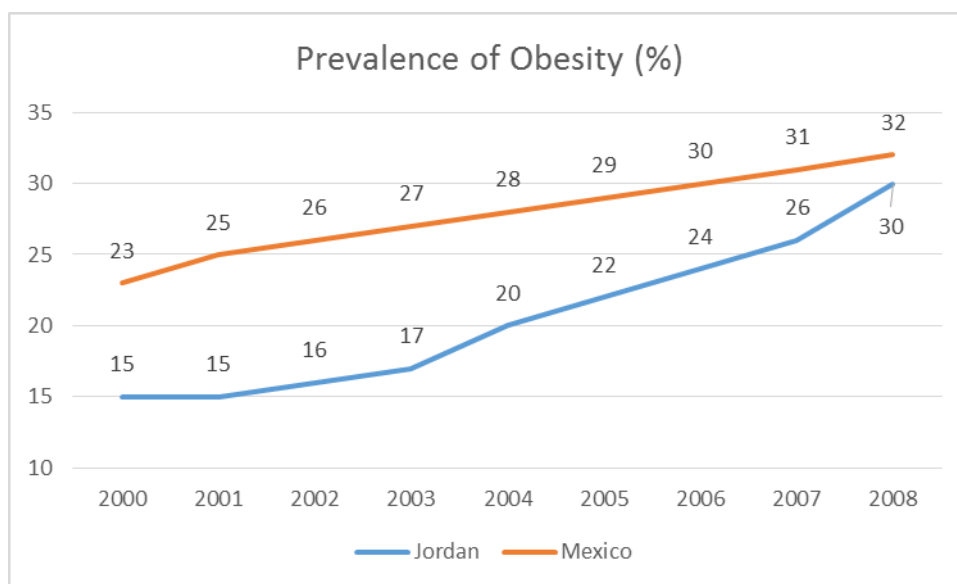
4.4.3 Comparison of Prevalence of Obesity in Jordan and Mexico

Prevalence of obesity in Jordan and Mexico is going to be analysed and compared in two groups, which are age and gender.

Age

Health at a Glance (2013) says that Mexico is after the United States, second country with the highest obesity. Graph 4 shows that in 2000, 23% of Mexican adults were overweight and obese which increased in 2008 to 32%. The graph also shows even more rapid increase in prevalence of obesity among adults in Jordan from 2000 with 15% to 2008 with 30%. There is no obvious stagnation or even decrease trend displayed in the graph.

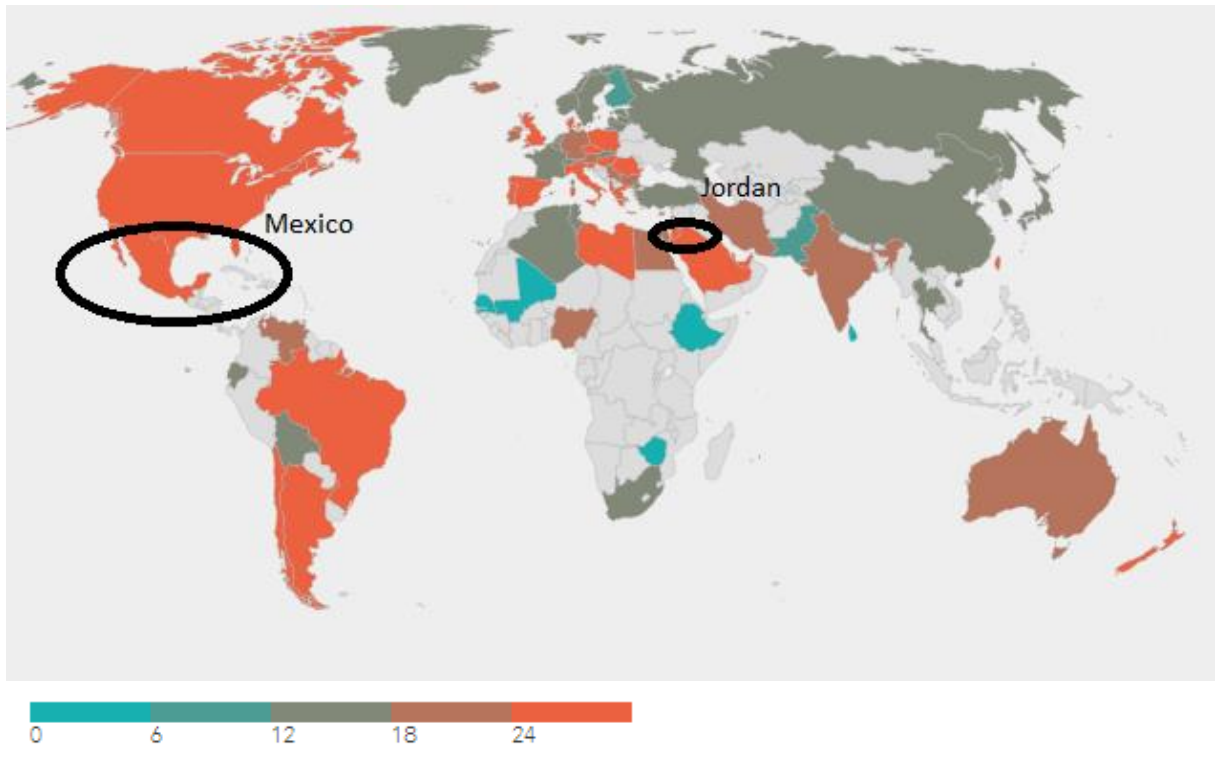
Graph 4 Prevalence of Obesity in Jordan and Mexico, 18+aged (2000-2008)



Source: CIA (2015)

Prevalence of obesity among adults in Jordan and Mexico was already compared, however children obesity in these countries is also to be concerned. Figure 14 shows a world map highlighting countries with the highest prevalence of obesity (red colour). Jordan and Mexico are included.

Figure 14 Prevalence of Obesity among children, World map, aged 11-15, (% , 2011)



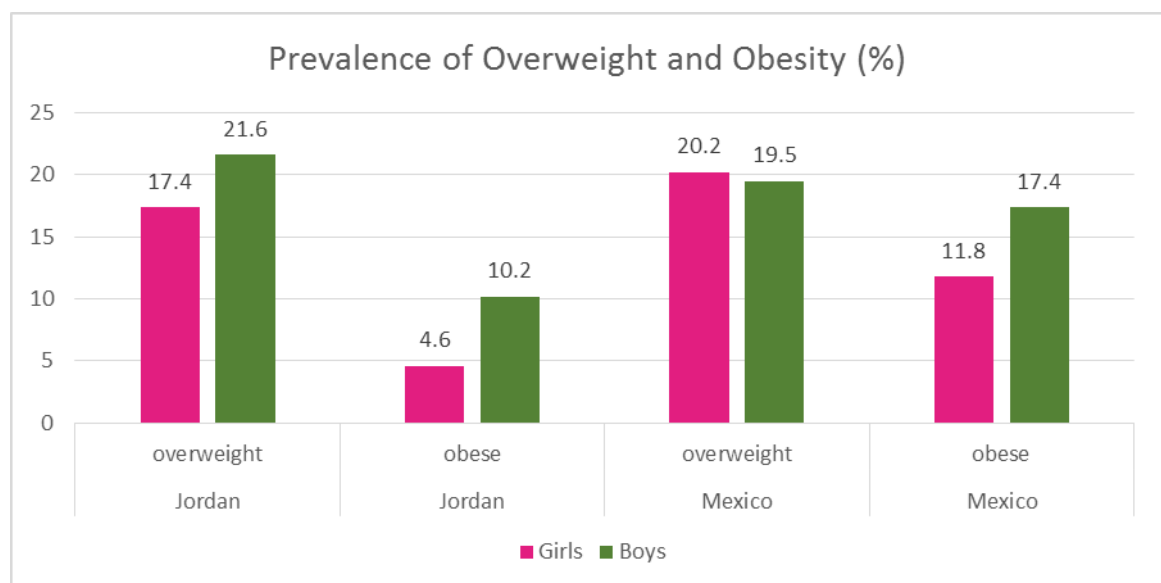
Source: World Obesity Federation, 2015

As already mentioned in literature review, the World Bank (2013) states, that emerging economy countries have 30% higher increasing child obesity as those of developed countries. According to WHO (2015), childhood obesity can eventually lead to premature death in adulthood. Children in developing countries are often more vulnerable to inadequate infant and young child nutrition food. Also, they are exposed to high-fat, high-sugar, high-salt, energy-dense, micronutrient-poor foods, which is lower in cost but at the same time lower in nutrient quality. This dietary pattern in combination with lower level of physical activity, results in sharp increase in childhood obesity while problems of undernutrition remain unsolved.

