REPUBLIC OF TURKEY
ANKARA UNIVERSITY
GRADUATE SCHOOL OF HEALTH SCIENCES
DEPARTMENT OF HEALTH CARE MANAGEMENT

THE RELATIONSHIP BETWEEN FOOD SECURITY AND SELECTED HEALTH RELATED INDICATORS

Seyed Mohammad MORTAZAVI

DEPARTMENT OF HEALTH CARE MANAGEMENT

MASTER'S THESIS

SUPERVISOR

Prof. Dr. Ece UĞURLUOĞLU ALDOĞAN

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Ethical Statement

Ankara University

To the Directorate of the Graduate School of Health Sciences;

The thesis titled "The Relationship between Food Security and Selected Health Related Indicators" which I prepared and presented as a master thesis, was written by me in accordance with scientific ethics and values. The idea/hypothesis of this thesis is entirely mine, as is my thesis supervisor. I conducted the research for the thesis, and all sentences and comments are mine. I declare that the information presented above is accurate.

Student's name and surname: Seyed Mohammad MORTAZAVI

Date: 17.04.2023

Signature:

Acceptance and Approval

Ankara University Graduate School of Health Sciences
Department of Health Care Management
Health Policy, Economics and Management Programme
The thesis titled “The Relationship between Food Security and Selected Health Related Indicators " prepared by Seyed Mohammad MORTAZAVI
was unanimously accepted as a MASTER THESIS by the following juries.

Thesis Defense Date: 17.04.2023

Prof. Dr. Türkan YILDIRIM
University of Health Sciences, Türkiye
Chairman of the Jury

Prof. Dr. Gülbiye YAŞAR
Ankara University

Prof. Dr. Ece UĞURLUOĞLU ALDOĞAN
Ankara University
Supervisor

The jury's decision on the thesis was approved by the Ankara University Graduate School of Health Sciences Board of Directors.

Prof. Dr. Fügen Aktan
Graduate School of Health Sciences
Director

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PREFACE

These days human development is as a purpose and the manner of national development of countries everywhere in the world. For this reason, World Health Organization enterprise's 2030 timetable for sustainable improvement outlines a transformative imaginative and prescient with 17 SDGs for social, environmental, and economic improvement. Even as SDG 2, to gain food security (FS), and SDG 3, to ensure healthy lifestyles and encourage wellbeing for everyone, regardless of age, awareness on human health, all goals are interrelated. Explaining the time "living in health and well-being" as one of the additives of human improvement, achieving the best degree of fitness, meals security and, nutrients is one of the extreme goals in public regulations across international. By definition, FS exist when "all people at all times have physical and economic access to sufficient, healthy and nutritious food to meet their nutritional needs and food preferences". Thus, get admission to adequate and desirable food and nutritional health are the principal axes of development, network health and infrastructure of future human generations. However, based on the scientific attitudes of new many years, economic and bodily get admission to enough meals for a wholesome and energetic life, as advantageous freedom, and duty for governments to ensure it as the right of society to flourish talents.

My profound gratitude goes to those who have helped me in preparing and writing this treatise. I would like to express my deepest appreciation to my thesis supervisor, Associate Prof. Ece UĞURLUOĞLU ALDOĞAN, for all her support and advice. I am also grateful to all my professors during this program, especially Prof. Dr. Gülbiye YAŞAR and Associate Prof. Çağdaş Erkan AKYUREK for all your time you spent helping me in many occasions.

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Seyed Mohammad MORTAZAVI

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SYMBOLS AND ABBREVIATIONS

ADER	Average Dietary Energy Requirement
BDN	Basic Development Needs Program
DES	Dietary Energy Supply
DHHS	Department of Health and Human Services
EIU	Economist Intelligence Unit
ER	Emergency Room
FAO	Food and Agriculture Organization of the United Nations
FI	Food Insecurity
FS	Food Security
GDP	Gross Domestic Product
GFSI	Global Food Security Index
GNI	Gross National Income
GPL	Global Poverty Line
HCR	Health Care Reform
HDI	Human Development Index
ICP	International Comparison Program
ILO	International Labor Organization
MDD	Major Depressive Disorder
MDGs	Millennium Development Goals
OECD	Organisation for Economic Co-operation and Development
PHC	Primary Health Care
SDGs	Sustainable Development Goals
SFIW	The State of Food Insecurity in the World
SUSFANS	Strengthening European Food and Nutrition Security
UHC	Universal Health Coverage
UN	United Nations
UNDP	United Nations Development Programme
UNDPI	United Nations Department of Public Information
UNICEF	United Nations International Children's Emergency Fund
USD	United States Dollar
WB	World Bank
WCED	World Commission on Environment and Development
WFP	World Food Program
WHO	World Health Organization

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1. INTRODUCTION

Food security is one of the social determinants of health. In the past decades, a lot of research has been done on the needs and conditions of human growth and development. Humans have a hierarchy of needs in which biological and physiological needs have priority over other needs. To meet higher needs, a person must be somewhat physiologically and safely undemanding, which shows the importance of food security in the health status of people (Hersey and Blanchard, 1969).

Human development and economic growth are interconnected, with food security being a key criterion for achieving both. Adequate nutrition is essential for living in health and well-being, and it is a serious goal in national and regional policies of countries. In recent decades, there has been a scientific consensus that economic and physical access to sufficient food is a basic human right and a duty for governments to provide. Food security is a fundamental human need and a cornerstone of a developed society, contributing to the mental, emotional, and physical health of its members. It is a calculated approach to solving food and nutrition problems and a framework for development planning and management (Gani and Prasad, 2007).

Food security is the cornerstone of a developed society. Food insecurity causes the fall of individuals' social capital reserves as well as the meaning of society's norms and human values, and it limits the scope of people's choice and in many cases deprives them of the right to choose and reduces their capabilities and living standards (UNDPI, 1998).

1.1. Food Security

Food security has several definitions. A background review of these definitions shows that the international attitude towards this issue has always been evolving. The history of the food security debate dates back to middle of 20th century.

Concepts such as the "right to food" were recognized in the United Nations Declaration of Human Rights and at the 1st World Food Summit. It was stated in this announcement all human beings have right for food, clothing, housing and medical care, etc., which in the field of food, this right includes adequate food, non-hunger and the ability to obtain food and improving conditions is to help develop and maintain food security (UNDPI, 1998).

Until the food crisis, the terms of food security for each country were formed with adequate grain reserves and price stabilization. Thus, in the strategy introduced by the World Food Conference in 1974, special emphasis was placed on the sustainability of food supply for food accessibility. In the definition of the Food and Agriculture Organization (FAO) of the United Nations (UN) in 1975, more emphasis was placed on food security in ensuring food supply with stable price at in the world (FAO, 2006). Whereas in 1983, the FAO analysis focused on availability of food, and the balance between supply and demand was equated with food security (FAO, 1983).

The World Bank's influential report in 1986, focused on poor conditions on the malnutrition and food insecurity. The report distinguishes among persistent malnutrition due to structural poverty and low-income levels and transient malnutrition as a result of natural disasters and economic recession (World Bank, 1986). Chronic malnutrition is a condition where people are unable to handle their basic nutritional wants in the long run. This problem can be solved by applying

some specific policies. Transient malnutrition is a condition in which there is a rapid decrease in production of food. This problem can be caused by deficit in food production, food prices, and household income, which lead to fluctuations in existence and availability of food. This type of malnutrition is generally unpredictable and occurs suddenly. Hence, planning to prevent this problem becomes difficult (FAO, 2008).

In December 1992, World Health Organization (WHO) and FAO jointly convened an International Conference on Nutrition. This was the first time in history that the issue of nutrition was discussed as the main and only topic of the summit at a major global summit. All participants signed a global pact to free the people of the world from malnutrition and hunger.

In 1996, a very comprehensive description of food security was considered, taking into account different dimensions: "All people at all times have the ability to physically and economically access sufficient amounts of healthy and nutritious foods that meet their nutritional needs and preferences for a healthy and active life (FAO, 1996).”

The above definition is widely accepted by thinkers in this field, referring to several aspects of food security:

- The availability, (the existence of sufficient food and the availability of food)
- Accessibility
- Consumption
- Stability in availability and its supply (FAO, 2006).

The concept of "food availability" includes the production of food across national borders (domestic supply) and the import of food. The concept of "access to and use of food" is the accessibility and use of resources to provide the food items needed by society so that the food and nutrition system operates in such a way that there is no fear of shortage of it. Access and use of food is important to create dynamic participatory environment. Undoubtedly, many factors endanger the access

of people and households to food in the country, such as high inflation, high unemployment, percentage of population below the poverty line, unbalanced income distribution, interest rates, chemical fertilizer prices, the cost of irrigation services and rising world food prices. The above factors, along with shortcomings in the transportation system, low efficiency of the distribution network, weak quality control system and food standards can endanger people's access to food in any country. "Sustainability in food intake" means stability and sustainability in receiving nutritional values needed by society. Food security not only requires adequate food supply at the macro level, but also oversees the fair distribution of food for all to achieve (Fosu, 1993).

Other discriptions of food scurity:

I. Access to enough supply of basic food at any times to maintain sustainable food consumption and compensate for changes in costs and producing of agricultural products (UN, 1975).
II. Ensuring that all individuals have physical and economic access to essential nutrients any times (FAO, 1983).
III. Access to sufficient food at any times to have a healthy and active life (World Bank, 1986).
IV. Conditions in which the country's food system operates efficiently and there is no fear of insufficient food shortage (Maxwell, 1988).
V. Food security is provided when individuals in a community consume at least 80% of the average daily calories calculated by the WHO (Reardon and Matlon, 1989).

In addition to the cases mentioned in recent years, scientists' researches show that the advancement of technology and the increase in usage of pesticides, additives, and antibiotics have harmful effects on human health, which clearly shows the importance of food safety. The description of food safety is ensuring that the food consumed by the people of the community is healthy and exempt of any pollution. This contamination can include microbial, parasitic, or chemical contamination (Becker and Lister, 2010).

According to the above definition of food security concepts, over time and changing conditions, due to changing levels of analysis in this area, change over time. Maxwell (1996) categorizes changes in the level of analysis as follows:

I. Changing from the macro level to the micro level.
II. Changing from emphasizing the dimension of access to food to the dimension of living.

III. Changing from objective indicators to mental indicators and changing the tools of judging about food security from general and quantitative indicators to undocumented evidence, based on people's feelings and perceptions of their food security situation (Frankenberger, 1992).

In the descriptions of food security, the balance of its supply and demand is of particular importance. As it gets closer to the definitions of recent times, the demand and consumption side of food becomes weightier and more central. To warrant of food security in a social system, organizations and institutions must cooperate and coordinate with an organization in charge of food security to monitor the production or import of food materials and products, education and advertising, and public awareness and macroeconomic policies (Sen, 1981; Sen, 1986; FAO/WHO, 1992; Sen, 1997).

Sen (1981) emphasizes accessibility, vulnerability, and sustainability in defining food security. Sen's Entitlement Approach states that there is a potential for increased hunger and food insecurity, even as the food-to-population ratio is increasing. This is because the supply and distribution of food is not fair. Each person's entitlement is to have a basket of different goods that can be obtained through various legal channels of supply of goods, in exchange for the supply of labor or assets owned by them. For someone who only owns their own workforce, the basket of goods that can be available is determined by the exchange space of entitlement or wages and the price of goods in the market. So that reducing wages and increasing the price of goods means reducing entitlement and thus increasing food insecurity, which harms the ability and capacity of the individual in the socio-

economic system. By introducing the concepts of entitlement, entitlement exchange space, and capability, Sen emphasizes a set of deep-rooted factors that affect beyond the basic concepts of food security (Sen, 1981; Sen, 1986).

At the International Nutrition Conference (December 1992), food security and related issues were developed as a theory for the first time. The conference was organized by various UN agencies, including FAO, WHO and United Nations International Children's Emergency Fund (UNICEF), with the active participation of more than 160 countries under the slogan "Food, Health and Life". According to the report of FAO/WHO International Conference in 1992, food security has three dimensions: ensuring enough food supply at each level, an appropriate level of sustainability of food supply each year. Every household should have access to the amount of food (FAO/WHO, 1992).

Sen (1997) argues that for a deeper perception of food security, one does not simply consider to food supply and for avoiding misinterpretation of Malthusian theory based on the threat of increasing population in reducing food supply, concentrate on food demand and various factors that affect the entitlement and capacity of individuals to have food. These factors are as follows:

a) Dependence between consumption and income.
b) Dependencies between separate sectors, such as the relationship between labor purchasing power affected by job opportunities and real wages, and access to food.
c) Dependence between different countries that provide the conditions for food import and export.
d) Dependence between food security and political and economic stability of a country.
e) Dependence between food security and the fair distribution of food among the members of a household.
f) Dependence between women's education and fertility decline.
g) Dependence between food security and political motives. Famine and food security problems are usually less likely to occur in countries with a

democratic political orientation.

h) Dependence between wars, military spending, and economic sanctions.
i) The relationship between childhood malnutrition and its effects on the health and skills of the individual and society (Sen, 1997).

Based on the definitions of food security the main concepts of food security are:

I. Adequate food

The adequate food is provision of significant foods for all people. The World Bank also defines adequate food as providing a standard life for the general public.

Food frequency includes the following:

a) Satisfactory level of production and product growth
b) Stability and growth of products
c) Stability in the supply of materials, including the existence of minimum fluctuations in production and supply every year. It is worth noting that these definitions refer to food as a qualitative thing; a calorie unit is used to quantify and assess nutritional adequacy (Nord et al., 2003).

II. Food access

On based of the definitions mentioned for food security, we know that access to food is considered from two different aspects: "physical access and economic access".

- Practical and balanced access to food, everywhere and for all families
- Economic access to food so that all families can get it at the usual prices and to the best of their ability
- The availability of food in families for all age groups, sex, and income levels
- People have access to special diets and easy food supply (FAO, 2006).

The term of access is regard to the assumption that food security is provided as long as a family has enough needed food. To get this target, on the one hand, the family must have a close and easy connection with the food distribution network in the place of residence (physical access) and in addition, the household income or expenses must be sufficient to prepare and buy the necessary food without much pressure (economic access). Access is defined at different levels, with several determinants at each level (FAO, 2006).

According to the term of accessibility, it can be divided into two types, chronic and transient:

a) Chronic food security

It is a flow of food insufficiency. The impact on families is such that households are deeply incapable of buying food to meet their needs. The root of this problem is poverty.

b) Transient food security

The transient type of insecurity is the temporary access of households to food, which can result from price, income, or food production fluctuations (Flores, 2004).

In addition to affecting physical health, food insecurity and hunger can have adverse effects. So, providing it for people is one of the vital objects of socio-economic development planning. Although it has different aspects, but in a general view, this concept is also considered as an indicator for measuring sustainable development, which itself is based on data and other indicators such as poverty, nutrition, employment, agricultural and food production, income, self-reliance, consumption, and foreign trade are formed. Changes in these indicators have a comprehensive influence on the different aspects of social and political life of society (FAO, 2006).

III. Food insecurity

Food insecurity is the restriction or uncertain access to adequate nutritional factors and adequate food, or the restriction or uncertain access to acceptable food in the community through conventional methods (Andersen, 1990).

IV. Hunger

Feeling uncomfortable or painful due to shortage and involuntary access to food. Therefore, any intentional under-eating of food (for example to lose weight) is not considered hunger (Andersen, 1990).

1.1.1. Food Security Measuring Indicators

Food security measurement indicators show food security indirectly by measuring behaviors related to food consumption, which are mentioned below (EIU, 2022):

I. Prevalence of poverty:

Poverty in economic-cultural and social dimensions is the cause of food insecurity and from the perspective that poverty of information about the ratio of families to the population whose income do not meet their food needs is directly related to food insecurity (Vientiane, 2005).

II. Low family income

This index is a measure of the ability of families to earn a living when income is low will certainly lead to food insecurity.

III. The ratio of expenses to income of each family

When a family's expenses exceed its income, FI is happened (Riley et al., 1999).

IV. The ratio of its expenses to the expenses of the whole family

When a family pays more for food than for other household needs,

V. The ratio of grain expenses to total food expenses

Whenever the consumption of cereals in the food basket of families increases, it indicates that the family will suffer from food insecurity.

VI. The ratio of households with availability of safe water

Lack of availability of safe water causes disease that is directly related to food insecurity.

VII. Percentage of leased agricultural land

Families and individuals who rent land to grow and produce crops have a clear influence on FI due to the loss of some of their income, especially in rural areas.

VIII. Unemployment rate:

This index causes income to fall and the ratio of food expenditure to total income to rise, indicating food insecurity.

IX. Survival rates of different groups:

Survival rate is an indicator of academic performance and measures the level of education in society, and if education is stopped in society, it prevents a person from earning a decent income, which is ultimately related to food insecurity.

X. Salary index:

This indicator is measured in terms of poverty and is estimated from poverty.

XI. Income ratio

The more unbalanced the revenue of the society, the higher the level of food insecurity.

XII. Child mortality rates

The more dead children under the age of one are in the community and the proportion is higher than normal, the worse conditions of the mother and kids.

XIII. Spread of weight loss among children under 5

The high spread of weight loss among children and adults indicates food poverty and food insecurity.

XIV. Spread of short stature among kids under 5

This indicator also shows the lack of nutrient consumption and its relationship with food insecurity.