According to Malik V.S. et al., (2012), ‘the worldwide prevalence of childhood overweight and obesity increased from 4.3% to 6.7% between 1990 and 2010. This increase means that an estimated 43 million children were overweight or had obesity in 2010, of whom 35 million live in lower and middle-income countries (LMCs)’. It can be said, that income is a significant factor influencing the prevalence of obesity in every country. This factor will be more described in the next chapter.

World Obesity Federation survey of prevalence of overweight and obesity in Jordan, with sample size of 937, young girls and boys (aged 12) in 2011 has found that prevailing overweight and obesity is higher among boys, which is surprising due to high prevalence of obesity among adult women. Overweight prevalence is more significant than obesity among youth in Jordan, however this can lead to obesity in older age. These already high numbers can be considered as alarming (Graph 5).

Graph 5 Prevalence of overweight and obesity among youth in Jordan and Mexico (2011)



Source: author`s elaboration from World Obesity Federation, 2015;

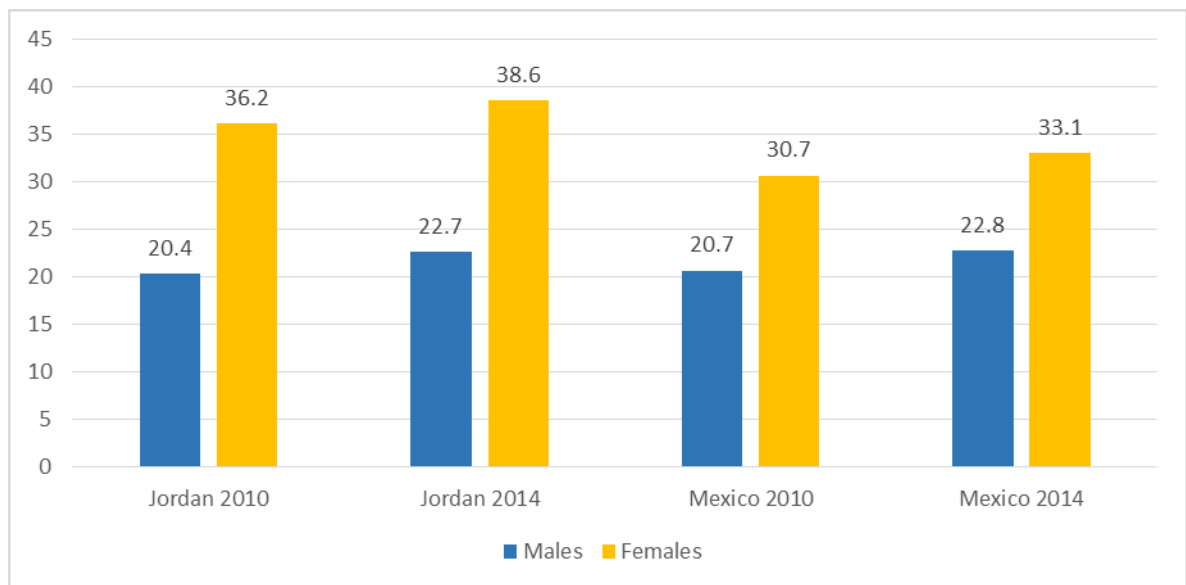
Another World Obesity Federation survey (2011) of prevalence of overweight and obesity in Mexico, with sample size of 16 351 young girls and boys (aged 11), has found that similarly as Jordan, Mexico has alarming prevalence of overweight among children, both girls and boys. However prevalence of obesity in Mexico is more than two times higher among girls and boys (Graph 5).

Child overweight rates in Mexico are among the highest in the OECD area. International data collated by the International Association for the Study of Obesity (2013) claims that almost 1 in 3 children is overweight in Mexico.

Gender

Graph 6 proves significant permanent prevalence of women's obesity trend from 2010 to 2014 in both countries, however in Jordan more significantly. Generally, is mentioned also earlier, women in particular, have always had a higher prevalence of obesity.

Graph 6 Graphical Jordan's and Mexico's Obesity in both genders, 18+ aged (2010, 2014)



Source: author's elaboration from WHO, 2014

In all of WHO regions were women more likely to be obese than men. Women's obesity was significantly higher than men's in low and middle income countries (WHO, 2015). Obesity among women has been linked to education, age, income parity, wealth status and smoking (M. Al Nsour et al., 2009).

Obesity of men can be mainly blamed on marriage, explained by a very good known saying 'a love goes through the stomach'. There is a lot more reasons to get obese for women than for men. The most common reasons for female obesity are puberty (hormonal changes), marriage, pregnancy, after-birth period, menopause, and birth-control

pills. Another very common cause of obesity for both genders is emotional troubles leading to overeating of sweets to calm down depression and anxiety (Cajthamlova, 2013).

Several studies have investigated the link between poverty and food insecurity of families and obesity ((Townsend et al., 2001), (Dietz, 1995), (Olson, 1999), (Alaimo et al., 2001). The coherent finding is that the white women in families that are food-constrained measured by poverty and food insecurity, are more likely to be obese.

In the following chapter, particular macro-factors connecting food security and obesity are going to be deeper examined in order to compare them between the two observed countries.

4.5 Macro-level Determinants of Food Security and Obesity Prevalence

There are few macro-level factors chosen with assumed influence on food security and obesity. They are gross national income (GNI), food price level, urbanization and fat/protein supply of food. In this chapter, each one of them is graphically explained in order to see the trend in certain period of time (period 2000-2013) and find the correlation with food security and prevalence of obesity.

As both, food security and prevalence of obesity in both countries has had only an increasing trend for the recent years, the macro-level factors should also have an increasing trend in income and urbanization and decreasing trend in prices of food to confirm any influence or correlation.

4.5.1 Gross National Income pre capita

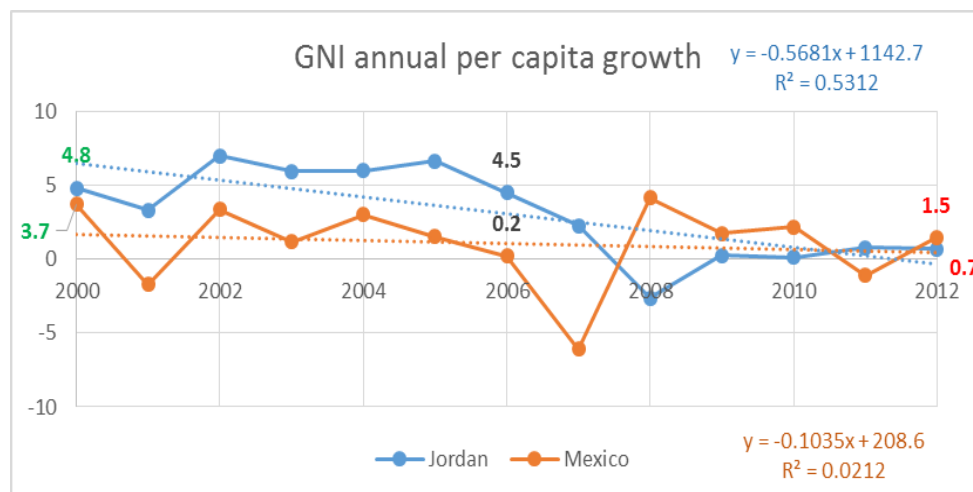
GNI is the first factor that should be analysed in order to find out whether it has an influence on food security and prevalence of obesity and if yes, how big influence it has.

GNI growth per capita is quite important measure of country`s economy that, according to many statements mentioned in the literature review, should have a big influence on consumers` food security and consequently obesity prevalence. As already mentioned in literature review, a key difference of obesity in developed and developing countries is that obesity in developed countries occurs more among the poorest individuals and in developing countries it is opposite and so obese people are prevalently the richest.