In the following, it is explained the five general indicators of food security measurement announced by the FAO in 2003 (FAO, 2003).

a. The first indicator, which can be called malnutrition, is usually measured by the FAO. This method is done by estimating the per capita energy supply related to the diet derived from the total food supply statistics. Hypotheses refer to distribute of this supply in households, which is defined according to the distribution of consumption, or other elements. The percentage of malnourished people to the all is determined by the part that is below the least energy required (Naiken, 2003). This FAO scale is helpful for comparison between nations or over time.

b. The second group of factors is called food absorption, the amount of food that is actually consumed by individuals or households. Indexes at the individual base can be calculated by assessing the actual food absorption by specific methods. Food uptake estimates are unavailable and costly to calculate. For this reason, food intake is always indirectly estimated by household surveys. Estimates at the household level in general, and multifunctional household estimates in particular, are used not only for food security but also for access to living standards. Statistics at the family level could be considered to evaluate the number of people in food insecurity, such as lack of food energy and low quality of food (Naiken, 2003).

c. The third method for diagnosing dietary shortage is to rate food intake by nutritional status. In which the condition of children in terms of physical health, usually in random samples and in different countries is examined. Measurement of physical characteristics is well used as a conclusion indicator for diagnosis and evaluation and can be used in conjunction with economic and social information to analyze the factors affecting

malnutrition. Achieving physical characteristics is, however, an indeterminate indicator, as it is not only achieved through food absorption but is also influenced by factors such as health, well-being, and efforts to support children. This indicator does not show food insecurity in family level that appear to be in the food security group, for example, while household rules cause an unequal distribution of food resources within the household and cause problems for both internal and external measurement methods. For example, when a household member (for instance, the head) is accountable, his or her responses may be based on his or her position and may be different for other household members. Thus nutritional status, accessible only to children, has limited power to explain food security in a large population (Dercon, 2001).

d. In the fourth method, food access is the amount of food provided by individuals or families who are unable to provide food due to their poverty. The next group of factors is related to accessibility of food, which can be evaluated by cost and income. Indicators of availability of to food, and specifically income, are used as essential indicators of food security in many nations. The relation of availability and certain fund is broken when domestic markets are inefficient - in cases such as natural disasters (Dercon, 2001).

e. Lastly, the fifth method is related to the fact that even if families are not malnourished now, they are in danger during future deprivations. Vulnerability is a vague term that is expressed by the entry of damage and its future consequences. Because vulnerability determines the condition of the globe in future and it will be difficult to measure vulnerability alone if we do not have information priorities (Dercon, 2001).

Vulnerability is measured in terms of qualitative or personal estimates of insecurity about food. All aspects are hard to distinguish from past quantitative measurement methods. Families may find themselves starving, even if they do not have obvious signs of malnutrition. Even if families are not malnourished now, they

will be at risk of deprivation in future. Other methods of measuring vulnerability to food deprivation through family surveys contain of the amount of income paid for food and other indicators (Guha-Khasnobis et al., 2007).

1.1.2. Factors affecting food security

The concept of food security is wide and involved with area of economic, agricultural, social, biological and physical elements. Food security needs enough supply of food at the macro level and equitable distribution to be achievable for all people.

Malnutrition among individuals in a society leads to the loss of large sums of national income. A small calculation of the costs incurred in this regard is necessary to rationally justify why a reasonable portion of the available resources should be allocated to the fight against malnutrition. Due to the limited economic resources of third world countries, the negative effects of malnutrition on the quality of life of individuals and also its complex effect on national production and socio-economic development is one of the important issues in these countries (Gupta, 1994).

In the world we are facing, food production is such that all six and a half billion inhabitants can always be full and enjoy the standard amount of food energy consumption. Unfortunately, at least 31 million people die of starvation each year alone. The answer to why these unfortunate pains can be found in different concepts (Gupta, 1994).

Civil wars and conflicts have been closely linked to food insecurity in developing countries (FAO, 2002). It is noteworthy, for example, that war and civil strife were the main reason for the urgent need for food aid in 15 countries in 2001 and 2002. Perhaps the reason for this impact is the huge damage that these conflicts are inflicting on the agricultural sector and the economy in general.

Studies conducted by Zhao in 1991 consider the essential determinatives of food security to be the growth rate, especially in agriculture and food production. Also, the results of his calculations show that price changes have negative effects on food security. Rapid population growth, famine and drought widen the dimensions of food insecurity. Many factors directly or indirectly contribute to malnutrition, hunger. The most important of these are: low production efficiency, household income problems, food waste, low literacy and low public awareness, poor eating habits, lack of access to water (healthy drinking and increasing urbanization along with Socio-economic changes.

In this field, several research have been done. Nutritional assessment studies focus more on estimating the connection between calorie consumption and income as an indicator of food security. (Rose, 1999).

Ravallion (1990) estimated the revenue elasticity for Indonesia at close to zero in 1990 and also, Skoufias (2001) examined the sensitivity of caloric income elasticity to cost changes in this country. In contrast, Strauss's estimate in Sri Lanka in 1984 was 0.82 (Strauss, 1984). Behrman et al. (1997) estimated the calorie-wage elasticity for Pakistan using panel data and estimated it at around 0.61. Dawson and Tiffin (1998) also estimated caloric demand for India in 1998 using the auto regression technique.

Behrman and Deolalikar (1987) have studied the revenue flexibility of calorie consumption for this country to be close to zero. The survey of Chinese economy in 2001 shows that the most important factors influencing food security are: prices, incomes, and demographic characteristics (Ewing, 2001). In 1998, Diagne presented a model involving more than ninety variables, examining the effects of exogenous variables on household food security. He considers prices, population characteristics, assets, community specifics, interest rates and other financial market variables, access to credit, per capita arable land, and per capita income from agricultural activities, development indicators, per capita consumption expenditures, education, per capita business centers and such factors as factors affecting food security (Diagne, 1998).

Social policies and macroeconomic factors affect changes in prices, wages, employment, and services, each of which can affect household resources for food security. In the mid-1970s, for example, Johnson argues that it related to stockpiles, production and agricultural policies. Particularly, the globalization is an vital factor in the period of food shortage as in the period of massive food supply (Johnson, 1976). Elamin et al. in a research paper on food security and commercialization of the economy in Sudan identified the factors affecting food security as labor, credit, agricultural land, rainfall, education index, labor force index, credit. (Elamin et al, 2004).

Although economic and income factors are essential for determination of food security, cultural and social items also effect the allocation of resources in the household, food budgeting and nutrition pattern. In other words, a significant group of society, despite having accessability to food, adopts inappropriate behaviors and food choices that are rooted in socio-cultural factors such as the level of literacy of the parent of the family, employment status and Socially depends on the supervisor and generally socio-cultural status. Barrett and Minten in 2007 considered the most vital items influence the level of FS as the revenue, employment, foreign trade and a set of other external factors (Barrett and Minten, 2007).

A 1999 study by Ruel and Garrett also identified food security determinants in Mozambique as assets, prices, demographic characteristics, and a set of exogenous variables including per capita consumption expenditure, level of education, per capita arable land, urban rural migration rate, household size, level of agricultural production, and livestock variables (Ruel and Garrett, 1999).

1.2. Health

Following the growing concerns of various countries about the development process, rapid population growth, rapid destruction and depletion of resources, increasing poverty and disruption of natural life cycles on Earth during the 70s and

80s, health concerns and Its severe effects on the economies and development of countries, especially developing countries, have been increasing to the point that many WHO experts have acknowledged the ineffectiveness of health-oriented approaches in the subject of health and considered a reversal of these attitudes inevitable (Priorities: Health for all, 2018).

The combination of these concerns eventually led to a change in attitudes toward health in the late 1970s, and in May 1977, at the end of the 30th Health Summit, held in 134 in the former Soviet Union of Almaty with the participation of 134 countries. "Health for All by the Year 2000" was proclaimed: The most important social aim of WHO and governments of countries in the future must be to achieve a level of health by which their lives, economically and be social, productive and useful (WHO, 2019).

One of the most important historical events in this development is the decision of the United Nations to adopt the primary care method to achieve various goals, including the realization of justice in public access to Primary Health Care (PHC) services (WHO, 2016).

1.2.1. Historical Developments of Primary Health Care

The official statement of the Thirtieth World Health Assembly in 1977, known as the Almaty Declaration, stated that governments should enabled societies to enjoy an effective and productive life. In 1978, the Health Care Conference was held in Almaty, the capital of the Republic of Kazakhstan, and the approach to health was introduced for all primary health care providers. In May 1979, the strategy was adopted by the Thirty-second Session of the WHO, and representatives of member states agreed to formulate and implement national health strategies for all based on their health care.

In 1981, the WHO completed the Health for All (HFA) World Strategy. The global strategy has provided a global framework that its implementation by all

member states is appropriate and flexible enough to adapt to countries' different conditions and needs. Subsequently, each member state developed its own strategy for achieving HFA (WHO, 2019).

1.2.2. Health for all: Goals, Strategic Principles and Indicators

Health is not a single and limited goal for everyone, but a process that leads to the continuous improvement of people's health. Health for all does not mean that in the coming years no one will be sick and disabled anymore and the medical team will provide medical care for every single person in the world and their ailments. Rather, it means that health will be established and wherever people live and work, health services will be available and people will have better opportunities to grow and reach a healthy and active old age. Also, individuals and families will have access to basic health care in an acceptable manner and commensurate with their ability and participation (WHO, 2019).

1.2.2.1. The Goal of Health for All Policies

The purpose of health for all people is based on several policies, including the belief that health is a basic human right and a social responsibility of governments worldwide. The goal is to reduce the gap in health statuses among people globally, and achieve equitable distribution of health facilities so that everyone has access to healthcare and support services. Individuals and groups should also have a role in shaping their own healthcare, and coordination and cooperation across sectors such as agriculture, education, and social affairs is necessary for successful implementation. Governments must provide adequate social and health facilities, and technical and economic cooperation between countries is vital for improving and implementing health strategies for all. Overall, political commitment, coordination, and cooperation are essential for achieving health for all (WHO, 2019).

1.2.3. Global Indicators for Health Monitoring and Evaluation for All

Health monitoring and evaluation are very important for improving health outcomes, optimal resource allocation, clear communication, accountability, learning and improvement and transparency of health programs. In the following, its global indicators will be discussed (WHO, 2017):

I. Health policy for all must be approved at the highest administrative level in countries. For example, the country's top officials in an official statement announced the country's commitment to health for all, so that the facilities are adequately and fairly distributed. Ensure the cooperation in the programs and provide the appropriate structure along with proper management for the development of the country's health.

II. At least 5% of Gross National Products should be spent on health.

III. Necessary measures have been taken and implemented to attract the participation of the individuals in the implementation of the health strategy for all. In other words, the necessary conditions have been provided to address the real wants and needs of the people, the policy of decentralization in decision-making has been realized and the representatives of various groups and organizations in health programs Participate such as women's organizations, trade unions, etc.

IV. An acceptable percentage of the country's health budget should be spent on local health services. This means that in order to provide care in the first level of contact with the community (health house, city health centers, rural and urban health centers) to be used.

V. Fair distributions of health resources and facilities for urban and rural areas.

VI. Health strategies for all for the country have been prepared, compiled and published and the necessary facilities have been provided for the implementation of the program.

VII. Members of the community should have access to primary health care, including the following:

a. Safe water at home or within walking distance of 15 minutes.

b. Immunization of children against six infectious diseases of childhood (diphtheria, tetanus, pertussis, measles, polio and tuberculosis)

c. On-site healthcare includes access to at least 20 essential medicines with an hour's walk or use of a vehicle.

d. Existence of trained staff for care of pregnancy, childbirth and child care for at least one year.

VIII. The children's nutritional condition, which is measured by the following criteria:

a. At least 90% of infants weigh more than 2,500 grams at birth

b. At least 90% of children are of appropriate weight for their age.

IX. Reduce the mortality of children less than one year to less than 50 per thousand.

X. Increase life expectancy at birth to more than 60 years

XI. Reaching literacy for women and men to more than 70% of the total population

XII. Increasing the per capita population of the society from the gross national product to more than $ 500 per year.

1.2.4. Definition of Primary Health Care

These isues are an essential section of the health system for developing a country. The first step of contact of the individual, family and society with the country's health system and takes services is primary health care as far as possibility for people at work and live. The purpose of providing these cares is improvements of people's health in the community and nowadays it is emphasized that health services should cover the full range of prevention, treatment and rehabilitation services. Philosophical and strategic aspects for it are mentioned bellow (WHO, 2016)

Primary health care has a philosophical aspect because, by definition, health

includes comprehensiveness and, in addition to health care, includes the integration and coordination of the major socio-economic parts of society, namely agriculture and animal husbandry, labor, housing, work, education, and communications. On the other hand, it relies on the participation of the people and wants to turn the basic needs of health into the demands of society. In addition, it ensures the fair distribution of social resources among the classes of people, especially the deprived classes of society, because it wants to bring health facilities as close as possible to the place of work and life of the people (WHO, 2016).

On the other hand, PHC has a strategic aspect. Primary health care recognizes health as an axis of development that should always be a priority in the overall development investments of society. The supply of it begins at the first step of community relation with the country's health system as a coordinated and integrated service and develops its comprehensiveness at the next levels, and also it requires the participation of the people in all stages of planning, implementation and monitoring. By leveling the services and through the referral system as well as using appropriate technology in accordance with local traditions and facilities, it makes these services available to everyone at the lowest price that communities and governments can afford. On the other hand, in order to achieve its goals, it needs a proper health system that makes it possible to achieve these goals, and this system must improve itself by conducting applied research and be receptive to the necessary changes for each stage.

1.2.5. Principles of Primary Health Care

In order to provide primary health care, the following principles should be considered (WHO, 2016):

1- Inter-sectorial Approach: Health is not available as single and is affected by different elements which they're intimately connected. Therefore, different sections of society that affect people's health should make a coordinated effort.

2- Community Participation: Without people's interest in presenting and developing services, no success is anticipated for it as “health by the people” and “putting people's health in their own hands”. In this way, health is a spontaneous approach that should be expand by people, and beside to the health sector, society should be involved in their caring. In addition, communities should participate in:

   a. Creating and maintaining a hygienic environment
   b. Active retention of preventive and promotional health
   c. Providing information about demands and needs of high-level managers
   d. Providing health care priorities and administering patients and clinics.

3- Appropriate Methods: Not only in primary health care, but also at all levels of health care, methods, tools, personnel, medicine, materials and even appropriate administrative system should be used in accordance with the conditions of the society. In providing services to the people, methods should be used that are in line with the culture of the community. Also use tools and personnel that are in line with working conditions. Therefore, appropriate technology is a combination of both the needs of health care and the socio-economic context of the society. The issue includes the following considerations:

   a. Costs (both capital costs and current costs)
   b. Efficiency and effectiveness of technology to deal with health problems
   c. The aim of the approach is acceptable to society and the health care providers
   d. Sustainability approach, including equipment maintenance capacity

   In addition, service providers at different levels must be trained to use the most appropriate and cost-effective methods and tools.

4- Equity: Health resources and related services should be made available

equally to all members of the community, and people with the same needs should have adequate health care accessibility. To ensure equal access, there should be more distribution and coverage of basic health care in the areas where there is the greatest need.

5- Comprehensiveness of Services: Basic health care is a comprehensive issue regards to the following interventions:

   a. Promotional interventions: The treatment of basic health care at the society level with the underlying reasons that affect health.

   b. Preventive interventions: These could be reducing the outbreak of diseases or deal with the reasons that have caused the person problems.

   c. Therapeutic interventions: These interventions decrease the prevalence of the problem by stopping the progression of it in the patient.

   d. Rehabilitation interventions: These interventions shorten the outcome or complications related to health problems.

The above approach should be supported by the community because it has a great impact on improving the health of individuals.

A comprehensive approach to primary health care requires staff that can provide solutions to health problems. For example, oral fluid therapy alone is not enough for a child with diarrhea. Maintaining a child's health requires educating the family on how to care for Child and environmental health and improving nutrition.

In addition to counseling on breastfeeding, growth monitoring, nutritional rehabilitation, and care, the care plan should include feeding the baby after the return of breastfeeding with locally available foods (WHO, 2019).

Primary health care services for healthy people (such as prenatal care, vaccinations, health education) should be established in the community as soon as

possible (Table 1.1) (WHO, 2016).

Table 1.1. Framework of primary care services in dealing with health related problems

Intervention in the disease	Promotional intervention	Preventive intervention	Therapeutic intervention	Rehabilitation intervention
Diarrhea	healthy water Public health Food security Health Education Child care	Personal health education Breastfeeding Vaccination	Oral fluid therapy Nutritional support (Drug treatment if needed)	Nutritional rehabilitation Oral fluid therapy
Pneumonia	Proper nutrition Suitable housing Clean air Health Education	Vaccination Breastfeeding Vitamin A supplement	Drug treatment	Nutritional rehabilitation
Measles	Proper nutrition Proper home ventilation Health Education	Vaccination	Drug treatment Nutritional support	Nutritional rehabilitation
Malaria	Proper nutrition Disease vector control Health Education	Use a mosquito net Drug prevention	Drug treatment	Nutritional rehabilitation
Anemia	Proper nutrition Disease vector control (noise) Health Education	Screening patients Prevention with iron and folic acid Degreasing	Nutritional supplement Blood transfusion Nutritional support	Nutritional rehabilitation (High-iron diet)
Tuberculosis	Proper nutrition Proper home ventilation Health Education	Vaccination No-contact with the patient	Drug treatment Family counseling Nutritional support	Social integration

Source: http://www.who.int/primary-health/en

1.2.6. Primary health care components

It should be noted that the eight activities that will be mentioned below are the minimum applicable measures for all communities and each community should plan and implement based on its needs and priorities to prepare services to the requirement of the people (WHO, 2016).

a. Health education including education on common health problems, prevention, and disease control methods.
b. Improve nutrition

c. Accessibility of drinkable water and improvement of the environment
d. Maternal and child health and birth spacing
e. Vaccination against infectious diseases transmitted in childhood
f. Control and Prevention of Infectious Diseases (Local Endemic Infectious Diseases)
g. Remedy of popular illnesses and injuries
h. Access to necessary medicines

With the beginning of the new millennium, the most important international consensus on health development was reached by 191 countries, under the title of the 2000 United Nations Millennium Declaration. The summit set out the Millennium Development Goals (MDG_S) to improve the health of poors around the world and to take positive steps to improve living conditions. According to the Millennium Declaration, eight MDG_S are binding on nations. To fight against poverty, illiteracy, hunger, lack of access to education facilities, gender inequality, child and maternal mortality, diseases and environmental destruction, join hands and take action and try to be more coordinated than before. From these eight ideals, 3 ideals are directly related to human health and the other 5 ideals are closely related to it. This indicates that maintaining and promoting health is now a basic global need, and programs related to the sustainable development of countries must be coordinated with ensuring the health of individuals in society (WHO, 2004).

1.2.7. Health Achievements Based on Millennium Development Goals

The Millennium Development Goals (MDGs) were eight international development goals established by the UN in the year 2000. These goals were set to tackle poverty, hunger, disease, and gender inequality around the world by 2015 (WHO, 2004).

Only one of the MDGs was specifically related to food security; MDG 1: Eradicate extreme poverty and hunger. According to this goal, one of the goals was to halve the proportion of people suffering from hunger between 1990 and 2015. The goal was to reduce the number of undernourished people in the world, improve

food security and promote sustainable agriculture. While this MDG did not focus solely on food security, it recognized the essential role of adequate food and nutrition in eradicating poverty and achieving sustainable development.