This means that obesity in low-income countries associates with wealth and obesity in high-income countries associates with lower socioeconomic status (Hurst et al., 2014). According to Global Health Institute (2014), economic growth is certainly increasing obesity in developing countries. The individuals who become richer and move to middle class often change traditional food for more Westernized cuisine including more fats and oil. According to National Center for Biotechnology Information (NCBI) (2013), most of the food insecure households are those with a lower income, ethnic minority and female-headed households.

Obesity in developing countries is a big problem rather for wealthier and more food secure people with a westernised lifestyle. However, the food insecurity remains an issue for the poor ones. On the other hand, obesity in developed countries occurs mostly among poor and food insecure people (The Economist, 2014). Another statements, according to Harvard School of Public Health (2016) is, that in low-income countries, wealthier and well-educated people are mostly more likely to be overweight or obese than people with lower incomes and less schooling. The opposite is in higher income countries, where wealthier people have lower rates of overweight or obesity than the poor ones.

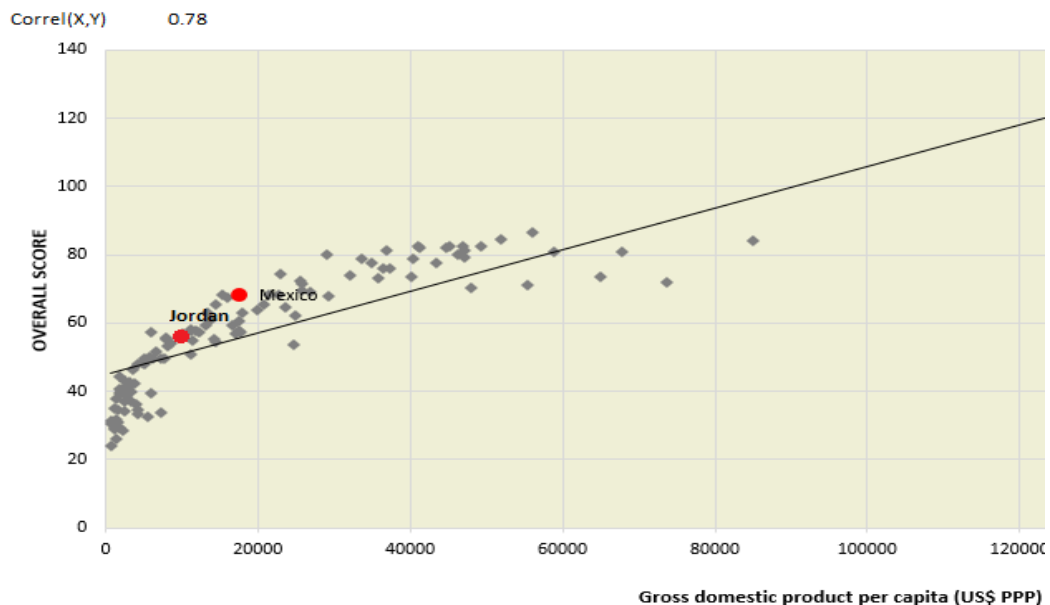
Graph 7 GNI per capita growth (2000-2012)



Source: author`s elaboration from World Development Indicators, 2015

Graph 7 shows relatively fluctuating trend of GNI in both countries (Jordan $R^2 = 0.53$; Mexico $R^2 = 0.02$). The trend line of GNI is influenced by the growth of world economy. Comparing years 2000 and 2012, there is significant decrease for both countries, particularly for Mexico, it is more than half and for Jordan it is 7 times less in 2012 than 2000. There is also an obvious drop of GNI for Mexico in 2007 and for Jordan in 2008 – influenced by world economic depression. Jordan's GNI (period 2000-2012) had fluctuating, however decreasing trend (-0.57) and so did Mexico (-0.1). The reasons for decreasing GNI might be due to high percentage of unemployment in Jordan, which is 13% or due to a much higher import than export (WHO, 2015, Supplement 1).

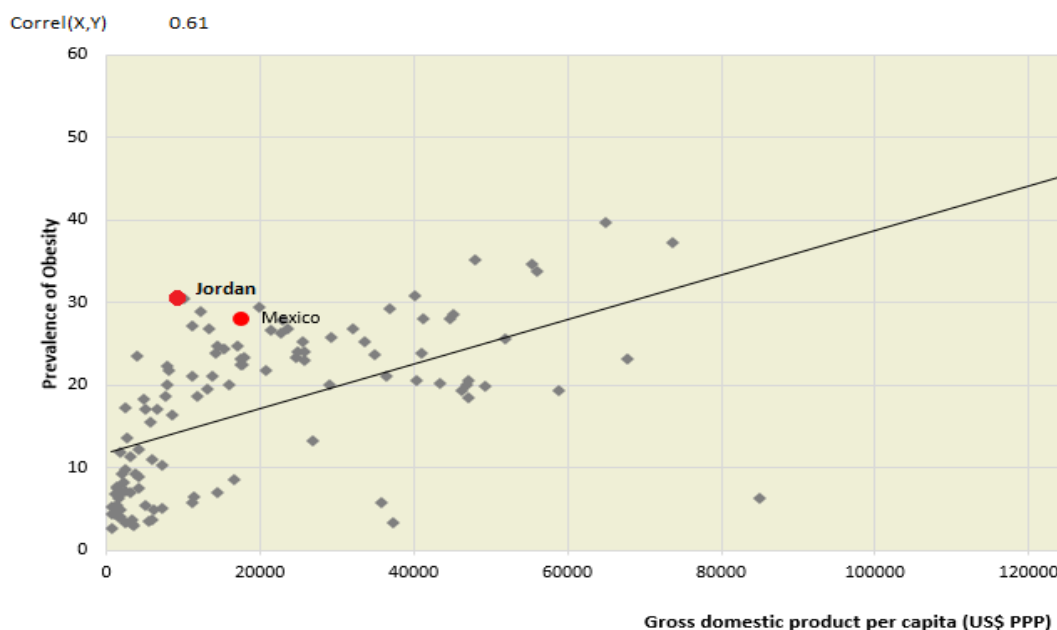
Graph 8 Correlation between GDP/capita and Food Security, (Jordan, Mexico, 2016)



Source: Global Food Security Index, 2016

The current correlation between GDP per capita and food security is 0.78, as illustrated in Graph 8, where Jordan belongs among countries with lower GDP and lower food security and where Mexico is obviously in better conditions than Jordan.

Graph 9 Correlation between GDP/capita and Obesity Prevalence, (Jordan, Mexico, 2016)



Source: Global Food Security Index, 2016

GDP per capita and prevalence of obesity are correlating by 0.61. According to GFSI (2016), while Mexico's position is not significantly offset, Jordan is determined as an outlier (Graph 9). Although both countries have less than average GNI, they both have significantly high percentage of obese population.

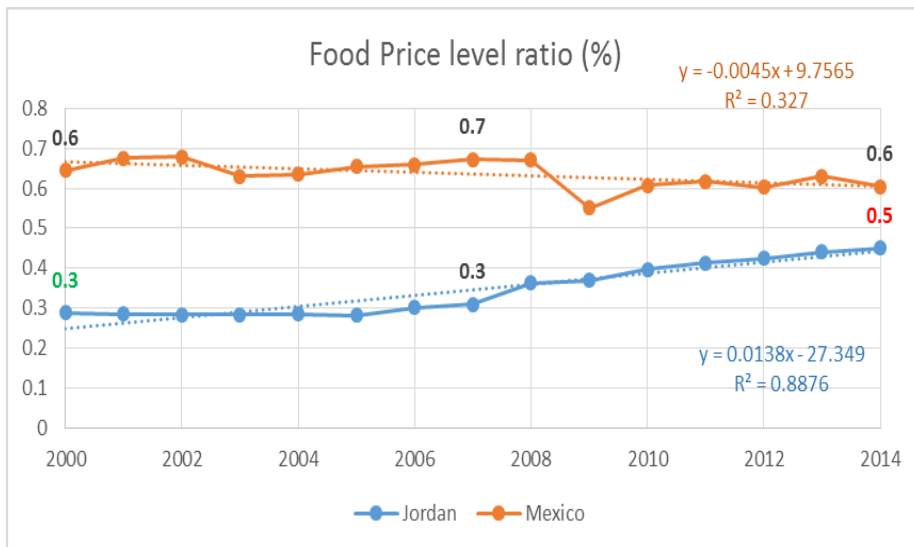
4.5.2 Level of Food Prices

Price of food is an important factor influencing the demand for food products or their substitutes. So, when the price of food goes up, the consumer decides to buy less of quantity or rather its cheaper substitute, which might lead to high-caloric food and so increase of obesity and decrease of food security.

As already mentioned in the literature review, according to Malik V.S. et al., (2012), *“trade liberalization can affect the availability of certain foods by enabling the trade of greater amounts and varieties of food, by removing barriers to foreign investment in food distribution, and through expansion of multinational food companies and fast-food chains”*. Dietary changes are driven by the increasing availability of low-cost food and drinks, which are basically low in nutritional value and high in energy/sugar. This might be the main factors influencing the decision-making of people whether to buy more expensive and healthier food or cheaper and high-caloric food.

It can be assumed that the prices of food do have an influence on growth of obesity in both, developed and developing countries. Mass-production and low-cost food production lead to higher *availability* and so higher consumption. This allows people to access different types of food and so high-calorie processed foods, especially in fast foods surprisingly mostly in developing countries such as the case of Jordan.

Graph 10 Food Price Level Ratio of PPP (2000-2014)



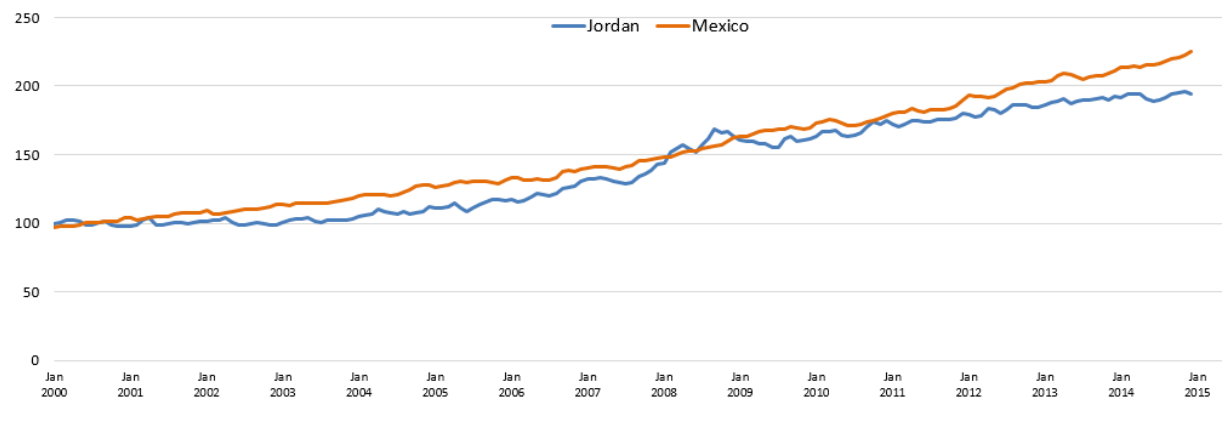
Source: author`s elaboration from World Development Indicators, 2015

Graph 10, showing the food price level ratio (2000-2014) has had only slightly increasing rate for Jordan. Comparing years 2000 and 2014, the food price level ration increased only by 0.2%. On the other hand, Mexico`s food price level ration from 2000 to 2014 changed couple of times and significantly decreased in 2009, the most probably because of economic recession by then. The reasons for increased food price level in Jordan might be demand for imported cereal commodities. Mexico`s price of food stagnation might be caused by surplus and so high export of oil products and fruits, vegetables and coffee (WHO, 2015, Supplement 2).

The globalization of food markets has resulted in the introduction of mass-produced, low-cost foods (e.g. vegetable oils) to the domestic food supply in many developing countries. These changes, including advertising campaigns, have a powerful effect on the food choices and dietary patterns of low-income households. Although many of these low-cost commercial foods are energy dense, they may be nutrient-poor

(Caballero, 2005). So, in the case of Jordan, increasing prices of food might lead to buying of cheaper high-caloric substitutes, which might be a partial cause of Jordan's high obesity level and low food security.

Graph 11 Food price inflation of Jordan and Mexico (2000-2015)



Source: Global Food Security Index, 2016

Since 1990, the prices of grocery have risen 2-3% each year. It is also obvious in the Graph 11, food price inflation of Jordan and Mexico. The causes of this inflation in world food prices are:

- A high gas prices leading to higher food prices. Food is transported great distances, which raises shipping costs and so the food prices.
- Most of the governments subsidize corn production used for bio-fuels, which takes corn out of the food supply and raises prices.
- As more people are growing more affluent, they like to eat more meat. Grains feed the animals that provide meat and so reduce the supply of grains for people and further increase price volatility (USDA, Food Price Outlook, 2016).

4.5.3 Urbanization

The clustering of populations in urban centres affects dietary patterns by changing the way that people interact with their environments in ways that transform food production and distribution systems. For example, urban living is associated with less compatible home food production and consumption, and also with limited land availability for cultivation. The positives of urbanization are that it brings infrastructure and resources such as improved transportation and refrigeration systems. Furthermore, growing foreign investment has contributed to the rise of fast food restaurants and western-style

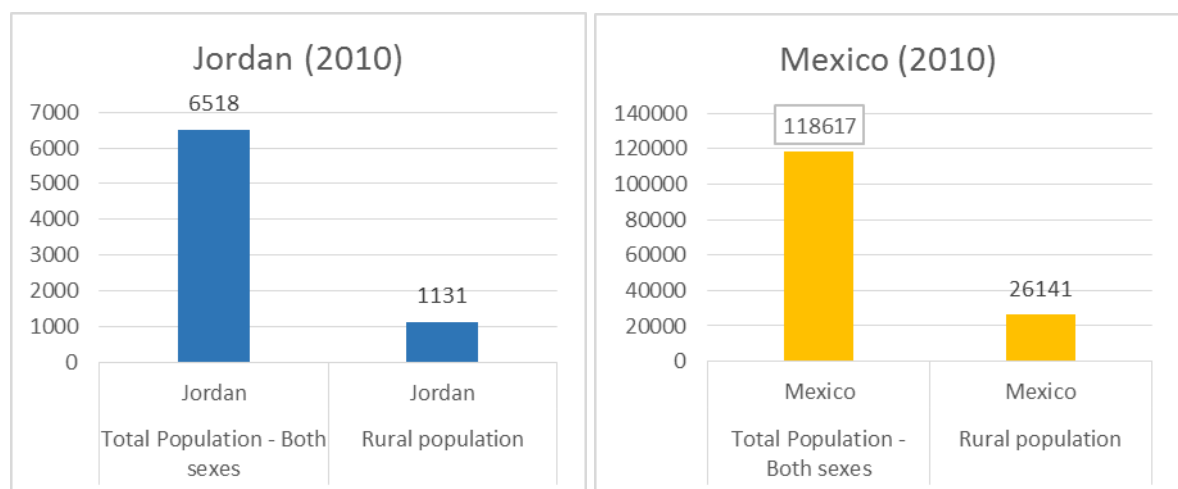
supermarkets, also influencing consumer food choices by offering greater variety, quality, convenience and competitive prices. These changes in the food environment are occurring at a rapid pace. As developing countries become more urbanized, the changes are expanding beyond large urban centres and into smaller cities and towns (Reardon et al., 2003).

Even the most of developing countries depend on agriculture, their governments economic planning often emphasize rather urban development (WFP, 2014).

Also as already mentioned in the literature review, the consequences of urban living on the development of obesity are numerous. They occur as a result of changes in the living environment of more food options available as well as through lifestyle alterations related to technological advancement. So, these changes have a direct effect on quality of diet and energy expenditure. As urbanization is going to continue, these trends of positive energy balance are expected to continue simultaneously (Malik V.S. et al., 2012).