On the other hand, three of the eight MDGs were specifically related to health; MDG 4: Reduce child mortality, MDG 5: Improve maternal health, MDG 6: Combat HIV/AIDS, malaria, and other diseases. Several targets were set under each of these health-related MDGs, such as reducing child mortality by two-thirds, reducing the maternal mortality ratio by three-quarters, and halting and reversing the spread of HIV/AIDS (WHO, 2017).

The MDGs were successful in driving global action and progress towards these health targets, although not all of the goals were fully achieved by the deadline of 2015. In 2015, the UN replaced the MDGs with a new set of development goals called the Sustainable Development Goals (SDGs), which include health-related targets such as universal health coverage and ending the epidemics of AIDS, tuberculosis, and malaria. In the following, each of the 8 goals of the MDGs is briefly explained (WHO, 2004; WHO, 2017; WHO, 2018b):

I. MDG 1: Eradicate excessive hunger and poverty
   - Intense poor conditions have decreased dramatically in past 20 years. In 1990, %50 of the people in low-income areas lived daily on about $ 1, down from %14 in 2015.
   - Globally, intense poverty has decreased more than 50% from 1.9 billion in 1990 to 836 million person in 2015; most progress was made in 2000.
   - The average workers with $ 4 a day income increased 3 times from 1991 to 2015.
   - Since 1990, the ratio of malnourished people in low-income areas has been reduced by 50%.

II. MDG 2: Public access to primary education
   - The net elementary school enrollment in low-income areas has risen about 8% from 2000 to 2015.

- The number of children at the age of elementary school who do not attend class has about halved globally, from 2000 to 2015.
- Since the consideration of the Millennium Development targets, Africa had the best improvement in primary education of all regions. Compared to 8% between 1990 and 2000.
- The rates of literacy between 15- to 24-year-olds worldwide riches to 91 percent in 2015 from 83 percent in 1990. The gap is very low among men and women.

III. MDG 3: Improve gender equality and women's empowerment

- Compared to the past, girls are attended school now. Developing areas in general have achieved the goal of gender equality in different level of education.
- In South Asia, about 70% of enrolled students in 1990 were girls in elementary school. Today, girls register more than boys about 3%.
- Currently, about 40% of wage workers in different sectors except agriculture are women,6% growth from 1990.
- From 1991 to 2015, the percentage of women working in tough occupations as a share of total working women decreased by 13 percentage points. In contrast, men's employment in vulnerable occupations fell by 9 percent.
- According to data collected from 174 countries during 20 years ago, women in about 90 percent of these samples have been able to get parliamentary representation.
- The number of female MPs has increased during 20 years ago. However, women still make up one-fifth of the members of parliament.

IV. MDG 4: Child mortality reduced

- The rate of death under 5 years old in the world is less than 50%; from 1990 to 2015.
- According to increase of population in low income areas, the number of under-five child mortality worldwide has decreased 50% from

1990 to 2015.

- Since the beginning of 1990s, under-five mortality rates in the world increased tripled.
- In Africa, the rate of child mortality under 5 years was increased annually more than five times faster than before.
- The measles vaccine has decreased 15.6 million deaths from 2000 to 2013. In addition the measles cases worldwide has decreased by 67%.
- More than 80% of children obtained vaccination in the world, including the measles vaccine.

V. MDG 5: Maternal health improvement

- Maternal mortality rates around the world have dropped by 45 percent since 1990.
- In Asia, the maternal mortality rate decreased about 65% from 1990 to 2013.
- In 2014, more than 71% of childbirth worldwide was performed with the presence and assistance of skilled health personnel, which is an increase compared to 1990 with 59%.
- In North Africa, the percent of pregnant women who underwent antenatal care increased 49 percent from 1990 to 2014.

VI. MDG 6: Fight against malaria, AIDS and tuberculosis.

- New HIV cases dropped by about 41 percent from 2000 to 2013.
- People suffer of HIV worldwide were receiving antiretroviral drug (ART) treatment, had a significant increase from 800,000 in 2003 to 13.6 million in 2014. Antiretroviral treatment prevented more than 7 million AIDS deaths from 1995 to 2013.
- More than 6 million deaths from malaria from 2000 to 2015 were basically prevented in children under 5 years old in Africa. On the other hand, worldwide malaria rates are estimated to have decreased.
- During 10 years from 2004 to 2014, about 1000 million mosquito nets

which were insecticide-infected were sent to target country in Africa.

- Based on the diagnosis, treatment interventions, and prevention related to tuberculosis saved the lives of approximately 37 million people from 2000 to 2013. The rate of TB mortality decreased and its prevalence decreased respectively by 45% and 41% from 1990 to 2013.

VII. MDG 7: Ensuring environmental sustainability

- Ozone layer unloading agents have been omitted since 1990, and according to the expectations ozone layer is repaired in this century.
- Land and sea preserved areas have increased significantly in most of the areas since 1990. Land protected areas in America increased about 15 percent from 1990 to 2014.
- In 2015, 91% of the world's population used drinkable water, in comparison with 75% in 1990.
- Of the estimated accessibility of more than 2 billion people to safe water since 1990, piped drinking water were available for 1.9 billion of them. Currently, more than 50% of the world's population (58%) enjoys this high standard.
- 147 countries have reached the drinkable water goal, 96 have reached their sewage goal and 77 have reached both of them in the world.
- Sanitary sewage system is available for about two billion people around the globe. On the other hand the proportion of people defecating outdoors has almost halved since 1990.
- In developing areas, the urban population living in slums has decreased about 10% from 2000 to 2014.

VIII. MDG 8: Expand global partnership for development

- From 2000 to 2014, formal assistance from rich nations for development purposes increased 66 percent in real terms.
- Imports from low income countries were duty-free by developed countries, increased about 15% from 2000 to 2014.
- In comparison of foreign debt services to exports in developing

countries, its proportion has decreased about 9% from 2000 to 2013.

- The mobile network is covered 95% of the people around the world in 2015.
- The mobile subscribers have almost increased incredibly tenfold in the last 15 years from 2000 to 2015.
- Using of Internet has increased 37% from 2000 to 2015. Due to, more than 3 billion people have connected to the content and applications of the World Wide Web.

1.3. Sustainable Development Goals

Politicians and statesmen are aware of the importance of the MDGs Indicators and acknowledge the elimination of poverty, hunger and the continuation of related activities after 2015. However, other issues that world faces include climate change and environmental problems and diseases, and there is an understanding that solving environmental problems is as important as reducing poverty. Given the importance of these issues, the sustainable development goals have been proposed and started in 2016 and will continue until 2030 (WHO, 2018).

Sustainable development as a concept with a history of more than three decades in the development literature today has become a major intellectual format in many countries, especially developing countries. While the concepts of development and the concept being discussed here may have multiple definitions and interpretations, there is a widely accepted scientific and practical consensus at the international level. The United Nations and related institutions have proposed this consensus as a practical development plan for countries. (WHO, 2018a).

Sustainable growth, as defined by Brundtland Commission, is construction that satisfies present wants without endangering the capacity of futures needs. Sustainable development is a holistic development that encompasses all various social, economic, cultural, environmental and other human needs (WHO, 2017).

Due to the complexity of the aspects of numerous development difficulties today, health as a full physical, mental and social is a topic that is strongly related to other political, economic, cultural, and industrial domains of every community. The most important issue and difficulty confronting politicians, decision-makers, and the general public in many nations is how to provide for, maintain, and improve the state of health (WHO, 2018b).

The SDGs include a number of goals in an effort to promote more just and peaceful communities. A particular objective of 17 goals for health is taken into account in this program, along with 3 goals for people, land, welfare, peace, and participation following sustainable development. Of the 17 goals listed in this program, the third goal's concentration is on fulfilling health goals (WHO, 2018). The third goal is: "Ensuring a healthy life and promoting well-being for all ages" The goals associated with the health ideal (clause 3) in the SDG by 2030 include the following:

- Reducing the maternal mortality worldwide to less than 70%
- End preventable deaths in infants and kids under 5
- Putting an end to outbreaks of diseases like AIDS, malaria, tuberculosis, and other tropical diseases that are neglected, as well as fighting hepatitis, water-borne illnesses, and other contagious diseases
- Lowering the number of early fatalities from non-communicable illnesses via mental health promotion, treatment, and prevention
- Enhancing drug and alcohol abuse prevention and treatment
- Reducing worldwide traffic-related fatalities and injuries by half
- Ensuring that everyone has access to family planning and education
- Achieving the global aim of access to health care, such as free, unrestricted access, financial burden on the populace, and affordable, reliable, high-quality access to life-saving drugs and vaccines
- Reduction in the incidence of illnesses and fatalities brought on by toxic chemicals and water, air, and soil pollution

Due to the changes made, the slogan of WHO for 2018 was determined and

that is "Health for All: Universal Health Coverage for All, Everywhere". The goal of globally health care is to guarantee all people has access to quality medical care whenever and wherever they need it. Receiving these services should be without financial hardship. No one should choose between good health and the needs of another life (World Health Day, 2018).

Finally, according to the above, it can be said that primary health care is still sustainable, and in the October 2018 conference of WHO, the emphasis is on strengthening the PHC and sustainable health development and universal health coverage (UHC).

1.4. Global Poverty Line

The Global Poverty Line (GPL), which equals USD 1.90 per day, is the benchmark for measuring severe poverty and encapsulates the average living conditions in the world's poorest nations. Other nations' severe poverty is also estimated using this GPL. Poverty's meaning has changed over time due to economic, political, social and cultural changes. Poverty can be defined and divided in different ways. Townsed's description (1985) from emphasizes the lack of means needed to participate in activities, receive a range of foods, and have regular living circumstances and services. Sen (1976) considers poverty as deprivation of basic capabilities and highlights how the idea of poverty may vary depending on where and when it occurs. According to the Asian Development Bank, poverty is the deprivation of the assets and opportunities that everyone deserves. Booth & Rowntree pay attention to poverty in terms of absolute and relative poverty and distinguish between the two.

Since the 1990s, UN and the World Bank have sought to reach a consensus on the concept of poverty and poverty reduction strategies. The UN has examined the concept of poverty from four perspectives: the financial approach, the empowerment approach, the strategy that addresses social exclusion, and the

participatory approach.

The most popular method for defining and quantifying poverty is the monetary approach. Depending on whether the definition of poverty is an absolute or relative concept, a threshold is defined that defines the boundary between the underprivileged and the general public. This threshold is called the poverty line. According to this definition in the definitions of poverty, anyone whose income or consumption is insufficient to cover their most basic requirements is said to be poor. (Ravallion, 1998).

1.5. Gross Domestic Product

Gross Domestic Product (GDP) is the value of all completed goods and services produced in a country during a certain time period (Dornbusch et al. 2004). Often, the share of healthcare expenditures in GDP in industrialized nations is higher than the GDP of less developed nations. This demonstrates how a country's degree of development has an impact on how important human health is to that society. Most of the OECD's wealthy nations spending over 7% of their gross domestic product (OECD) and domestic development on health care (WB, 2005). Health spending is expected to increase from 8.8% of GDP in 2015 to 10.2% of GDP on average throughout the OECD by 2030. Although this number is lower in poorer nations and in many of them, less than half of the figure. In countries with high human development indicators (which are calculated and announced annually by UN based on the three factors of average life expectancy, per capita income, and level of education), the average cost of public health resources per year. In 2005, it was 5/2 percent of GDP, while in countries with average human development it was 2/7 percent and in countries with low human development 2/1 percent (UN, 2005).

1.6. Various theoretical perspectives on ensuring food security and health

Ensuring food security and health is a complex issue that can be approached from different theoretical perspectives. Overall, these theoretical perspectives highlight the multifaceted nature of food security and health, and emphasize the need for holistic and integrated approaches that address social, economic, environmental, and cultural factors. Here are some of the most important perspectives and a brief explanation of each.

1.6.1. Income-based approach

This approach is very similar to the monetary approach that poverty measure. Because poverty means lack of enough money to purchase the essential supplies and maintain a person's minimum living, and food insecurity (FI) is a subset of food poverty and poverty, so that the person does not have enough income to buy food needed to survive (Sibrian, 2008). In this view, assuming that impoverished families paied a high percent of their income for food, they obtain information about their income through a survey of households and estimate the amount of food they consume (Svedberg, 2002). Additionally, the cost elasticity is larger in rural regions than in metropolitan ones due to the low income of rural residents (Alexandri et al., 2015). Many foods are converted to calories, and if the calories are below the threshold offered by international nutritionists, then the person becomes involved in food insecurity. This approach has problems in practice. For example, the calorie-income stretch cannot be calculated, or the food security of children, which depends on their parents' income. Therefore, to solve this problem, most of the surveys conducted have studied the level of households. But according to Frankenberger (1992), these surveys underestimate the cost of food because they do not take into account the value of home-made food.

Medical care can increase the quality of life or cure a serious illness.

Community health and improving the level of care can be significantly affected by the neighborhood's social and economic circumstances. Economic reasons include a lack of available funding and the limits of access to medical services along with social determinants of health have been considered very important. Bacon-Shone and McGhee (2007), in their study showed that people's income in different countries has a very significant impact on their treatment costs. The results showed that people in a country with universal insurance coverage are less concerned about their medical expenses than in a country without a national universal insurance plan, and people with higher incomes suffer less from food insecurity than people with lower incomes. A study in the United States, Washington State, identified economic and social status as the most important factors in determining health, citizens and immigrants with better economic and social status had better health status and less use of emergency room services (SEDH, 2007). Deaton and Stiglitz (2007) in their studies emphasized the significance of economic and social status on people's health and their health costs. Mackenbach (2006) also found in a study that in Europe the increased risk of death varies between 25% and 50% and even 150% among middle-aged and low-income groups.

1.6.2. Basic-Needs Approach

The Basic Needs Approach was a new development model that the International Labor Organization (ILO) created in the 1970s to combine the non-economic aspects of development (ILO, 1976). According to the ILO, achieving all of humanity's fundamental requirements constitutes development, and that development's essential elements are:

- The minimum consumption needs of the household, i.e. food, housing and clothing.
- Having basic services such as health, safe drinking water, transportation and education.
- Access to a job with sufficient benefits for any person who has the

ability and desire to work.

- Providing needs that are mostly of a qualitative nature, such as establishing a healthy, humane and pleasant environment and public participation in decisions that affect their lives and individual freedoms.

In this approach, the identification of basic human needs by the government and development agencies is of great importance. Although the list provided by the authors is different, the majority of them agree on the presence of food in this list (Denton, 1990).

This strategy has the benefit over the income-based approach in that food purchase is discussed and not the individual's income, because the person may have enough income but fail to meet their food needs, so in this approach, food security is considered in the short term.

According to Sen (1981), the basic needs approach, despite the emphasis on food security, is ultimately a supply-oriented approach that is insufficient in analyzing and explaining phenomena such as hunger and deprivation. He believes that the development process should be evaluated on the basis of its ability to expand the capacity and capabilities of all members of society, and not on the basis of economic expansion.

As opposed to that the direct impact of economic poverty on increasing mortality and disability in disadvantaged communities, prompted the Eastern Mediterranean Regional Organization to move towards improving the standard of living in member nations by presenting the Basic Development Needs Program (BDN). In fact, the BDN approach is a socio-economic approach that aims to enhance society's health indicators and to reach a higher standard of living. Among the important goals related to health and living environment in the BDN approach are the following: expand health services by prioritizing immunization programs, maternal and child health, family planning, prevention and management of contagious and non-contagious illnesses, providing basic medicines and school health, raising the level of nutrition education and food security and safety,

promoting healthy living and consuming safe water as well as reducing the use of harmful substances such as tobacco (WHO, 2003).

1.6.3. Sustainable development approach

Early in the 1970s, the phrase "sustainable development" was used in development literature. The term emphasizes two very important points in the process of development and growth. The first is to adopt environmentally friendly strategies. In this approach, poverty and inequality are mentioned as one of the important reasons for the indiscriminate exploitation of families deprived of resources such as pastures, forests and the sea, which they are forced to provide for their livelihood. According to Bariloche model, less developed countries can not take the same steps in the development process that the current developed countries have taken in the past, not only because it is unlikely to happen again, but also because in the event of past mistakes, It is not desirable in environmental degradation and the solution must be in creating an environmentally friendly society (Herrera et al., 1976).

The second point that the term sustainable development emphasizes is the issue of equality, both between different generations and within each generation. Theorists of this approach emphasize the point of designing and analyzing the concept of satisfying basic needs as a precondition for development. For example, the Brundtland (1987) report emphasizes needs and intergenerational equality to contribute to sustainable development:

> "Sustainable development is development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs."

In this strategy, sustainable development is the goal that meeting the basic needs of the people and raising their standard of living are among the basic requirements. Important indicators of meeting the basic needs of the people and the quality of life include nutrition, access to food and good health.

1.6.4. Human development approach

The human development approach is in response to the failures of theories of development economics and, on the other, in the critique of views that emphasize only efficiency through pricing policies, since the 1980s in the context of economists such as Amartya Sen, Keith Griffin, etc. was reflected and entered the texts from the beginning of the 1990s with the introduction of the "Human Development Index" (HDI).

This index was presented in the critique of the inadequacy of conventional economic signals such as GNP and GDP per capita, and in a comparative assessment of socio-economic developments over time, as a more comprehensive criterion, it was quickly and popularly accepted (Sen, 1992).

According to proponents of the human development concept, the design of sustainable development strategies and the basic needs in the course of development and growth, due to the emphasis on equitable distribution of income, has been a step ahead of conventional economic approaches. Nevertheless, they are considered "supply-oriented" approaches. Hence, the ultimate objective of economic growth is the growth of human capabilities. The concept of human development itself says that enhancing human existence is development's primary objective. Increasing income and expanding employment are necessary, but they are the means of development, not the goal. The goal of development is to nurture human capabilities and expand their well-being. Income is only one of the necessities of life and of course important, but the real life of man is something else entirely. Enjoying a long, healthy and creative life in a rich environment and in a civil, democratic society is the ultimate goal of development (Griffin and Mckinley, 1994).

Criticizing approaches focused solely on food supply (at the micro and macro level), this view introduces the concept of San's entitlement approach (1981) about FS and emphasizes the access of all households to a set of nutrients that increase human capabilities. Sen believes that in order to have a deep understanding

of food security, various factors affecting people's entitlement should be considered, and among the most crucial ones in relation to FS and health, the following can be mentioned: The association between consumption and income, the connection among food security and macro stability, the relation among women's education and fertility decline, as well as the relationship between primary malnutrition and its long-term implications on a person's health, abilities, and society (Sen, 1981).