The contribution of the urban environment to the underweight–overweight paradox will probably continue to increase, since it is predicted that most of the population growth in the next 30 years will occur in urban areas, and almost all these new urban areas will be located in developing countries (Caballero, 2005). Therefore urbanization can be assumed as third factor influencing food security and prevalence of obesity and should be reviewed.

Graph 12 Population composition of Jordan and Mexico (thousands units, 2010)



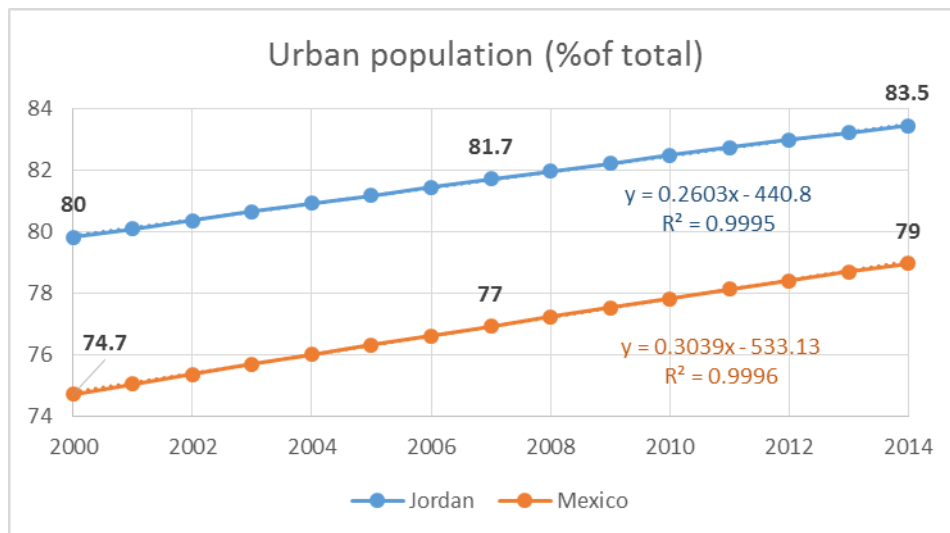
Source: author`s elaboration from FAOSTAT, 2015

Total population and rural population ratio for both countries is very similar, as shown in the Graph 12 from 2010, confirming the similar situation of overpopulated urban areas issue.

As already mentioned in literature review, the studies have shown association between food insecurity and obesity in rural areas of Ghana, Malaysia and Colombia. The food insecurity there is rather correlated with underweight than obesity (Schwartz, 2014). This statement can confirm the higher prevalence of obesity rather in urban areas than rural.

In Graph 13, an annual increase in urban population shows a higher percentage for Jordan, which might be connected with chronic high rates of poverty and unemployment mainly in rural areas. However, both countries have a very high percentage of population living in the cities, which continues to increase. Major urban area in Jordan is Amman, the capital with 1.155 million people (WHO, 2015, Supplement 1). The mostly populated areas in Mexico are Mexico city with 20.999 million people, Guadalajara, Monterrey, and Puebla (WHO, 2015, Supplement 2).

Graph 13 Urban population (2000-2014)



Source: author`s elaboration from data extracted from The World Bank, 2015

Urban food, built environments, and the new technologies that link with city living might lead to poorer diets and sedentary lifestyle. Although, urbanization makes easier access to health care, occupation and education, from which can help rein obesity rates, in many low and middle-income countries, new urban areas are simply not able to

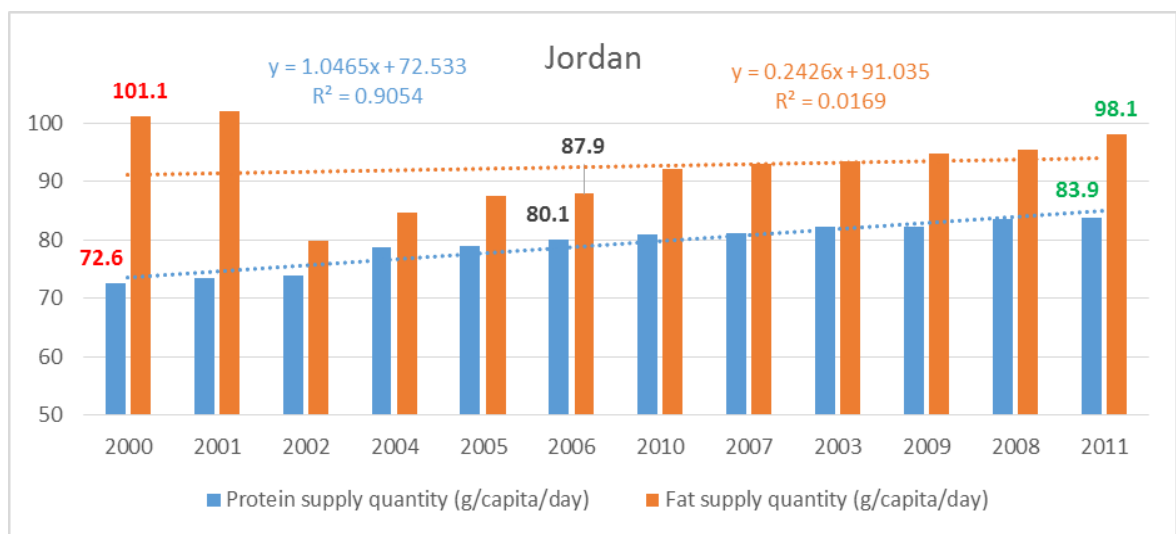
develop the health care and education infrastructure so quickly (Harvard School of Public Health (2016)).

It can be considered that increasing urbanization in both countries do have a partial influence on their low food security and high prevalence of obesity in Jordan and Mexico.

4.5.4 Fat and Protein Supply in Food

The last factor, which might influence food security and obesity together is fat and protein supply of food. In case of Jordan, Graph 14 shows the constant prevalence of fat supply quantity of food against protein supply quantity. This still higher prevalence of fat be the serious reason of such a high prevalence of obesity in Jordan. Compromising diet quality often leads to a higher intake of energy from foods that are higher in fat and carbohydrate, but lower in nutrient density. These energy-dense foods are often less expensive than foods of lower energy density or higher nutrient density, such as fruits, vegetables, and whole-grains (J Am Diet Assoc. 2007). However, comparing years 2000 and 2011, the difference between fat and protein supply decreased from 28.5 to 14.2 g/capita/day. Despite of these positive results, Jordan's prevalence of obesity keeps increasing. The main agricultural products in Jordan are citrus, tomatoes, cucumbers, olives, sheep, poultry, and dairy (WHO, 2015, Supplement 1).

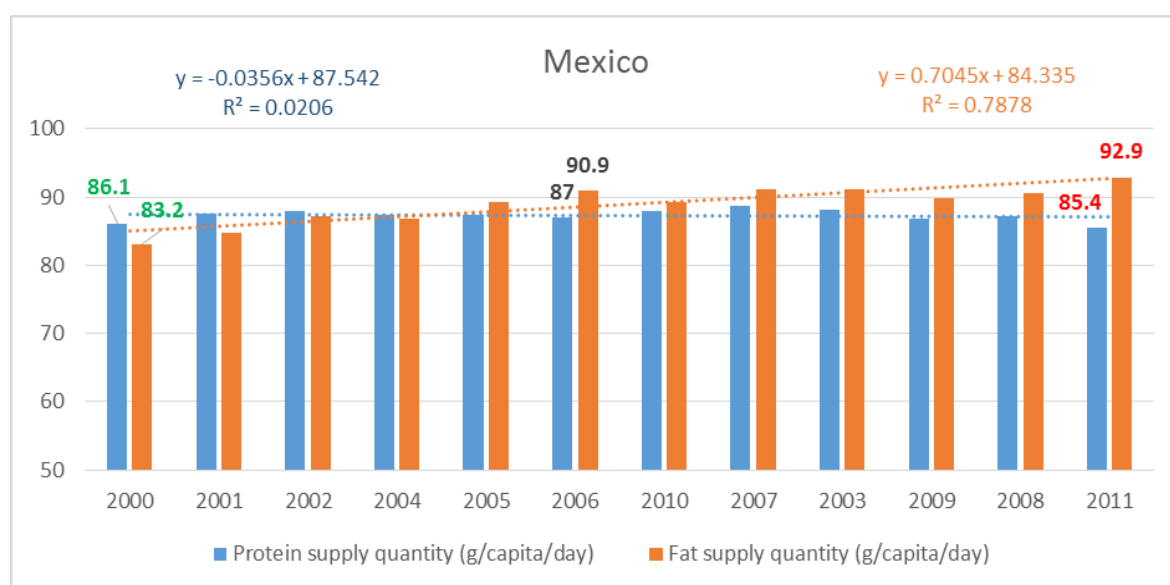
Graph 14 Fat and Protein Supply Quantity of Jordan (2000-2011)



Source: author's elaboration from FAOSTAT, 2014

Graph 15 illustrates Mexico's fat and protein supply quantity in food per capita in period 2000 – 2011. It shows different growth than in case of Jordan. In 2000, the protein supply exceeds fat supply by only 2.9g/capita/day and eventually switched the positions, where in 2011 fat supply exceeds protein supply by 7.5g/capita/day. Mexico's agricultural main products are corn, wheat, soybeans, rice, coffee, fruit, and tomatoes (WHO, 2015, Supplement 1).