In the early 1980s, some analysts focus on improved government services, like better education and health services, which are among the basic needs, considered it as a kind of investment in human resources and in line with the indicators and criteria for evaluating growth and development, such as the Human Development Index, that this index is much more efficient in terms of living quality than the GDP index. This index emphasizes the important point that human life is much more valuable than just the market value of goods bought and sold. The impact of low mortality, better health, more education in school and other basic human needs can be combined in general and reflected in the human development index (UNDP, 2020).

Abraham Maslow is one of the psychologists who has done a lot of research on the needs and conditions of human growth and prosperity. According to him, human beings have a hierarchy of needs in which biological and physiological needs take precedence over other needs. The second category of needs is food security. In order to meet one's higher needs, one must be somewhat physiologically and safely needless (Hersey and Blanchard, 1969).

The growth and health of the body is directly related to a healthy diet. Nutrition not only affects a person's physical growth and appearance, but also how we feel and perceive the environment, our mood and our behavior. The importance of some nutrients for the body, especially vitamins, minerals and proteins, is so essential that they are involved in the nutrition and health of brain cells, and therefore, by using proper nutrition, some neurological and mental disorders can be prevented. Adequate nutrition promotes vitality and health, increases a person's

useful life, reduces disability and disease, makes life pleasant, happy and satisfying for human beings, and prevents premature aging. Unlike malnutrition, which is prevalent today, especially among underdeveloped countries, it is a major cause of death and most of its victims choose children. Despite having access to food that is generally enough, a sizable portion of individuals worldwide experience some type of malnutrition because they are unaware of nutrition. The crisis of rising food prices between 2007 and 2008 and More than one billion people worldwide are now hungry, which is a historic high caused by the global economic slump (FAO / WFP, 2009). Obvious issues, such as micronutrient deficiencies resulting from inadequate consumption of mineral-rich foods and vitamins, have increased significantly during the crisis years (Brinkman et al, 2009) and less attention are paid to this problem (Mason et al, 2005).

According to certain research, economic expansion is a positive factor in reducing food insecurity and malnutrition (Headey, 2013 ; Breisinger & Ecker , 2014). While some studies, such as Ecker (2012), demonstrate that in certain places of the world, the relation among economic growth and FS is weak, and sometimes a lack of correlation, so that in Arab countries, production growth GDP has not led to a reduction in child malnutrition in recent decades (WB, 2014; El-Zanathy, Way et al., 2009).

Human development can be considered simultaneously, both as a goal and as a path of national development and economic growth. According to the previous studies reviewed in this section, health and food security are prerequisites for and enablers of human progress.. According to the term "living in health and well-being" achieving a certain degree of health is important for human growth, FS and nutrition is one of the serious goals in national and regional policies of countries. According to scientific views in recent decades, economic and access to enough food on a bodily level to live a healthy and active existence, on the one hand as the right of individuals to flourish their capabilities and on the other hand as a duty for the government to provide it. FS is in fact the cornerstone of a developed society and a crucial component of the mental, emotional and members' physical well-being. So, in a scientific sense, FS is a methodical approach to addressing food and

nutrition issues as well as a predetermined framework for managing and planning development.

1.7. Background of the Study

In latest decades, with the emergence of the concept of human development, the case of food security, which has long been raised, has taken on new dimensions and has received special attention under the influence of The United Nation activities. Nutritional health and adequate access to food are the basic axes of development and infrastructure It nurtures the future generations of each country. Extensive research conducted in the last two decades shows the scientific foundations and Empirical evidence to prove the role of nutrition in health, increase efficiency and its relationship with economic development (United Nation Human Development Report, 2003).

Accessibility of adequate food is common human rights and it is the duty of governments to take serious measures to enhance the nutritional status of their society (Byres, 1982).

The need for food is one of the physiological desires of people which the absence of it endangers existence of human. This need continues as long as human is alive. With the ever-increasing population of the world, the need for food is growing constantly with tremendous acceleration. The Food & Agriculture Organization has estimated that population of the world will be more than 8 billion by 2030, and that providing food for this population requires more effort in agriculture and related sciences. Despite significant advances in the last three decades, annual food consumption has increased by only about 20%. According to current estimates, by 2030, the supply of food production in developing countries should be 70% higher than its present production in order to keep pace by increasing population and properly meet their needs (FAO, 2001).

Andersen and Rajul (1995) in their study to attain a balance among adequate food production and global food needs, the existence of issues are necessary for the development of subdivisions such as strengthening economic growth in all sectors, implementing appropriate policies to reduce population growth and migration to urban areas, the optimal use of resources considered the existence of technology, agricultural research, facilities for farmers, and economic reforms (Andersen and Rajul, 1995).

Quality of life is considered an important indicator in measuring economic development that several factors such as nutrition level and food security are involved in measuring this quality.

Food security is ensured while the per capita foods of the family is properly chosen and arranged and enough food is prepared properly in such a way that healthy component and nutrients reach the organs of the body. FAO (2008) states that the main object of food security is to ensure that all humanity have access to essential foodstuffs, so that they are not living in poverty or concern of hunger. In fact, the aim of food security and adequate food supply is not only to satisfy overt hunger or satiety, but also to meet the cellular needs for nutrients, that is latent hunger (cellular satiety).

In addition, the fast increasing of the world's population, the process of development, rapid destruction and decreasing of natural resources, increasing poverty and disruption of natural life cycles on Earth increased the concerns of various countries during the 70s and 80s. These concerns about health status , health resources and its severe effects on the economy and development of countries have been growing, especially in developing countries, to the extent that many WHO experts have acknowledged the ineffectiveness of health-oriented approaches to health, and a change in this attitude was considered inevitable (WHO, 2004).

One of the most important historical events in this agreement development is the decision of the UN to adopt the method of preliminary care in order to achieve

various goals, including the realization of justice in public access to primary health care.

The WHO considers primary health care is the essential segment of healthcare system that should be accessible to all members of society. In any country, the development of the health system and socio-economic development depend on these services. Health care is effective in people's workplace and life when the individual, family and society are connected with the health system.

The preservation and improving the health of people in each community should be the purpose of providing primary health care , and today it is emphasized that health services should cover the full range of prevention, treatment and rehabilitation services. It is worth mentioning that the eight primary health care activities are the minimum measures applicable to all communities, including:

Health education (education on common health problems, prevention and control methods of diseases), improving nutrition, availability of clean water and improving the environment, maternal and child health and spacing between births, vaccination against infectious diseases that can be transmitted during childhood, restraint and test of infectious diseases (local endemic infectious diseases), remedy of common health problems, access to basic medicines. Every society should plan and implement based on its needs and prioritization to solve people’s problems.

1.8. Problem Statement

Human development can be considered simultaneously, both as a goal and as a path of economic development and national growth. Meanwhile, food security and healthcare are the indicator and means to evaluate level of developing human. According to the term "living in health and well-being" as one of the components of human improvement, achieving an appropriate level of health, nutrition, and food security are serious goals for countries. According to scientific views in recent

decades, economic and availability of food for better life, on the one hand as the right of individuals to flourish their capabilities and on the other hand as a duty for the government to provide it (Gani and Prasad, 2007).

In 1948, food security was placed more emphasis on ensuring adequate food supply and price stability nationally and internationally (FAO, 2006). In 1983, the FAO analysis focused on the availability of food, and the balance between supply and demand was equated with food security (FAO, 1983). The term food security, if combined with how resources are allocated, is a suitable scale for the rate of well-being of the individual and the household (Pinstrup, 2009).

There is a very comprehensive description of food security, with different dimensions, was set out as follows: "All people, at all times, have the ability to physically and economically access sufficient amounts of healthy and nutritious foods that meet their nutritional needs and preferences for a healthy and active life" (FAO, 1996).

The description mentioned above, which is accepted by scientists in this field, refers to several aspects of food security (FAO, 2006):

- Accessibility of food and adequate food: The accessibility of enough amount of food with acceptable quality to be provided through domestic production, imports or food support. This dimension addresses the issue of food security from a food supply perspective.

- Access to food: Adequate national food supply alone does not guarantee household food security. Therefore, a person's access and financial ability to get the right food in order to get nutrients, means that there is food security.

- Food consumption: Use of food via appropriate diet, health care and healthy water to attain the best nutritional status that meets all physiological needs of the individual.

- Stability in access to food and stability in its supply: To ensure food

security, individuals and households must receive to enough food. They should not be concern about unavailability due to sudden shocks due to financial crises and weather risks or periodic accidents leading to seasonal malnutrition. Each of these dimensions of food security covers certain sub-indicators.

In Table 1.2, in terms of sufficient food of the food security indicator, the average component of adequate dietary energy supply represents the percentage of Dietary Energy Supply (DES) of the Average Dietary Energy Requirement (ADER).

Table 1.2. Comparison of food security measurement between developing countries and developed countries (2014)

Dimensions of food security	Food Security Components (Scale)	developing countries	developed countries	world
food availability and adequate food	Average adequate dietary energy supply (percentage)	119	136	122
Access to food	Depth of food deficiency (per kilocalorie per day)	98	8	82
	Domestic food price index (index)	4.01	1.68	2.85
Stability in food access	Index of fluctuations in domestic food prices (Index)	7.2	3.9	6.4
	Per capita change in food production	2.4	7.2	2.8
Food consumption	Percentage of population with improved access to water resources (percentage)	85.8	99.3	88.7

Source: FAO (2015)

In the case of availability of food, the depth component of food deficiency indicates how many calories are needed to compensate for malnutrition if other conditions are constant, which can be calculated from the difference among the average food energy required and the average food energy consumed by the

malnourished population. The component of the national food price index is a relative index of the cost of food and non-alcoholic beverages in a country. This index has been calculated since 2011 during the International Comparison Program (ICP) data and information from the World Bank.

Another food security problem is access to food. The crisis of rising food prices between 2007- 2008 and the economic downturn in the world have cause to a growth of hungry people to a historic level of more than one million people worldwide that marking the height of malnutrition (FAO / WFP, 2009). While food quality issues such as micronutrient deficiencies are less considered than inadequate food intake (Mason et al., 2005) the danger of micronutrient malnutrition has raised remarkably during recent crisis years (Brinkman et al., 2009). Therefore, correct and timely decisions for researchers and politicians indicate the importance and need to pay more attention to identifying the food security situation of countries and elements that have contributed to strengthening or weakening it. This need has become more prominent in Europe and requires the implementation of initiatives such as Strengthening European Food and Nutrition Security (SUSFANS) (Rutten et al, 2016).

In the terms of stability in food availability, the component of domestic food price fluctuations calculates changes in the related to food cost of a country. To calculate this index, the standard deviation of the monthly food consumer price level and data of purchasing power equality are used. The per capita component of food production change is calculated toward to the constant value of per capita production during the period (2006-2004) in international dollars.

In the terms of food consumption, a percentage of the people with availability to modified water resources such as domestic and public tap water and rainwater collection, and in contrast to untreated water, refers to water resources such as water tanks, wells and unprotected springs. The acceptable amount of water consumption, 20 liters per day for each person, is accessible from one kilometer.

In this regard, this study first deals with the conceptual study of factors affecting food security and also some of the health parameters, and then indexing is necessary for analyzing the health situation and food security of the studied countries (OECD). Different scales have been used in measuring food insecurity in different studies. The multiplicity of scales used is one of the challenges in this field because the outcomes of various studies are not similar so that according to the total results can achieve the overall food security status in the society and also the choice of food insecurity measurement scale also affects the outcomes (Kaiser et al., 2004). Therefore, identifying a comprehensive and dynamic index that can highlight the various quantitative and qualitative dimensions of food security has specific emphasis. Therefore, the Global Food Security Index (GFSI) introduced by the Economist Intelligence Unit (EIU) is used to monitor food security in countries. This index has calculated the balance and amount of food security in 109 different countries of the world since 2012.

The Economist Intelligence Unit introduced this indicator : "All people, at all times, have the ability to physically, socially and economically access sufficient amounts of healthy and nutritious foods to meet their nutritional needs and preferences for a healthy and active life" (FAO, 1996). Traditional composite indicators were more focused on food supply and demand, but this new index also considers three factors of food security: financial capacity, accessibility and consumption, and quality of food consumed. In fact, in this index, in addition to quantitative sub-indices, some qualitative and descriptive sub-indices such as agricultural sector infrastructure and nutrition plans are discussed.

In the GFSI index, the goal of food security is not only abdominal satiety that is measured by indicators such as the daily calorie intake to the minimum amount of calories, (Babatunde et al., 2007; Faridi and Wadood, 2010) rather the goal is abdominal-to-cell satiety (BenSlimane et al., 2015). Therefore, not only the accessability of food and the financial ability of the person has a special place in food security, but also the quality and variety of food consumed and receiving sufficient micronutrients are important. A study of household food consumption

patterns shows that in food-insecure families, more attention is paid to the energy intake and abdominal satiety of family members. For this reason, these families increase their daily energy intake from cheap sources such as bread, potatoes, and fats, in contrast, there is a reduction in the consume of major micronutrients due to reduced intake of rice, vegetables, fruits, red meat, milk, and dairy products. In other words, the diversity of food consumption in insecure households decreases and has a straight effect on the health status of the family (ZerafatiShoae et al., 2007).

1.9. Purpose of the Study

This study includes of two parts. The first part is a systematic review, which aims to find previously reviewed studies relating food security to health. The second part seeks to test the relationship between health parameters and food security to identify their type and relationship. The relationship has been examined between the food security scores of OECD countries and their health status, health risks, health resources and healthcare use. Finally, effective solutions can be found to improve health and food security. Therefore, the purpose of this study is to determine whether there is a relationship between health indicators and the level of food security in OECD nations. Also, based on the results, suggestions were made to improve and ensure food and health security.

1.10. Research Questions

1- What is the situation of food security and health in the world?

2- What is the food security status of OECD countries according to the Global Food Security Index (GFSI)?

3- Are food security scores in OECD countries related to health parameters such as health status, health risks, health resources and healthcare use?

1.11. Significance of the Study

The success of any political structure depends on the development, efficiency of the economy and the quality of the government's economic policies. Existence of security is one of the essential components for the development and progress of any country. The term security can be searched in various fields, such as economic, social, cultural, natural resources, environmental and health. Food security has significant impact on the national security of any country by creating vital security and health. Hence, food security and healthcare are the main axes of national development, which in recent years has revealed new attitudes, needs and priorities at the policy level. To the extent that the issue of effects of food security on the health status of societies has become one of the great problems of the 21st century. To ensure FS and healthcare of a society and the social system, organizations and institutions must cooperate and coordinate with organizations like WHO; that are responsible for macroeconomic policies, continuous monitoring, education, promotion and informing the community.

Based on the FAO (2009), the world population will be more than 9 billion by 2050, and also climate change will reduce rainfall and consequently reduce food production. The FAO also stated in its report (2013) that 800 million people, or about 12.5% of people in the world, beared from severe hunger between 2011 and 2013 and were unable to provide the food they needed. Most of these people were in developing countries and the speard of malnutrition in these countries was 14.3% during the years 2011-2013. According to the (WHO) in 2004, 4.6% of children under 5 faced with underweight. These reports demand more attention from countries around the world, especially developing countries, to the subject of food security.

Despite the widespread emphasis on food security policies by related organizations (FAO, WFP), in recent decades because of increasing in population, inefficient agriculture, decreasing of water resources, and mismanagement in the use of these resources, which has more consequences in the agricultural segment by

reducing food production and the income of the rural strata are reflected. Therefore, the food basket of households is affected and there is a possibility that food security and their health will face a crisis.

Whereas the study of impacts of food security on the health of communities is very important for researchers and politicians to make correct decisions to recognize the variables that contribute the food security over the community health or have an inhibiting effect, so in this study in detail to a conceptual study of the influance of food security on the economic and non-economic variables of health that can be clearly expressed quantitatively. For this purpose, using the global food security indexed, the food security situation and health parameters of OECD countries are monitored. Finally, the relation among food security and health parameters in these countries is examined.

Although food security has gotten complimentary insights from various disciplines and approaches there isn't any study that observes the relationship between food security scores of OECD countries and their health status, health risks, health resources, and healthcare use. This research helps to remove this gap and that the results of this study will be effective for the decisions of the authorities and will be a new idea for future study in this field.

1.12. Systematic Review

A systematic review was used to search and evaluate all unbiased research studies related to this study. The systematic literature search was performed in 4 Databases including Ebscohost, PubMed, Scopus and the Web of Science through September 2021. The following keywords were used: food security, food insecurity, health status, health risks, health resources and healthcare use. Restriction imposed on publication was date from 2010.

Studies whose original article was fully unavailable or whose original work was published in a language other than English, and studies whose subject matter

was not directly relevant to this study's topic were all excluded. The primary objective of this partsystematic review is to find out what research has been done on the connection between FS and health status, health risks, health resources, and healthcare use.

Duplicate results from electronic database searches were combined and eliminated. Abstracts and titles that didn't fit the requirements for inclusion were weeded out. In order to determine which papers should be considered while reviewing, the full texts of the remaining articles were acquired.

Using a standardized framework, data were retrieved from the included studies. Name of primary author, nation, publication year, setting, control, recruitment strategy, sample size and characteristics, outcomes, intervention, data collecting technique, and findings were all included in the data.

3600 studies were found in the initial search from 4 reliable databases. The number of studies was decreased to 621 after recurring instances were found. The steps are then reviewed based on the PRISMA flow chart (Fig. 2.1.). Initially, the articles were deleted after reviewing the titles and abstracts, as well as articles that were deleted due to incomplete data, and then articles that due to the impossibility of accessing the full text. Finally, the remaining articles gained the necessary credibility to perform a qualitative evaluation and were finally used in a systematic review.

The goal of this systematic review study is to discuss FS situation of the world and then accentuate the connection between the food security scores of OECD countries and health status, health risks, health resources, healthcare use, GDP and GNI.

1.12.1. Data Sources and Search Strategy

A thorough systematic literature review was done on Ankara University E-Library Database, PubMed, Scopus, Ebscohost and the Web of Science through September 2021. The following medical subject heading terms were used: food security, food insecurity, health status, health risks, health resources, healthcare use. The restriction applied to the publication date since 2010.

1.12.2. Inclusion criteria

The following were the exclusion criteria: studies whose original publication was not available at all, research whose primary publication was not in English, and studies whose subject was not directly relevant to this study. This systematic review's major objective aimed to ascertain the relationship between FS and several health indices including; health status, health risks, health resources, healthcare use, and also GDP and GNI.