Graph 15 Fat and Protein Supply Quantity of Mexico (2000-2011)



Source: author's elaboration from FAOSTAT, 2014

On the other hand, each body should contain a certain amount of fat, so called a good fat. The reasons are energy reserves for bad times, heat insulator against the cold and mechanic protection of organs and bones (Svacina, 2008).

Comparing fat and protein supply of both countries, Jordan has always had higher fat supply and lower protein supply, which makes Jordan worse-off. However, both countries are a lot worse-off comparing to the world's average fat supply, which in 2000 was 73.5 g/capita/day and in 2011 was 82.5 g/capita/day. On the other hand, protein supply world's average in 2000 was only 75 g/capita/day and in 2011, it was 80.5 g/capita/day, which makes Jordan and Mexico better-off than the world's average.

To summarize all of the mentioned macro-level factors` correlation, according to Caballero (2015), in more urbanized developing countries with middle incomes, food scarcity may not be necessarily the driving factor behind the energy intake. Instead, the availability of cheap, energy-dense foods makes it easier to consume more calories.

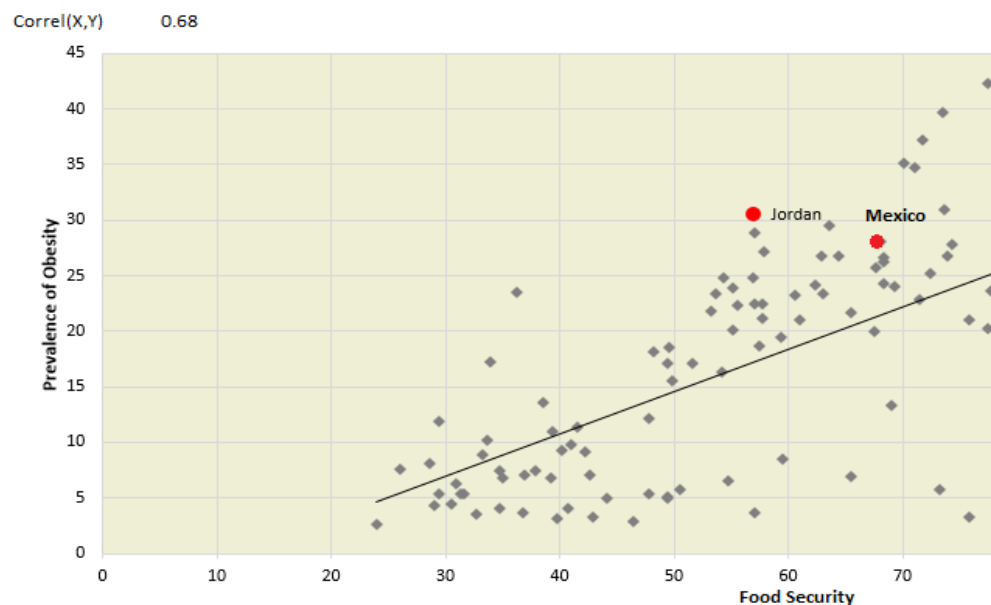
5 Results and Discussion

After reviewing all the particular factors in both countries for food security and obesity, the correlation of food security and obesity is described in this chapter and the countries' scores and figures are compared.

National data indicates that obesity is most prevalent among those at highest risk of food insecurity. The co-existence of obesity and food insecurity may sound contradictory. While links between food insecurity and low diet quality might be expected, the association between food insecurity and overweight is a paradox. This paradox has only recently started to be investigated (Burns, 2004).

The question of direction of influence remains. Most of the studies assume that food insecurity influences obesity, but in fact, it can be also assumed inversely. They both can be the risks factors of each other simultaneously. Obesity, for instance, may cause food insecurity by lowering ability to work due to individual's high weight a so shortening if income and so budget to gain more food. Obese people also require higher quantity of food which also leads to cutting the budget more (Hurst et al., 2014). Therefore, the correlation between obesity and food security (0.68) is displayed in Graph 16. From this graph, it is obvious that Mexico's food security is higher and prevalence of obesity is lower than Jordan's, which was already proven in previous chapters.

Graph 16 Obesity and Food Security correlation (2016)



Source: GFSI, 2015

The following tables are going to summarize the comparison of all of the mentioned determinants of Jordan`s and Mexico`s food security and prevalence of obesity.

Table 7 Food Security of Jordan and Mexico comparison (scores, 2016)

	Jordan	Mexico	Better-off
Overall scores	56.9	68.1	Mexico
Affordability	57.3	66.5	Mexico
Availability	58.4	67.5	Mexico
Quality and Safety	52.1	73.9	Mexico

Source: author`s elaboration summary from the previous chapters

Table 7 clearly classifies Mexico as better-off country than Jordan determining all the food security factors – affordability, availability, quality and safety.

According to Food Research and Action Center (FRAC) (2011), there are many research studies in the world providing results of co-existence of food insecurity and obesity. Other studies have found no association between food insecurity and obesity or even lower risk of obesity within the countries with high food insecurity. Overall, the most compliant evidence for a higher risk of obesity is among food insecure women. Also several other studies prove relationship among children as well. This statement may be confirmed by this thesis, summarized in Table 8.

Table 8 Prevalence of Obesity of Jordan and Mexico comparison (%)

	Jordan	Mexico	Better-off
Age (18+aged, 2014)	30.5	28.1	Mexico
Age (11+, 2011)	14.8	29.2	Jordan
Gender (18+ aged, 2014)	Males- 22.7 Females - 38.6	Males - 22.8 Females - 33.1	Jordan - males Mexico - females

Source: author`s elaboration summary from the previous chapters

Regarding prevalence of obesity, Mexico is in better condition, because its increase in obesity is slower than Jordan`s, especially in women. On the other hand, Mexico is suffering from the prevalence of obesity among children more than Jordan.

Table 9 Macro-level Factors of Jordan and Mexico comparison (%)

	Jordan	Mexico	Better-off
GNI (2000-2012)	Negative trend	Negative trend	Mexico
Prices of Food (2000-2014)	Positive trend	Stagnating trend	Mexico
Urbanization (2000-2014)	Positive trend	Positive trend	Mexico
Fat/Protein Supply in Food (2000-2011)	Fat: Negative trend Protein: Positive trend	Fat: Positive trend Protein: Negative trend	Mexico

Source: author`s elaboration summary from the previous chapters

Table 9 summarises the trend development for listed macro-level factors. During the recent 12 years period, GNI growth for both countries, for many reasons, decreased. In case of Jordan, the decrease was more rapid than in Mexico. The prices of food increased for Jordan and stagnated for Mexico, comparing the beginning and end of period 2000 and 2014. Urbanization for both, but for Jordan even more, has been recently rapidly increasing and is supposed to continue in the future. These three factors have had only negative impacts for Jordan`s and Mexico`s food security and prevalence of obesity, so far. However, at least fat and protein supply of food in Jordan have been improving recently. It cannot be said to Mexico, where the fat supply has been increasing and protein supply decreasing.

From all of these findings, it can be assumed and confirmed that even the countries with lower food security may have surprisingly higher prevalence of obesity in developing countries like Jordan and Mexico. These relationships are influenced by factors, displayed in table 9, such as GNI, price of food, urbanization and fat and protein supply.