1.12.3. Study Selection

Duplicate results from electronic database searches were combined and eliminated. Abstracts and titles that didn't fit the requirements for inclusion were weeded out. In order to determine which articles should be integrated in the review, complete texts of the remaining papers were acquired.

1.12.4. Data Extraction

Using a standardized framework, data were retrieved from the included studies. Name of primary author, publication year, nation, region, study population, and properties, recruitment strategy, control, treatment, and consequences, data collecting technique, and findings were all included in the data.

1.12.5. Quality Assessment

The validity of the tools mentioned in the papers was evaluated with great attention; that is, how well the surveys accomplished their stated objectives. A quick assessment of the tools' content validity (comprehensiveness of many features) and construct validity, particularly for questionnaires, was conducted.

1.12.6. Data Analysis and Synthesis

Researches were categorized based on the hypothesis or treatment they examined. Due to the absence of homogeneity, the results for the dependent variables were evaluated and explained in a narrative format. Due to the variability of the therapies tried and the outcomes assessed, meta-analysis could not be done.

1.12.7. Screening

3600 studies were found in the initial search from 4 reliable databases. There were 405 studies left after the repeated cases were found. In addition, 179 articles and 141 papers were eliminated following examination of their titles and abstracts, 46 papers were excluded because of insufficient data, and 15 papers were also excluded because it was unable to read their full text. The remaining 12 papers ultimately received the necessary points to proceed through qualitative evaluation and were utilized in the systematic review (Fig. 2.1).

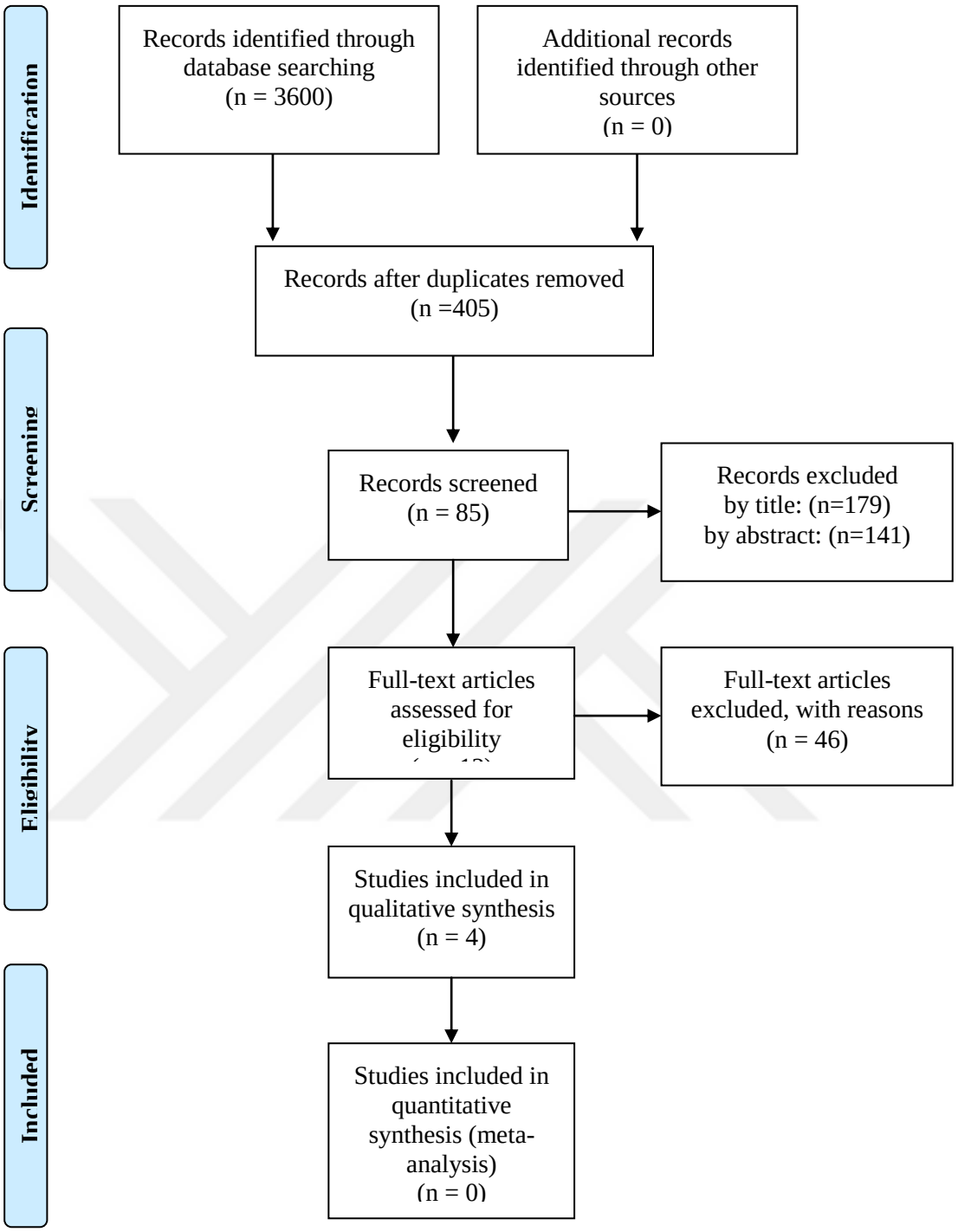


Fig. 2.1. Review stages based on PRISMA flow diagram

The search query for each database is given below along with the number of articles in their initial search:

1. **Scopus**, 2746 articles, search query: (ALL (food AND security) OR ALL (food AND insecurity) AND ALL (health AND status) AND ALL (health AND risks) AND ALL (health AND resources) AND ALL (healthcare AND use)) AND PUBYEAR > 2009

2. **Ebscohost**, 559 articles, search query: https://search.ebscohost.com/login.aspx?direct=true&db=asn&db=asb&db=ast&db=air&db=bpr&db=bsu&db=e5h&db=ddh&db=e020mww&db=e600xww&db=nlebk&db=e680sww&db=e000bww&db=eir&db=eric&db=hev&db=8gh&db=e011xww&db=hsr&db=ipa&db=lxh&db=f6h&db=e864sww&db=msn&db=mdc&db=kah&db=mlf&db=n5h&db=nsm&db=ddu&db=bwh&db=ssr&db=s3h&db=trh&db=obo&db=uvt&db=nmr&bquery=food+security+OR+food+insecurity+AND+health+status+AND+health+risks+AND+health+resources+AND+healthcare+use&cli0=FT&clv0=Y&cli1=DT1&clv1=201001-202212&type=1&searchMode=Standard&site=ehost-live

3. **Web of Science**, 278 articles, search query: food security (Topic) or food insecurity (Topic) and health status (Topic) and health risks (Topic) and health resources (Topic) and healthcare use (Topic) and 2021 or 2020 or 2019 or 2018 or 2017 or 2016 or 2015 or 2014 or 2013 or 2012 or 2011 or 2010 (Publication Years) and Articles or Review Articles (Document Types) and English (Languages) and Articles or Review Articles (Document Types) and Elsevier (Publishers) and Book Chapters or Proceedings Papers or Data Papers (Document Types) and Elsevier (Publishers)

4. **PubMed**, 17 articles, search query: (((((food security) OR (food insecurity)) AND (health status)) AND (health risks)) AND (health resources)) AND (healthcare use)

2. MATERIALS AND METHODS

The major goals of this part are to clearly indicate and explain the procedures used to conduct this study. This section provides details on study design, research tools, and data collection.

The study's research strategy consists of three parts. The first part of the research presents the data's sources and description of variables. In the second part of the research, a systematic review methodology has been used to see the publications related to food security and health status, health risks, health resources and healthcare use. The third part of the study has been looked at the relationship between food security and health status, health risks, health resources and healthcare use in OECD countries by specification model.

In recent decades, food security is becoming a worldwide concern, attracting the attention of governments and academia. Especially after the food crisis in the 1970s and the COVID-19 pandemic in 2019, scientific circles paid special attention to the implementation of FS policies in underdeveloped nations. Without healthy and adequate food, it is impossible to live a healthy life. Therefore, introducing a comprehensive index that can provide a realistic depiction of the nation's food security situation and the provinces and cover its quantitative and qualitative dimensions and determine the elements that contribute to strengthening or weakening food security, to make the right decisions for researchers and policymakers have been needed.

2.1. The Data Sources and Description of Variables

2.1.1. Independent Variable

GFSI was used as a food security independent variable, which is a composite indicator intended to track country progress towards achieving national

FS. It is created by The Economist Intelligence Unit and supported by DuPont. It has been produced annually since 2012 and covers more than 100 countries.

2.1.1.1. Global Food Security Index

GFSI was launched by EIU based on the definition of FS at the World Food Summit (1996): "Food security is provided in a way that all individuals, at all times, have the ability to access physically, socially and economically sufficient amounts of healthy and nutritious foods that meet their nutritional needs and preferences for a healthy and active life". This index is a dynamic model, combines quantitative and qualitative analysis with unique indicators of three components of FS: availability to sufficient and diversified amounts of food, financial capacity (affordability), and food quality and health. In identifying the factors that contribute to food insecurity, this index goes beyond hunger and emphasizes the unique quality indicators that reflect the policies of governments and have not been considered in many other indicators of FS. This index's primary objective is to identify nations and regions vulnerable to food insecurity, in which the cellular satiety component is targeted along with abdominal satiety and can be used as a guide for relevant policymakers in implementing food security improvement policies. In fact, the GFSI index comprehensively addresses three dimensions of FS, such as financial strength, availability of food, and quality and health, each of which and its constituents are presented below (EIU, 2015).

I. Affordability

This sub-index assesses a person's ability and potential to pay for food and the costs associated with the risk of food shock. In fact, the GFSI index considers financial strength from two perspectives: 1- Do people have the ability and power to buy food? And 2- is the structure of society capable of coping with food shocks? In this regard, the financial capacity to express these two views includes the following components (EIU, 2015):

- Food Consumption (FC) as a percentage of total families spending: A national assessment of the proportion of domestic spending that goes to food shows how important food is in relation to other expenditure. The little proportion of meals expenses in total household expenditures means that households are more immune to rising food prices and potential shocks. The calculation of the GFSI index for many countries of the world shows that the countries that are in a better position in this field are usually the countries whose families spend less than 10 percentage of their total expenses on meal (Sibrian, 2008).

- Portion of people under global poverty line (UP): This ratio is a tool to measure the poverty rate, which includes the proportion of people living with not more than $1.901 per/ day. People living below the poverty line have very limited resources and face significant food purchasing difficulties (WB, 1986).

- GDP: according to the level of Gross Domestic Product per capita of each country can be a criterion for assessing the country's relative wealth and the typical capacity of people to ingest food. Food security is quite high in nations with higher GDP per capita (Mariano, and Giesecke, 2014).

- Aagricultural import tariffs (T): This index takes into account the price of food within every nation. Tariffs on imported agro products, when accompanied by rising food prices, can seriously damage a country's food security. That is, there is an adverse correlation between the financial capacity of families and the tax rate on imported food and drink (Timmer, 2014).

- Access to financing for farmers (F): This indicator pays attention to FS in relation to food price. Easier entry to financial facilities helps farmers and small businesses to respond appropriately to price shocks. In other words, create a dynamic agricultural sector (Timmer, 2014).

- Presence of food security net programs (FP): These programs include: food subsidy programs, school nutrition programs and international food aid assistance that protects the individual against food-related shocks. The more sustainable and stable these programs are, the greater the degree of global food security with poor

FS (EIU, 2015; Timmer, 2014).

II. Availability

This sub-index covers the factors affecting the supply and easy access to food, the risk of this access and the country's infrastructure in food production and distribution. Economies with developed agricultural infrastructure and markets provide more favorable conditions for food supply and availability and thus food security. Such environments have a low risk in the face of food supply shocks and, if faced with a risk, they control it very well. The components of the food availability group are:

- Sufficiency of food supply (S): This sub-index studies the average food supply to answer basic questions such as is there enough food available in the country (Gandhi and Zhou, 2014).

- Volatility of agricultural production (V): The supply of domestic food products is affected by fluctuations in agricultural production in that economy. Production variations have a notable influence on FS because they make it challenging to manage the food supply or result in unneeded surpluses or shortages of food (Gandhi and Zhou, 2014; Fischer, et al., 2014).

- Food Loss (L): Food loss includes the number of agricultural products that are removed from the food supply cycle from the planting to the consumer's distribution. A significant portion of the food produced is lost during the stages of planting, processing, transit, and storage, which points to serious structural issues with the food supply chain (Fischer, et al., 2014).

- General Expenditures of Agricultural Research and Development (RD): It is an indicator to measure the national spending in agriculture sector to become better market efficiency. The more money spent on R&D, the greater the capacity and potential of the nation to increase the availability of enough food (Alston, et al., 2015).

- Agricultural infrastructure (In): In the storage of agricultural products, reducing food waste during transportation is of great importance. Therefore, proper infrastructure of roads and ports for transportation and accelerating the distribution of agricultural products is of great importance. Without such networks, the country will face many problems in importing and distributing food products, especially in rural and remote areas (Timmer, 2014).

- Corruption (C): The natural resources use, and the distribution of food are distorted and rendered inefficient by corruption. Food supplies can be misdirected through corruption, and some places may be off-limits. Measuring corruption has its difficulties because this phenomenon is basically done secretly and with deliberate concealment of its actors. Activists are trying to find evidence of their corruption, so it is very difficult to track corrupt practices and measure their occurrence. Therefore, it is inevitable to measure corruption by indirect methods such as: surveying the views and opinions of companies and government officials, examining corruption at the level of organizations according to their institutional characteristics and accurate audit of projects (Alston, et al., 2015).

- Political stability risk (PS): There is a possibility of damaging the proper infrastructure of food production and distribution caused by political unrest and financial malfeasance. Political instability can restrict the availability of food due to transportation limitations, diminished foreign help, and supply chain disruption (Debucquois and Cordes, 2014).

- Urban absorption (UA): In this sub-index, the growth rate of a country's real GDP is compared to the growth rate of urbanization. The purpose of this comparison is to provide a response to the query whether the country has sufficient resources to finance urbanization or not, because rapid urbanization, without proper infrastructure, ability and potential of the country to adapt to rapid change can provide bottlenecks in food supply to the growing urban population (SFIW, 2014).

III. Quality and Safety

The third group of sub-indicators is the quality of nutrition and healthy food in each country. This group is classified as food utilization in some cases due to the study of the amount of energy and nutrients received by individuals, the preparation of healthy foods and the variety of diets. Under the Nutrition Quality and Health Index, the idea of FS differs from its conventional aspects, including poverty, which emphasizes the financial strength of individuals, and in which a healthy diet is considered to help maintain and improve the general health of the body and sufficient fluids provide adequate vitamins and minerals as well as calories. Hence, the quality and health of food is formed by five components (SFIW, 2015):

- Diet diversification (D): The proportion of non-starchy items in a person's diet.. Diets that include a high percentage of non-starchy foods including dairy, meat, and veggies products other than grains and legumes offer a wholesome diet. In underdeveloped nations with limited incomes, access to non-starch products is difficult. Therefore, from the point of view of this sub-index, they have lower food security (Maitra and Prasada, 2015).

Micronutrient Availability (M): This index includes three micronutrients of vitamin A, animal iron and plant iron. In high-income countries, access to micronutrients is easier; However, the degree of development of different nations is not significantly correlated and the availability of micronutrients. The national diet and availability to micronutrients are significantly influenced by factors other than money, such as culture (Maitra and Prasada, 2015).

- Obtained protein (P): Based on the availability of necessary amino acids, which the body is unable to produce and must be supplied through correct nutrition, this index determines the amount of good quality protein ingested. According to EIU calculations, intake of high-quality proteins and income are strongly correlated (Maitra and Prasada, 2015).

- Nutritional standard (Ns): include the existence of guidelines, strategies, national nutrition plans and the study of government healthy nutrition monitoring

programs. This sub-indicator reflects the views of policy makers in the field of nutrition standards (Maitra and Prasada, 2015).

- Food safety (Fs): This sub-index examines the existence of governmental organizations that guarantee nutrition, food safety, and safety. In this sub-index, the quantity of people who have access to clean water and the presence of a formal grocery store are two fundamental aspects of food safety that are investigated. This sub-index is necessary to assess the degree of development of the country in ensuring food safety (WFS, 2015).

2.1.1.2. Data collection of Independent Variable

Instead of collecting original data, data that had previously been gathered for a variety of reasons, such as government records or earlier research has been used for this study.

Due to thorough data gathering, using secondary data was quick and economical. However, the information was lacking or not totally pertinent. GFSI was used for FS independent variable, it has been produced annually since 2012 and covers more than 100 countries, and data were collected from The Economist Intelligence Unit site (https://foodsecurityindex.eiu.com/Home/DownloadIndex).

2.1.2. Dependent Variables

The health parameters including; health status (life expectation at birth, life expectation at 65, infant mortality rates, potential years of life lost, deaths from cancer, suicide rates), health risks (Daily smokers, alcohol consumption, overweight or obese population, lack of social support), health resources (health spending, pharmaceutical spending, doctors per 1000 population, nurses per 1000 population, health expenditures), healthcare use (doctors consultations, CT exams, MR exams, Cesarean, Infant vaccination rates, length of hospital stay, hospital

discharge, healthcare utilization), and also GDP and GNI has been used as dependent variables.

2.1.2.1. Data collection of Independent Variable

Instead of collecting original data for the dependent variable, as same as the independent variable, Data that had already been collected for different purposes were used, such as government records or prior research (secondary data).

Also, dependent variables of health indicators including health status, health risks, health resources, healthcare use, GDP and GNI were obtained from the OECD health database (https://data.oecd.org/health.htm).

2.2. Model Specification

This section looked at the relationship between food security and health status, health risks, health resources, healthcare use, GDP and, GNI in OECD countries. GFSI was used for FS independent variable, which is a composite index that aims to monitor progress towards FS at the national level. Since food security data was not available for all 38 OECD member and partner countries, only 31 countries were examined (Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Spain, Finland, France, Germany, Greece, Hungary Iceland, Ireland, Israel, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Sweden, Slovak, UK, Turkiye, and USA). Also, dependent variables of health indicator including health status, health risks, health resources and healthcare use were obtained from the OECD health database.