5.1 Recommendations

The major health problems among Jordanian women are overweight and obesity. The relationship between overweight or obesity and particular diseases such as diabetes, high blood pressure or high cholesterol are well established. It is necessary to raise the awareness of the consequences of overweight and obesity and set the legislation and regulations in order to help to control and prevent overweight and obesity, particularly among women. Also a national programme with interventions preventing and controlling

obesity should be implemented. The government can get inspiration from Mexico, which according to GFSI does have a strong support, for instance, in presence of safety net programmes (100scores, Table 6).

The study of Centres for Disease Control (2008), revealed that a high percentage of people with diabetes are not diagnosed. The high prevalence of diabetes and obesity coupled with high levels of undiagnosed conditions point to the need for immediate implementation of programs to prevent and control the burden of chronic diseases in Jordan. The high rates of undiagnosed diabetes, high blood pressure, and high cholesterol will result in severe chronic disease complications.

A recommendation for Jordan is a support of Jordan's 2004 Behavioural Risk Factor Survey. Only 23.3% of obese survey participants who had visited a health care facility in 2004 were advised by a health professional to lose weight. In clinical settings, overweight and obesity should be assessed as risk factors for chronic diseases. Indeed, people who receive advice from a health professional to lose weight are more likely to attempt to do so than those who do not receive this advice. Health professionals should assess body weight and recommend weight loss (a combination of a low-calorie diet and increased physical activity) to overweight and obese patients and weight maintenance to patients of normal weight (M. Zindah et al., 2008). There should be also provided a space for women to improve their physical activities and education level by improving women rights.

Although overweight and obese people, not only in Jordan and Mexico but worldwide, need to reduce caloric intake and increase physical activity which helps lose weight and to prevent or control diabetes. In addition overweight and obese patients should be informed about the importance of achieving and maintaining a healthy weight. Workplaces should provide opportunities for employees to be physically active. Schools should offer physical education that encourages physical activity, and parents should reduce their children's television and computer time and encourage active play. Urban policy makers could also provide an environment that enables and encourages individuals to be physically active. In general, restoring physical activity to daily routines is crucial.

Since 2011, a number of OECD countries tightened their regulation of the marketing of potentially unhealthy foods and beverages to children. As part of its National Strategy, Mexico introduced new regulations to protect children from exposure to

advertising of potentially unhealthy foods. The new regulations ban the advertising of potentially unhealthy foods, on radio and TV, with exceptions of certain types of programmes (e.g. sport events) (OECD, 2014).

In 2013, Mexico has adopted one of the most comprehensive government programmes A National Strategy for the Prevention and Control of Overweight, Obesity and Diabetes. The policy rests on three pillars: improved public health and surveillance; better medical care for people with chronic diseases; regulation and fiscal measures. Mexico is also reinforcing its regulatory framework on food advertising to children, labelling of processed food, availability of food in schools and taxation of unhealthy food (OECD, 2014).

In January 2014, Mexico implemented a new tax levied at a rate of 8% on food with an energy content exceeding 275 Kcal per 100 grams, and 1 peso (EUR 0.06) per litre on sugar-sweetened beverages. In February 2015, the US government proposed food nutrition labels to revise serving sizes, display calories more prominently, and include information on added sugars. (Popkin et al., 2013, *Obesity Reviews*).

All of these preventions of obesity programmes in Mexico are too young to see any improvements yet. However they are on the right way how to potentially stop or even lower the prevalence of obesity. Jordan`s government could be inspired by all of the mentioned regulations recently implied in Mexico and imply maybe even some more of regulations, especially the ones supporting women`s and children`s physical activities.

There are many things that could be improved regarding food securities of Jordan and Mexico, for instance, too high corruption level in both countries. However, if the issue with prevalence of obesity would be at least partially solved, the food security could be improved as well, as it is confirmed that they correlated to each other, influenced by macro-level factors.

6 Conclusion

The main aim of this work was to analyse and confirm the paradox of correlation between low food security and high prevalence obesity in developing countries, using Jordan and Mexico as an examples. Additional hypothesis was: how much, if at all, do the macro-factors like income, prices of food, urbanization, fat and protein supply in the food, may influence the food security and the continuous increase of prevalence of obesity in particular countries?

The theoretical part of this thesis expresses many statements of few organizations, institutions and health specialists. It explains that food security is when the household has always an access to food. It means that it is important to be able to maintain the acquirement and utilization of food and to cope with its shocks. The main four pillars of food security are based on the affordability, availability, utilization and stability. Food insecurity may be defined as a limited or even lack of nutritious and safe food. This can lead to hunger, which is involuntarily lack of food, caused by natural disasters, wars or poor farming practices.

Although obesity has always been existing, its prevalence keeps increasing with no success of slowing down this trend. Expertly said, it is an abnormal accumulation of body fat. There are many causes like age, gender, hormones, education, habits and genetics. The most used measurement of obesity is BMI based on weight and height of individuals. However it is considered as not sufficient and reliable tool to measure obesity. Therefore the GFSI was introduced and also used tool due to ability of measuring in macro-level so the results of the whole population can be reached in the research of particular countries later on. Obesity causes a large number of diseases, such as heart disease, diabetes, high blood pressure and cholesterol, asthma, kidney stones, infertility, and many types of cancers.

Regarding relationship between food insecurity and obesity, the strongest association was found among women and children. Many researchers assume that the highest rate of obesity in developed countries is among the poorest persons with food insecurity and vice versa, in most of the developing countries, the highest rate of obesity is

among the middle-class persons, however still with food insecurity, caused by dual burden. However, the relationship between the food insecurity and obesity is complex.

More detailed findings are explained in practical part, where the hypothesis are empirically quantified. According to GFSI (2016), the food security scores for Jordan is 56.9/100 and for Mexico it is 68.1/100 and therefore meets the better food security conditions than Jordan. However, both of the countries scores are not satisfactory due to many indicators of food security determining these relatively poor conditions and so they can be considered as low food security countries. The percentage of prevalence of obesity in 2014, in Jordan is 30.5% and in Mexico 28.1%, which again gives Mexico a little less unsatisfactory conditions for healthy environment. The only worse results for Mexico is the prevalence of obesity among children with 29.2%, where Jordan has 14.8%. On the other hand, Jordan`s percentage for females prevalence of obesity is 38.6% and so higher than Mexico, for which it is 33.1%.

The macro-level factor, GNI, measured in period 2000 – 2012, has decreasing trend for both countries, however for Jordan it is more rapid decrease within this period. The prices of food, during the period 2000 – 2014, are slightly increasing for Jordan, while Mexico has the same number in the beginning of period as well as in the end. Very rapid growth trend, during period 2000 – 2014, is for urbanization factor, which is forecasted to keep growing eventually. The measures of fat and protein supply in food, during the period 2000 – 2011, very different for both countries. While surprisingly, Jordan improves its amount of fat and protein ratio in the food, Mexico increases fat supply and decreases protein supply. However, Mexico`s current fat and protein supply is still better than the Jordan`s. Generally, comparing Jordan and Mexico`s results, it was confirmed that Jordan is worse-off in every macro-level factor.

The practical part, investigating food security and prevalence of obesity proves, that Jordan has lower food security and despite that it has higher prevalence of obesity than Mexico. Also every macro-level factor, used to compare these countries, prove that Jordan`s living standards conditions are just worse than in Mexico. Therefore, it can be confirmed that there are countries meeting the situation of lower food security and higher prevalence of obesity than other countries. However, both of these developing countries are in poor conditions of food security and high obesity prevalence. Therefore, it is true

that there are developing countries suffering from both, low food security and high prevalence of obesity.

Despite of all of these findings, there are still some questions that could not be considered as completely solved. For instance, what portion of higher and lower income population participate on the prevalence of obesity? Or, is the food security and prevalence of obesity more public (governmental) or individual fault? These hypothesis can be suggested as potential researches for further investigation. Furthermore, this whole work might be a good stimulate for further studies, for instance, more countries can be analysed the same way as it is in this work to further confirm or reject the hypothesis.