Given that the data contain observations obtained from multiple food security and health parameters over a period (2012-2019) for 31 OECD countries, this study cannot be considered just a time series or cross-section. Therefore, the data panel is used which is a combination of regression and time series. The

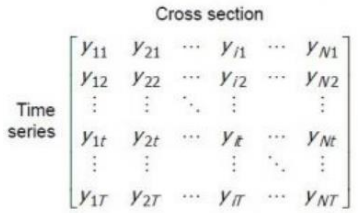
difference between the two methods is that in cross-sectional statistics, independent samples are selected from the target population at different time points, while in the panel model; the samples are fixed and consist of units that were present during the whole period of study.

In examining the hypotheses of this research, the problem statement is to find the relationship between FS and health parameters, whether they have a significant relationship with each other. Cross-sectional and time-series data can be combined to produce information that is valuable for estimating econometric models as well as crucial policy-making insights.

On the other hand, panel data contain more information, more diversity, and less alignment between variables, resulting in more efficiency. While in time series we see more linearity between variables. Since, panel data combines cross-sectional and temporal series., the cross-sectional dimension adds a great array and as a result more reliable estimates are possible (Baltagi, 2008)..

Given that the data cover the years 2012 to 2019 and have the 31 countries' effect, linear regression panel data analysis was used to test the hypotheses. It should be noted that RStudio was used to analyze the panel model and the plm-package in that software. The plm is a package for R that aims to simplify analysis of linear panel models estimation. The plm-package delivers capabilities for estimating a large range of models and deduction.

A dataset that tracks how things behave is tracked over time is called a panel data, often known as cross-sectional time-series data or longitudinal. These subjects in this research are OECD countries (N = 31) and is evaluated over a period of 8 years (T = 8). In this study, which used a panel data model, our observations have reached NT in number (31 * 8), which it results in varied estimations that are more accurate. In time-series data this variance is calculated as $\sigma \wedge 2 = \sigma 2$ / N-K but in panel data it can be calculated as $\sigma \wedge 2 = \sigma 2$ / NT-N-K. The panel data's variance is lower and hence a more accurate estimate since the second fraction's denominator is larger than the denominator of the first fraction (Baltagi, 2008).



According to the mentioned cases for examinning the connection between FS and health parameters in OECD nations in an 8-year period, RStudio was used to analyze the panel model and the plm-package in that software. The work process is as follows:

After collecting the data, a different number of observations were observed between countries, which require compliance with the methods, and was not compatible. As mentioned earlier, the panel data is an N × T matrix with N being the number of panel observations and T being the period. Therefore, the full count of observations in the balanced panel data is equal to n = N × T. While in this study the panel data are unbalanced, the total number of observations is less than this value, so it has: n <N × T.

The 3 primary problems that lost data causes are: increasing difficulty in processing and evaluating the data; increasing bias; and decreasing efficiency. Inference is seen as a method to get over the challenges that come with listwise deleting instances with incomplete data since missing data might cause issues with data processing. In these other words, when one or more values are missing for a case, many statistical tool defaults to discarding any instance that has a missing value, which may introduce bias or reduce the generalizability of the findings (Baltagi, 2008).

For this purpose, the imputation process of replacing lost data with alternative values was used. Imputation maintains all instances by replacing the original data with an average worth based on further available information. After all missing values have been reproduced; the data set may be examined using techniques for complete data. We employed the mean imputation technique in this instance.

This method has the advantage of keeping the sampling distribution for that continuous parameter by substituting any unfilled value with the variable's mean in all other situations. Mean imputation, however, weakens any associations involving the imputed variables. this is the case because, there is a guarantee that the measured variables, including the imputed variable, have no relationship in imputation scenarios.

Average imputation can be performed within the categories comprising the 31 OECD countries in this study, and can be stated as $\hat{y}_i = \bar{y}_h$ where $\hat{y}_i$ is the imputed value for record i and $\bar{y}_h$ is the sampling distribution of data from respondents in a certain class h. This is a specific example of generalised econometric replacement is this.:

$$\hat{y}_{mi} = b_{r0} + \sum_j b_{rj} z_{mij} + \hat{e}_{mi}$$

Here the principles b_{r0} , b_{rj} are calculated by regression y on x in unimputed information, data are divided into respondent (r) and missing (m) categories, and z is a bogus variable that represents classifier.

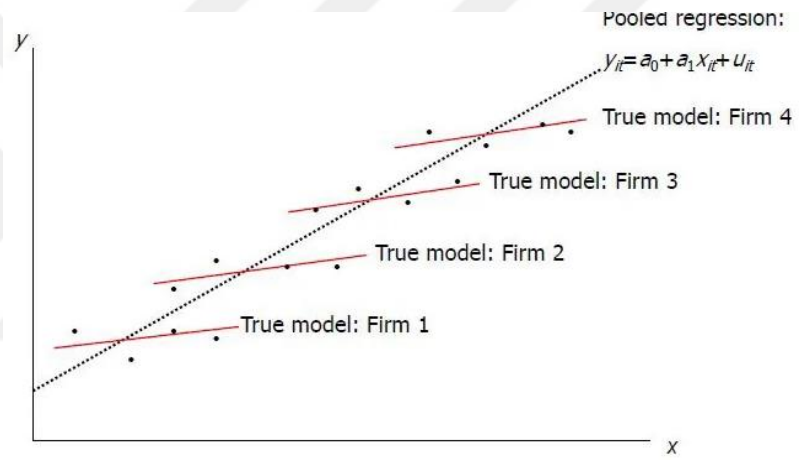
In this study, a method called the Hausman-test was chosed to evaluate fixed effects and random effects models according to the explanatory power of the dependent variable. This test assesses an estimate's appropriateness in comparison to a different, fixed, less effective estimator. This helps us to assess whether a statistical model corresponds with the data (Baltagi, 2008).

Since the relationship between regressions and random effects should be tested to compare these two models, so in according to the Hausman test, the null hypothesis is that there is no relationship between regression coefficients and random effects. Under this hypothesis, the OLS and GLS estimators are both compatible, but the OLS estimator is inefficient. Under the opposite hypothesis, the OLS estimator is efficient and consistent but the GLS estimator is inconsistent. The statistics of this test are as follows:

$$H = (b_1 - b_0)'(\mathrm{Var}(b_0) - \mathrm{Var}(b_1))^{-1}(b_1 - b_0)$$

Since the p-value obtained in Hausman test was not significant, the more effective random effects estimator was selected even though the hypothesis is rejected was not disproved, and random effects were selected (because individual errors were not related to regressions).

In the stochastic effects model, the key hypothesis is that the observational variables are not time-dependent and there is no dependence between the regressor variables. a panel data set that has been flattened with a linear regression model fitted using the OLS technique is what the Pooled OLS regression model is. The Pooled OLS model can provide suitable non-sloping estimators for such model parameters as follows (Baltagi, 2008):



- Design panel models using the plm-package for each hypothesis

The panel data model used in this research is as follows:

$$Y_{it} = \alpha_{it} + \sum_{k=1}^{k} \beta_{kit} X_{kit} + \varepsilon_{it}$$

i represents cross-sectional units (OECD countries) $i = 1,\ldots, 31$

t represents time (2012-2019)

k represents the model of each hypothesis so $k = 1$

ε_{it} a random disturbance term of mean 0

The most typical is parameter homogeneity, which implies that $\alpha_{it} = \alpha$ for all

i; t and $\beta_{it} = \beta$ for all i; t.

The random-effects model was chosen as the final model based on the Hausman test findings from the preceding phase. Rational effects model estimation is a different approach to estimate using fixed effects models. The distinction between this model and The breadth of the origin for each of the variables is not fixed, despite fixed effects and are selected randomly. Therefore, the value of α_i in the general model is equal to:

$\alpha_{it} = \mu_i + v_{it}$, where v_i is a random variable that has an σ^2_v. variance and a of mean zero. An essential presumption is that the variable v_i must not be affected by the underlying factors and components of the error u_i. If v_i and explanatory factors are associated, then skewed and inconsistent estimates are obtained (Baltagi, 2008). The benefit of that model over the fixeed effects model, however, is that there are fewer variables that need to be calculated. This model's general structure is as follows:

$$Y_{it} = \mu + \beta' X_{it} + v_i + u_{it}$$

We utilized the GLS estimator to estimate this model, which has a heterogeneous variance since the differences between the various portions are not equal. The outcomes are as follows:

$$\widehat{\beta} = (X'\Omega^{-1}X)^{-1}(X'\Omega^{-1}Y)$$
$$\widehat{\Omega} = \mathrm{I} \otimes \Sigma$$

Where $\sum$ is the variance of u_{it} and I is the unit matrix and Ω is the variance-covariance matrix.

In the continuation of this section, for each of the hypotheses, a panel model was written in R. Coefficient tables were obtained for each hypothesis, which examines the independent variable's coefficient and the width coefficient of the origin.

In addition, the correlation between the variables was examined and their

relationship graph was drawn (Baltagi, 2008).

The essential concepts of variance and standard deviation and connected statistical concepts that are combined in correlation. Variance is the spread of the variable about the mean and The square root of the variance is the standard deviation. The following formula may be used to calculate the correlation coefficient, which shows how strongly two variables are related:

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

Where:

- r_{xy} – the linear connection between the variables x and y's correlation coefficient
- x_i – the values of the x-variable in a sample
- $\bar{x}$ – the mean of the values of the x-variable
- y_i – the values of the y-variable in a sample
- $\bar{y}$ – the mean of the values of the y-variable

The coefficient of correlation is a value between -1 and +1. A correlation coefficient of 1 denotes a fully positive link. As variable x rises, variable y also rises. Variable x decreases as variable y decreases. A correlation value of -1 displays an exact negative connection. As variable x increases, variable z decreases. As variable x decreases, variable z increases. There is a common rule of thumb for judging the strength of a connection based on its r value, using the absolute value of the r value to make all values positive:

Absolute Value of r	Strength of Relationship
r < 0.3	None or very weak
0.3 < r <0.5	Weak
0.5 < r < 0.7	Moderate
r > 0.7	Strong

+ It is typically thought that there is a significant correlation when the r value between two variables is greater than 0.7.

2.3. Summary Statistics

Data obtained from several parameters of food security and health over a period (2012-2019) for 31 OECD countries, this study cannot be considered simply a time series or cross-sectional. Therefore, panel data is used, which is a combination of regression and time series. To test the hypotheses, linear regression panel data analysis was used. It should be noted that RStudio was used to analyze the panel model and plm-package in that software. The hypothesis examined in this research is whether FS ratings are significantly correlated and health status, health risks, health resources, healthcare use, GDP and GNI in OECD countries. The food security scores of GFSI, which is open to the public and introduced by EIU is used as an independent variable. The dependent variables are taken from the OECD health database which will be health status, health risks, health resources, healthcare use, and GDP, and GNI.

The research hypotheses in this study were as follows:

H1: There is a significant relationship between food security scores and health status in OECD countries.

H1a. There is a significant relationship between food security scores and life expectation at birth in OECD countries.

H1b. There is a significant relationship between food security scores and life expectation at 65 in OECD countries.

H1c. There is a significant relationship between food security scores and infant mortality rates in OECD countries.

H1d. There is a significant relationship between food security scores and potential years of life lost in OECD countries.

H1e. There is a significant relationship between food security scores and deaths from cancer in OECD countries.

H2: There is a significant relationship between food security scores and health risks in OECD countries.

H2a. There is a significant relationship between food security scores and Daily smokers in OECD countries.

H2b. There is a significant relationship between food security scores and alcohol consumption in OECD countries.

H2c. There is a significant relationship between food security scores and overweight or obese population in OECD countries.

H2d. There is a significant relationship between food security scores and lack of social support in OECD countries.

H3: There is a significant relationship between food security scores and health resources in OECD countries.

H3a. There is a significant relationship between food security scores and health spending in OECD countries.

H3b. There is a significant relationship between food security scores and pharmaceutical spending in OECD countries.

H3c. There is a significant relationship between food security scores and doctors per 1000 population in OECD countries.

H3d. There is a significant relationship between food security scores and nurses per 1000 population in OECD countries.

H4: There is a significant relationship between food security scores and healthcare use in OECD countries.

H4a. There is a significant relationship between food security scores and doctors consultations in OECD countries.

H4b. There is a significant relationship between food security scores and CT exams in OECD countries.

H4c. There is a significant relationship between food security scores and MR exams in OECD countries.

H4d. There is a significant relationship between food security scores and Cesarean in OECD countries.

H4e. There is a significant relationship between food security scores and Infant vaccination rates in OECD countries.

H4f. There is a significant relationship between food security scores and length of hospital stay in OECD countries.

H4g. There is a significant relationship between food security scores and hospital discharge in OECD countries.

H5: There is a significant relationship between food security scores and Gross Domestic Product.

H6: There is a significant relationship between food security scores and Gross National Income

3. RESULTS

The results of this research were reported in two parts. The first part was the systematic review results, and the second part was the output of the statistical analysis of the linear regression panel data.

3.1. Outcomes of The Systematic Review

Total publications included in this systematic review were a total of 4. Table 3.1 shows the characteristics of several research projects that looked the relationship between health and FS. Of them, 4 were conducted in the US. The most recent and longest papers were released in 2021 and 2011 respectively. Moreover 1 of these studies was systematic reviews, 2 were cross-sectional, 1 was qualitative and 1 was reviews.

Table 3.1 Characteristics of studies included in review

	Title	Type of the study	Statistical Methods	Exposure
1	Food Insecurity and Hypoglycemia Among Safety Net Patients with Diabetes	Cross-sectional survey	multivariate logistic regression	the US Household FS Survey Module, a 6-item survey
2	Association between food insecurity and access to a mental health professional: cross-sectional analysis of NHANES 2007–2014	Cross-sectional survey	multivariable logistic regression models	self-reported interaction with an MHP within the last year
3	Food Insecurity and its Impact on Body Weight, Type 2 Diabetes, Cardiovascular Disease, and Mental Health	Systematic Review	meta-analysis	Health status & health risks
4	Care for food-insecure enrollees in medicare advantage vs traditional medicare	retrospective cohort study	2-stage least squares regression model	the 2015-2016 Medicare Current Beneficiary Survey

Table 3.2 is a summary of their findings outlining the link between food security and health. Because of the diversity of the interventions examined and outcomes assessed, meta-analysis could not be done.

Table 3.2 Summary of findings of the included studies

	Title	Author (year)	Setting	Results
1	Food Insecurity and Hypoglycemia Among Safety Net Patients With Diabetes	Hilary K. Seligman, 2011	USA	Participants who experienced food insecurity were substantially younger, had lower household incomes, and smoked more frequently. (34%). In urban health and community safety clinics, about 50% of diabetic patients are at danger of hunger because they cannot afford food. Also, after correcting for other risk variables, this food instability remains a major risk factor for recurring episodes of severe hypoglycemia.
2	Association between food insecurity and access to a mental health professional: cross-sectional analysis of NHANES 2007–2014	Burruss N.C., 2021	USA	According to this study, those with FI were substantially more likely than persons who haven't seen an MHP in the past year and don't have FI.
3	Food Insecurity and its Impact on Body Weight, Type 2 Diabetes, Cardiovascular Disease, and Mental Health	Thomas M.K. 2021	Multi countries	According to several research, failed mental health outcomes are associated with FI such as a higher incidence of stress, sadness, anxiety, sleep problems, and suicidal thoughts. FI has a detrimental influence on the results of type 2 diabetes, psychological wellbeing, and medical costs. These extensive analyses repeatedly demonstrated that FI was associated with worse mental health outcomes.
4	Care for food-insecure enrollees in medicare advantage vs traditional medicare	Park S., Langellier B.A. 2021	USA	Focused on food insecure participants in TM, FI participants in MA showed significantly lower health care consumption and financial hardship. Participants who indicated FS showed a similar trend, however the difference in health care usage between FI enrollees in MA and TM was greater than the difference between participants who claimed food security in MA and TM. MA and TM's health conditions were not considerably different from one another.

The results showed that food insecurity was the problem of 46% of people. Participants who experienced food insecurity were noticeably younger, had lower household incomes, and smoked more frequently (34%). In the fully adjusted model, hypoglycemia was significantly associated with body mass index, alcohol abuse, comorbidity burden, and food insecurity. In urban health and community safety clinics, about 50% of diabetic patients are in danger of going hungry because they cannot afford food. However, after adjusting for other hypoglycemia risk factors, a significant risk factor for recurrent bouts of severe hypoglycemia is still FI. The findings revealed high levels of blood glucose becoming more common (28%) and argued that this increased risk might be partially explained by FI. Hypoglycemia is one of the most frequent pharmacological adverse effects that prompt ER trips and hospitalization. One of the most frequent pharmacological adverse effects that prompt trips to the ER and hospitalization is hypoglycemia (Seligman, 2011).

Major Depressive Disorder (MDD) was reported by 8.2% and food insecurity by 13.9% of the 19,789 participants. Bivariate analysis revealed that persons with food insecurity had considerably increased likelihood of MDD (5.4% vs 2.9%, p 0.0001) and of having viewed a MHP in the previous 12 months (14.1% vs 6.8%, p 0.0001). Oldest with food insecurity had greater rates of seeing an MHP in multivariable models (OR = 1.33, CI: 1.06, 1.65).

Adult men and women residing in low- and middle-income nations, along with adult women, have an association among food insecurity and obesity, are discussed in these systematic reviews and analysis by method Meta. Diabetes type 2 and food insecurity were shown to differ by gender, with adult females having a higher probability of developing the disease. High food insecurity was linked to a greater risk of cardiovascular death as well as cardiovascular disease. Additionally, several studies have linked FI to mental illness outcomes, such as greater likelihood of stress, sadness, anxiety, sleep problems, and suicide thinking. FI has a detrimental influence on the course of type 2 diabetes, psychological wellbeing, and

medical expenses. These in-depth analyses have repeatedly demonstrated that FI is linked to negative mental health consequences (Thomas, et al., 2021).

There were no significant differences between MA and TM registrations based on FI status. Food insecure participants in MA exhibited considerably reduced using health services and monetary pressure compared to FI participants in TM. An analogous pattern was seen among participants who reported FS, however the variations in the usage of healthcare between FI participants in TM and MA was higher than the difference between FS participants in TM and MA. There was no discernible difference between TM and MA's health status (Park et al., 2021).

3.2. Statistical analysis of linear regression panel data output

In this section, for each of the hypotheses, a panel model was written in R. Coefficient tables were obtained for each hypothesis, which examines the width percentage of the origin and the coefficient regarding the predictor variables.

The essential concepts of standard deviation and variance connect statistics-related ideas that are combined in correlation. The standard deviation is the variation squared, which is the measure of how widely apart two variables are from one another. The correlation coefficient, which shows how closely two variables are related. In addition, the correlation between the variables was examined and their relationship graph was drawn.

H1: There is a significant relationship between FS scores and health status in OECD countries.

H1a. There is a meaningful relationship between FS scores and life expectation at birth in OECD countries.

H1b. There is a significant relationship between FS scores and life expectation at 65 in OECD countries.

H1c. There is a meaningful relationship between FS scores and infant mortality rates in OECD countries.

H1d. There is a significant relationship between FS scores and potential years of life lost in OECD countries.

H1e. There is a meaningful relationship between FS scores and deaths from cancer in OECD countries.

1. Regarding the first assumption:

In the first hypothesis, it is investigated whether the health status is related to the FS variable in OECD countries. Based on information from 31 OECD-selected countries tested between 2012 and 2019, there are 5 variables of health status data, and the first hypothesis has been tested.

H1a. There is a significant relationship between life expectancy at birth and food security:

```
Coefficients:
               Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   70.059428   1.513603 46.2865 < 2.2e-16 ***
FOOD.SECURITY  0.137004   0.019438  7.0483 1.811e-12 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of R software obtained using the panel model, it concludes:

• There is a significant relationship between life expectancy at birth and food security. In other words, the greater the food security, the higher the life expectancy at birth.

Using the cor function in software R, the correlation between the two variables of life expectancy at birth and food security was obtained:

> cor(data$Life.expectancy.at.birth, data$FOOD.SECURITY)

[1] 0.6838335

There is a moderate, positive, linear relationship between life expectancy at birth and food security.

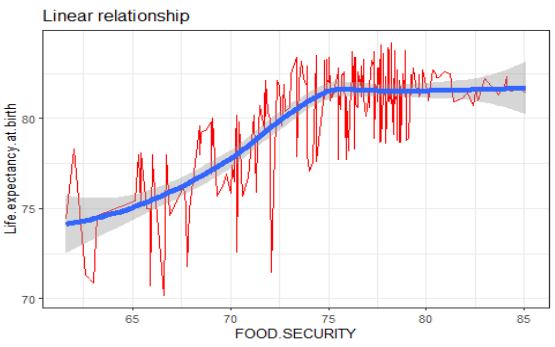


Fig. 3.1 The graph of the relationship between the two variables of life expectancy at

birth and food security

H1b. There is a meaningful relationship between life expectancy at age 65 and food security:

```
Coefficients:
                Estimate Std. Error z-value Pr(>|z|)
(Intercept)   18.4718046  2.0445418  9.0347   <2e-16 ***
FOOD.SECURITY  0.0086268  0.0265886  0.3245   0.7456
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is no meaningful connection between life expectancy at age 65 and food security. In other words, the more or less food security, the life expectancy at age 65 does not change.

Using the cor function in R, the correlation between the two variables of life expectancy at age 65 and food security was obtained:

> cor(data$life.expectation.at.65, data$FOOD.SECURITY)

[1] 0.05682051

This means that there is no correlation, or relationship, between the two variables.

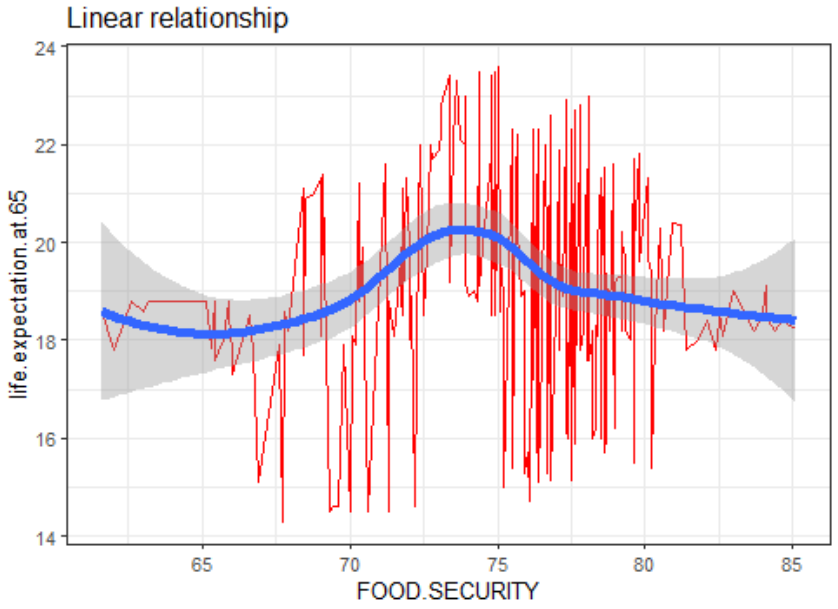


Fig. 3.2 The graph of the relationship between the two variables of life expectancy at age 65 and food security

H1c. There is a significant relationship between infant mortality rate and food security:

```
Coefficients:
               Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   11.446115   1.350679  8.4743 < 2.2e-16 ***
FOOD.SECURITY -0.093509   0.017441 -5.3615 8.253e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a significant relationship between infant mortality rates and food security. In othar words, the higher the food security, the lower the child mortality rate.

Using the cor function in R software, the correlation among the two variables of infant mortality rate and food security was obtained:

> cor(data$Infant.mortality, data$FOOD.SECURITY)

[1] -0.7560413

There is a fairly strong negative relationship between child mortality rate and food security.

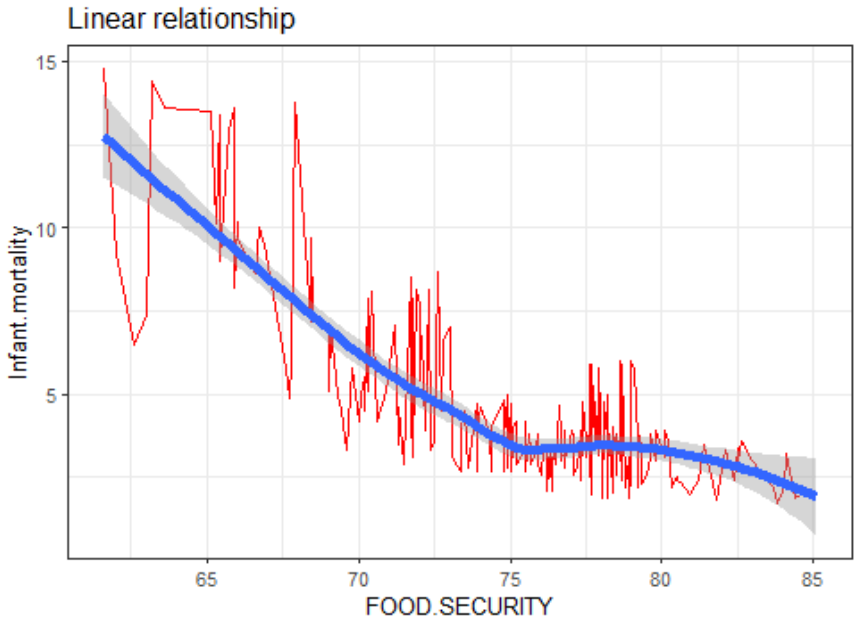


Fig. 3.3 The graph of the connection between the two variables of child mortality rate and FS

H1d. There is a meaningful connection between FS and potential years of life lost:

```
Coefficients:
               Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   6889.465    610.740 11.2805 < 2.2e-16 ***
FOOD.SECURITY  -27.158      7.066 -3.8434 0.0001213 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a significant relationship between potential years of life lost and FS. In other words, the greater the food security, the shorter the years of life lost.

Using the cor function in R software, the correlation between the two variables of years of potential life wasted and food security was obtained:

> cor(data$potential.years.of.life.lost, data$FOOD.SECURITY)

[1] -0.6353062

There is a moderate, negative relationship between potential years of life lost and food security.

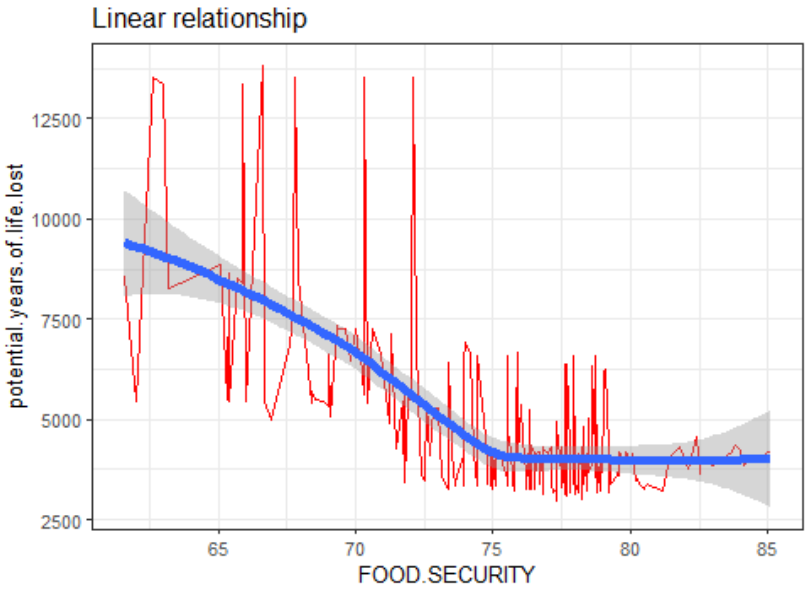


Fig. 3.4 The graph of the connection among between the two variables of potential years of life lost and food security

H1e. There is a meaningful connection between the number of deaths due to cancer and FS:

```
Coefficients:
               Estimate Std. Error z-value Pr(>|z|)
(Intercept)   242.83853   17.85740 13.5988  < 2e-16 ***
FOOD.SECURITY  -0.56819    0.22431 -2.5331  0.01131 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a meaningful connection among the number of deaths due to cancer and FS. In other words, the higher the food security, the lower the death rate from cancer.

Using the cor function in R software, the correlation between the two variables of deaths from cancer and food security was obtained:

> cor(data$DEATHCANCER, data$FOOD.SECURITY)

[1] 0.1281148

There is a very weak positive, linear relationship between deaths from cancer and food security.

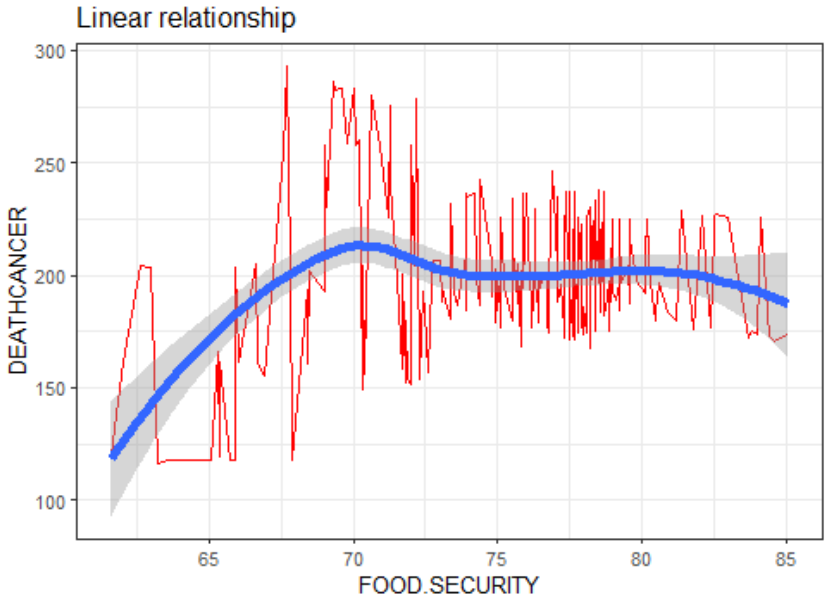


Fig. 3.5 The graph of the connection between the two variables of deaths from cancer and FS

H2: There is a significant relationship between FS scores and health risks in OECD countries.

H2a. There is a significant connection between FS scores and Daily smokers in OECD countries.

H2b. There is a meaningful relationship between FS scores and alcohol consumption in OECD countries.

H2c. There is a significant connection between FS scores and overweight or obese population in OECD countries.

H2d. There is a meaningful relationship between FS scores and lack of social support in OECD countries.

2. Regarding the second assumption:

In the second hypothesis, it wants to examine whether health risks are importantly – related to the FS variable in OECD countries.

H2a. There is a significant relationship between the number of smokers and food security:

```
Coefficients:
              Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   43.27968    7.89401  5.4826 4.191e-08 ***
FOOD.SECURITY -0.32403    0.10349 -3.1310  0.001742 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a meaningful relationship between the number of smokers and FS. In other words, the higher the food security, the lower the number of smokers.

Using the cor function in R software, the correlation between the number of smokers and food security was obtained:

> cor(data$Daily.smokers, data$FOOD.SECURITY)

[1] -0.007989884

There is no correlation, between the number of smokers and food security.

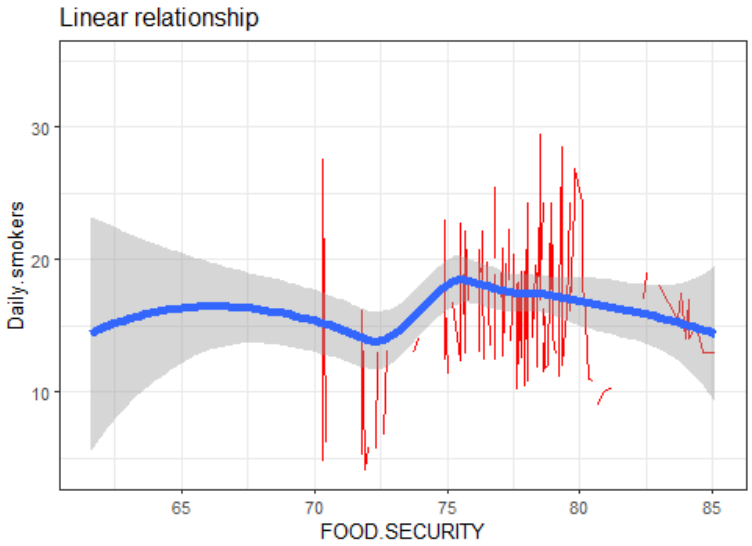


Fig. 3.6 The graph of the relationship between the number of smokers and food security

H2b. There is a meaningful connection relationship between alcohol consumption and FS:

```
Coefficients:
                Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   13.019346   1.358215  9.5856 < 2.2e-16 ***
FOOD.SECURITY -0.058029   0.016825 -3.4490 0.0005627 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a significant connection among alcohol consumption and FS. In other words, the higher the food security, the lower the alcohol consumption.

Using the cor function in R software, the correlation between drinking alcohol and FS was obtained:

> cor(data$alcohol.consumption, data$FOOD.SECURITY)

[1] 0.3171181

There is a Weak, positive, linear relationship between alcohol consumption and food security.

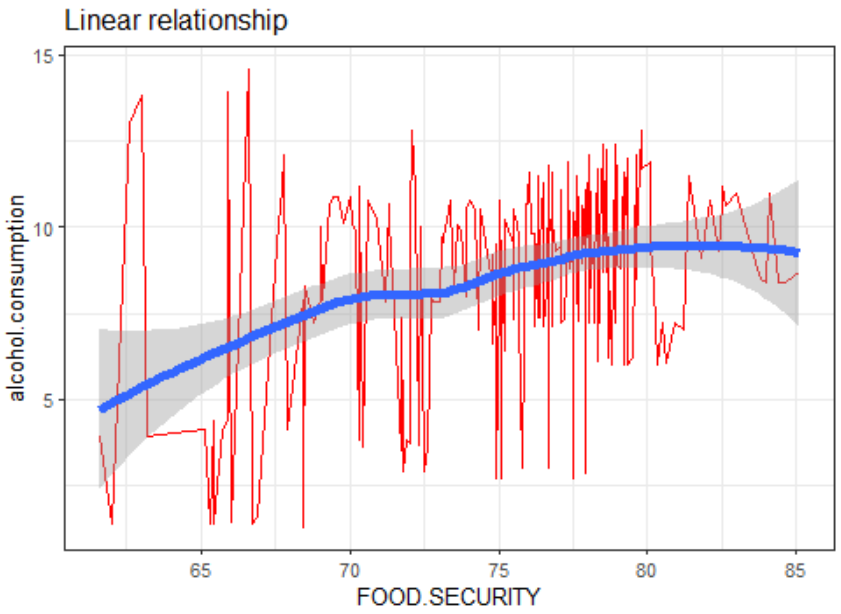


Fig. 3.7 The graph of the connection between alcohol consumption and food security

H2c. There is a meaningful connection between the number of obese people and food security:

```
Coefficients:
              Estimate Std. Error z-value Pr(>|z|)
(Intercept)   39.15120   18.34174  2.1345   0.0328 *
FOOD.SECURITY  0.28204    0.23876  1.1813   0.2375
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is no meaningful relationship among the number of overweight or obese people and FS. That is to say, the higher the food security, the more the number of overweight or obese people does not change.

Using the cor function in R software, the correlation between amount of overweight people and food security was obtained:

> cor(data$overweight.or.obese.population, data$FOOD.SECURITY)

[1] -0.08715179

There is no linear relationship between the number of overweight or obese people and FS.

* For the reason that that the variable of the number of overweight people has a lot of lost data, it is not possible to output a relationship diagram.