Based on all of the findings, it can be assumed that the correlation between the low food security and high prevalence of obesity is empirically confirmed by using Jordan and Mexico as an examples proving the hypothesis and they can be partially influenced by macro-level factors such as GNI, prices of food, urbanization, and fat and protein supply in the food.

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8 Appendix

Supplement 1

Jordan – General Information

Population: 7.7 million (WHO, 2015)

Climate: mostly arid desert; rainy season in west (November to April)

Terrain: mostly desert plateau in east, highland area in west

Land use: agricultural land: 11.4%; arable land 2%; permanent crops 1%; permanent pasture 8.4%; forest: 1.1%; other: 87.5% (2011 est.)

Natural hazards: droughts; periodic earthquakes

Environmental current issues: limited natural freshwater resources; deforestation; overgrazing; soil erosion; desertification

Urbanization: urban population: 83.7% of total population (2015); rate of urbanization: 3.79% annual rate of change (2010-15 est.)

Major urban areas - population: AMMAN (capital) 1.155 million (2015)

Obesity - adult prevalence rate: 30.5% (WHO, 2014) country comparison to the world: 28

GDP (\$PPP): 80.5 billion (WHO, 2015).

GDP - composition, by end use: household consumption: 78.9%; government consumption: 23.1%; investment in fixed capital: 28%; investment in inventories: 0.2%; exports of goods and services: 36.8%; imports of goods and services: -67% (2015 est.)

GDP - composition, by sector of origin: agriculture: 3.8%; industry: 29.9%; services: 66.3% (2015 est.)

Agriculture - products: citrus, tomatoes, cucumbers, olives, sheep, poultry, dairy

Industries: tourism, information technology, clothing, fertilizers, phosphate mining, pharmaceuticals, petroleum refining, cement, inorganic chemicals, light manufacturing

Industrial production growth rate: 3.6% (2015 est.), country comparison to the world: 64

Labour force - by occupation: agriculture: 2%; industry: 20%; services: 78% (2013 est.)

Unemployment rate: 13% (2015 est.), country comparison to the world: 141

Budget surplus (+) or deficit (-): -6% of GDP (2015 est.), country comparison to the world: 181

Public debt: 79.2% of GDP (2015 est.), country comparison to the world: 33

Exports: \$7.882 billion (2015 est.), country comparison to the world: 97

Exports - commodities: clothing, fertilizers, potash, phosphates, vegetables, pharmaceuticals

Exports - partners: US 15.8%, Iraq 15.3%, Saudi Arabia 12.4%, India 7.8% (2014)

Imports: \$17.76 billion (2015 est.), country comparison to the world: 76

Imports - commodities: crude oil, refined petroleum products, machinery, transport equipment, iron, cereals

Imports - partners: Saudi Arabia 19.6%, China 10.5%, US 5.8%, India 5.5%, UAE 4.8% (2014)

Supplement 2

Mexico – General Information

Population: 123.8 million (WHO, 2015).

Climate: varies from tropical to desert

Terrain: high, rugged mountains; low coastal plains; high plateaus; desert

Land use: agricultural land: 54.9%; arable land 11.8%; permanent crops 1.4%; permanent pasture 41.7%; forest: 33.3%; other: 11.8% (2011 est.)

Natural hazards: tsunamis along the Pacific coast, volcanoes and destructive earthquakes in the centre and south, and hurricanes on the Pacific, Gulf of Mexico, and Caribbean coasts.

Environmental current issues: lack of clean water and deforestation national security issues; other issues: scarcity of hazardous waste disposal facilities; rural to urban migration; natural freshwater resources scarce and polluted in north, inaccessible and poor quality in centre and extreme southeast; raw sewage and industrial effluents polluting rivers in urban areas; deforestation; widespread erosion; desertification; deteriorating agricultural lands; serious air and water pollution in the national capital and urban centres along US-Mexico border; land subsidence in Valley of Mexico caused by groundwater depletion

Urbanization: urban population: 79.2% of total population (2015); rate of urbanization: 1.57% annual rate of change (2010-15 est.)

Major urban areas - population: Mexico City (capital) 20.999 million; Guadalajara 4.843 million; Monterrey 4.513 million; Puebla 2.984 million; Toluca de Lerdo 2.164 million; Tijuana 1.987 million (2015)

Obesity - adult prevalence rate: 28.1% (WHO, 2014), country comparison to the world: 23

GDP (\$PPP): 2 076.8 billion (WHO, 2015).

GDP - composition, by end use: household consumption: 67.3%; government consumption: 12.1%; investment in fixed capital: 21.2%; investment in inventories: -0.7%; exports of goods and services: 38.4%; imports of goods and services: -38.3% (2015 est.)

GDP - composition, by sector of origin: agriculture: 3.5%; industry: 34.1%; services: 62.4% (2015 est.)

Agriculture - products: corn, wheat, soybeans, rice, beans, cotton, coffee, fruit, tomatoes; beef, poultry, dairy products; wood products

Industries: food and beverages, tobacco, chemicals, iron and steel, petroleum, mining, textiles, clothing, motor vehicles, consumer durables, tourism

Industrial production growth rate: 3.3% (2015 est.), country comparison to the world: 77

Labour force: 52.81 million (2015 est.), country comparison to the world: 13

Labour force - by occupation: agriculture: 13.4%; industry: 24.1%; services: 61.9% (2011)

Unemployment rate: 4.5% (2015 est.), country comparison to the world: 45

Budget surplus (+) or deficit (-): -3.5% of GDP (2015 est.), country comparison to the world: 131

Public debt: 45.2% of GDP (2015 est.)

Exports: \$430.9 billion (2015 est.), country comparison to the world: 12

Exports - commodities: manufactured goods, oil and oil products, silver, fruits, vegetables, coffee, cotton

Exports - partners: US 80.2% (2014)

Imports: \$434.8 billion (2015 est.), country comparison to the world: 10

Imports - commodities: metalworking machines, steel mill products, agricultural machinery, electrical equipment, automobile parts for assembly and repair, aircraft, aircraft parts

Imports - partners: US 48.8%, China 16.6%, Japan 4.4% (2014)

Supplement 3

Fat and Protein Supply Quantity of Food in Jordan

Year	Protein supply quantity (g/capita/day)	Fat supply quantity (g/capita/day)	Food supply (kcal/capita/day)
2000	72.55	101.08	2727
2001	73.54	102.99	2839
2002	73.87	79.84	2938
2004	78.65	84.75	3076
2005	79.03	87.48	3080
2006	80.12	87.93	3106
2010	81.04	92.22	3114
2007	81.17	93.11	3119
2003	82.33	93.59	3122
2009	82.35	94.83	3125
2008	83.53	95.43	3149
2011	83.85	98.09	3152

Source: FAOSTAT, 2016

Supplement 4

Fat and Protein Supply Quantity of Food in Mexico

Year	Protein supply quantity (g/capita/day)	Fat supply quantity (g/capita/day)	Food supply (kcal/capita/day)
2000	86.1	83.16	3037
2001	87.67	84.85	3085
2002	87.9	87.15	3103
2004	87.37	86.89	3109
2005	87.32	89.36	3105
2006	87.06	90.91	3065
2010	88.02	89.21	3079
2007	88.65	91.14	3101
2003	88.19	91.06	3079
2009	86.87	89.76	3043
2008	87.14	90.57	3041
2011	85.44	92.91	3028

Source: FAOSTAT, 2015

Supplement 5

Food Security scores for Jordan and Mexico (2012-2016)

FS	2012	2013	2014	2015	2016
Jordan	55.6	54.8	54.9	56.9	56.9
Mexico	66.8	65.9	65.7	67.2	68.1

Source: GFSI, 2016

Supplement 6

Food Security Indicators comparison for Jordan and Mexico (2016)

	Jordan	Mexico
Nutritional standards	65.4	100
Micronutrient availability	29.5	63.4
Volatility of agricult. prod.	59	92.4
Political stability risk	22.2	55.6
Protein quality	40.9	62.1
Food safety	84.9	96.7
Sufficiency of supply	64.3	75
Agricultural infrastructure	61.1	70.4
Diet diversification	57.1	64.3
Food loss	81.8	88
GDP per capita (US\$ PPP)	6.6	11.8

Source: GFSI, 2016