H2d. There is a significant connection among lack of social support and FS:

```
Coefficients:
                Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   30.040280   5.838985  5.1448 2.678e-07 ***
FOOD.SECURITY -0.323376   0.077149 -4.1916 2.770e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a meaningful relatianship between lack of social support and FS. That is to say, the greater the food security, the less social support there is.

Using the cor function in R software, the correlation between lack of social support and FS was obtained:

> cor(data$lack, data$FOOD.SECURITY)

[1] -0.3197459

There is a weak, negative, linear relationship between lack of social support and food security.

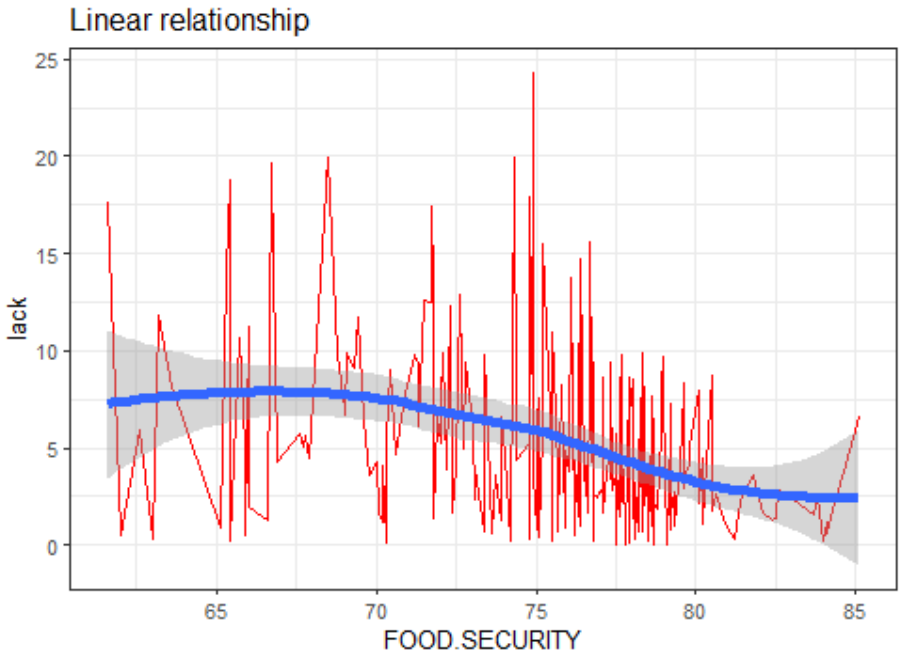


Fig. 3.8 The graph of the connection between lack of social support and food security

H3: There is a significant connection between FS scores and health resources in OECD countries.

H3a. There is a significant relationship between FS scores and health spending in OECD countries.

H3b. There is a meaningful connection between FS scores and pharmaceutical spending in OECD countries.

H3c. There is a meaningful relationship between FS scores and doctors per 1000 population in OECD countries.

H3d. There is a meaningful relationship between FS scores and nurses per 1000 population in OECD countries.

3. Regarding the third assumption:

In the third hypothesis, it wants to examine whether health resources have a meaningful connection with the FS variable in OECD countries.

H3a. There is a significant relationship between health spending and food security:

```
Coefficients:
               Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   -3007.339   1412.631 -2.1289   0.03326 *
FOOD.SECURITY    89.818     18.398  4.8819 1.051e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a significant relationship between health costs and food security.

Using the cor function in R software, the correlation between health spending and food security was obtained:

> cor(data$Health.spending, data$FOOD.SECURITY)

[1] 0.6719844

There is a moderate positive relationship between health spending and food security.

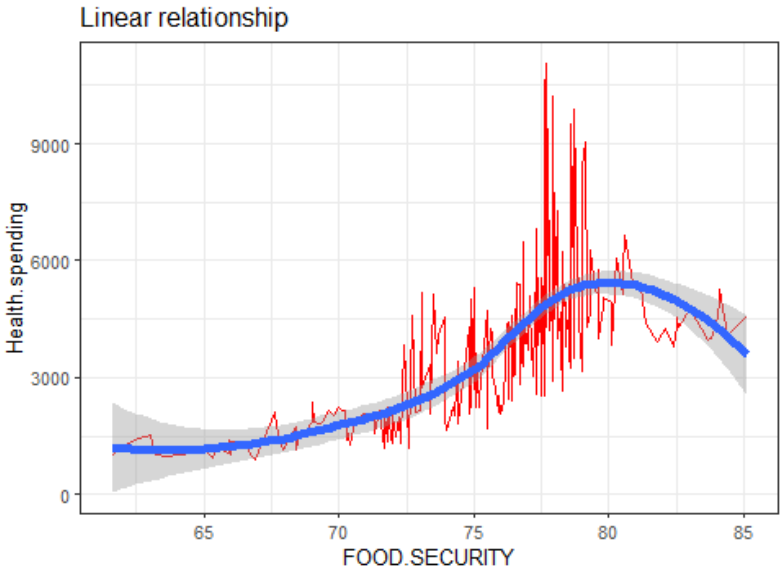


Fig. 3.9 The graph of the relationship between health spending and food security

H3b. There is a meaningful relationshiip between pharmaceutical spending and FS:

```
Coefficients:
                Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   40.403431   4.128913  9.7855 < 2.2e-16 ***
FOOD.SECURITY -0.324181   0.053351 -6.0764 1.229e-09 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a meaningful connection between pharmaceutical spending and FS. In other words, the greater the food security, the lower the cost of medicine.

Using the cor function in R software, the correlation between pharmaceutical spending and food security was obtained:

> cor(data$pharmaceutical.spending, data$FOOD.SECURITY)

[1] -0.5823588

There is a moderate negative relationship between pharmaceutical spending and food security.

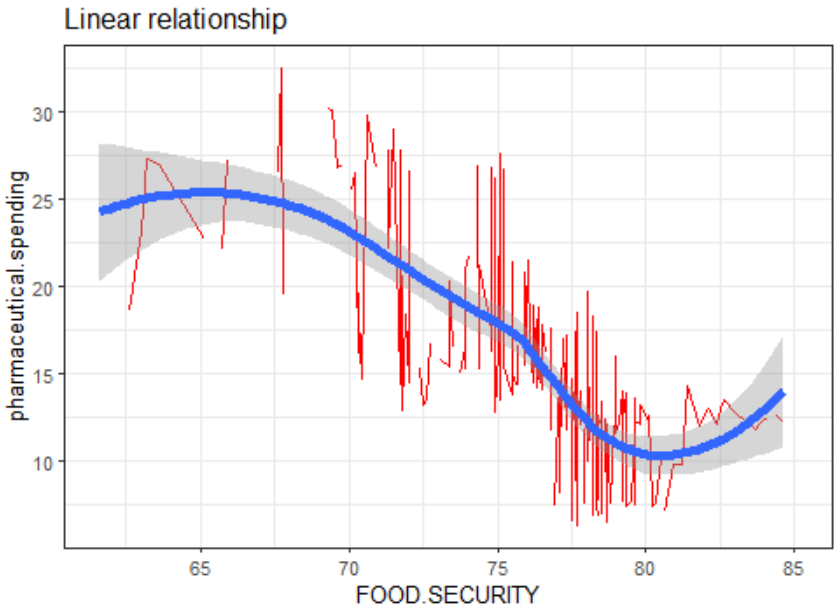


Fig. 3.10 The graph of the connection between pharmaceutical spending and food security

H3c. There is a notable connection between the number of doctors per 1000 people and food security:

```
Coefficients:
               Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   1.1404357  0.5088031  2.2414     0.025 *
FOOD.SECURITY 0.0292577  0.0064472  4.5381 5.677e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a notable connection between the quantity of physicians per 1000 people and FS. In other words, the higher the food security, the higher the number of doctors per 1,000 people.

Using the cor function in R software, the correlation between the number of doctors per 1000 population and food security was obtained:

> cor(data$doctors, data$FOOD.SECURITY)

[1] 0.3370288

There is a weak positive relationship between the number of doctors per 1000 population and food security.

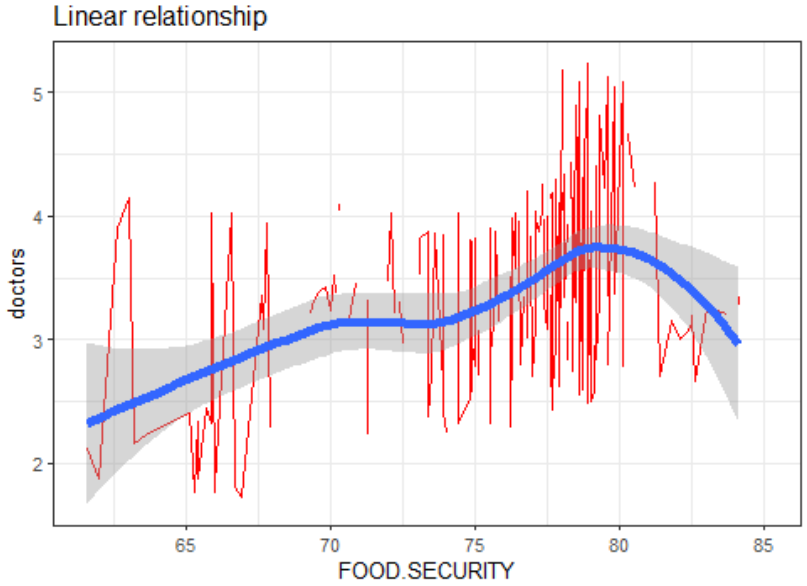


Fig. 3.11 The graph of the connection between the number of doctors per 1000 populations and food security

H3d. There is a notable relationship between the quantity of nurses per 1000 people and food security:

```
Coefficients:
              Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   6.472921   1.431166  4.5228 6.102e-06 ***
FOOD.SECURITY 0.033101   0.017280  1.9156   0.05542 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is no notable connection between the quantity of nurses per 1000 people and FS. That is to say, the greater the food security, the more the number of nurses per 1,000 people does not change.

Using the cor function in R software, the correlation among the quantity of nurses per 1000 population and food security was obtained:

> cor(data$Nurses, data$FOOD.SECURITY)

[1] 0.5686566

There is a moderate positive relationship between the number of nurses per 1000 population and food security.

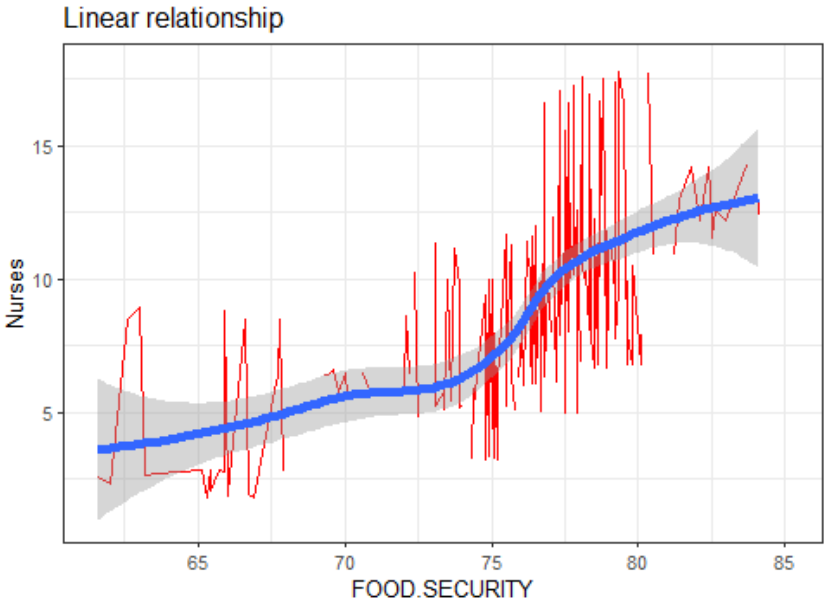


Fig. 3.12 The graph of the connection between the quantity of nurses per 1000 populations and food security

H4: There is a significant connection between FS scores and healthcare use in OECD countries.

H4a. There is a notable relationship among FS scores and doctors consultations in OECD countries.

H4b. There is a meaningful connection between FS scores and CT exams in OECD countries.

H4c. There is a significant relationship among FS scores and MR exams in OECD countries.

H4d. There is a notable connection between FS scores and Cesarean in OECD countries.

H4e. There is a meaningful relationship between FS scores and Infant vaccination rates in OECD countries.

H4f. There is a significant connection among FS scores and length of hospital stay in OECD countries.

H4g. There is a notable relationship between FS scores and hospital discharge in OECD countries.

4. Regarding the fourth assumption:

In the fourth hypothesis, it wants to examine whether the use of medical care has a notable relationship with FS variables in OECD nations.

H4a. There is a notable connection among doctors' consultations and FS:

```
Coefficients:
              Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   5.518457   1.500179  3.6785 0.0002346 ***
FOOD.SECURITY 0.012108   0.018564  0.6522 0.5142673
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is no significant relationship between physician consultation and FS. That is to say, the greater the food security, the more the doctors' advice will not change.

Using the cor function in R software, the correlation between doctors' consultations and food security was obtained:

> cor(data$doctors.consultations, data$FOOD.SECURITY)

[1] -0.1653905

There is no correlation between doctors' consultations and food security.

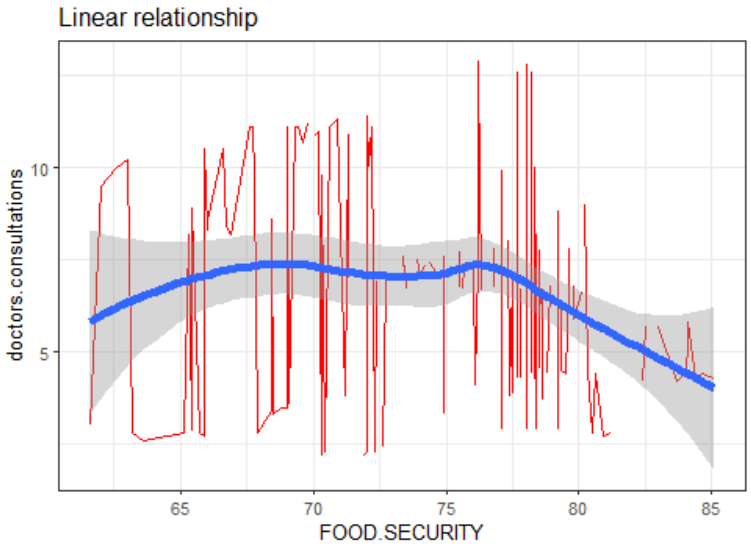


Fig. 3.13 The graph of the relationship between doctors' consultations and food security

H4b. There is a significant relationship between CT exams and food security:

```
Coefficients:
               Estimate Std. Error z-value Pr(>|z|)
(Intercept)   -57.32842   36.45413 -1.5726 0.115807
FOOD.SECURITY   1.21004    0.46382  2.6088 0.009085 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a significant relationship between CT exams and food security. That is to say, the greater the FS index, the higher the CT exams.

Using the cor function in R software, the correlation between CT exams and food security was obtained:

> cor(data$CT.exams, data$FOOD.SECURITY)

[1] -0.0597504

There is no correlation between CT exams and food security.

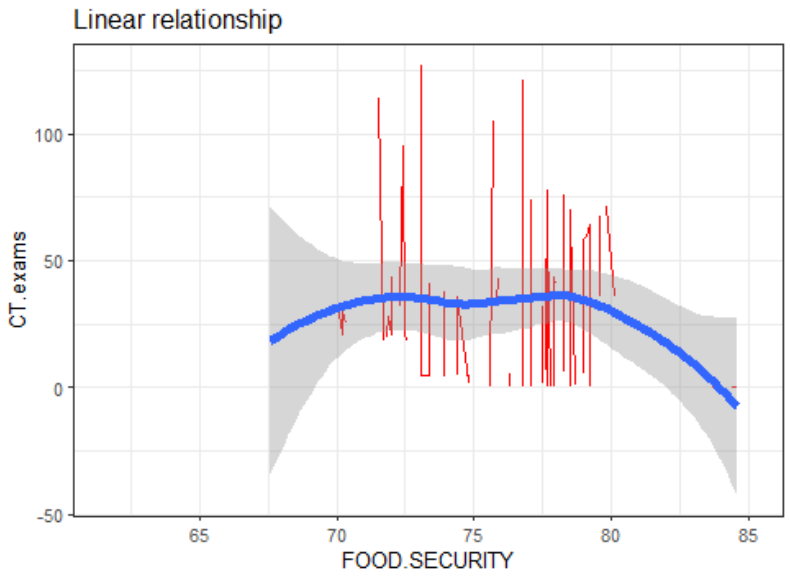


Fig. 3.14 The graph of the relationship between CT exams and food security

H4c. There is a significant relationship between MR exams and food security:

```
Coefficients:
               Estimate Std. Error z-value Pr(>|z|)
(Intercept)   -39.49567   44.69451 -0.8837  0.37687
FOOD.SECURITY   0.95312    0.57457  1.6588  0.09715 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is no notable connection between MR exams and food security. In other words, the higher the FS, the MR exams will not change.

Using the cor function in R software, the correlation between MR exams and food security was obtained:

> cor(data$MR.exams, data$FOOD.SECURITY)

[1] 0.01478992

There is no correlation between MR exams and food security.

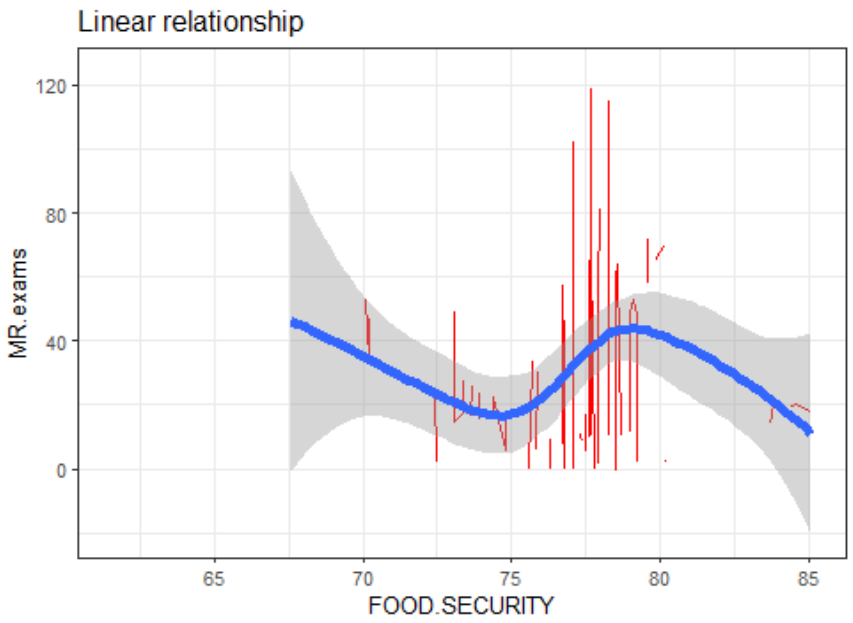


Fig. 3.15 The graph of the relationship between MR exams and food security

H4d. There is a notable connection among the number of cesarean and FS:

```
Coefficients:
                 Estimate  Std. Error z-value  Pr(>|z|)
(Intercept)    2.6306e+02  6.8270e+01  3.8533 0.0001165 ***
FOOD.SECURITY -8.1448e-04  8.7141e-01 -0.0009 0.9992542
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is no notable relationship among the quantity of cesarean and FS. In other words, the higher the food security, the more the number of cesarean does not change.

Using the cor function in R software, the correlation between cesarean and food security was obtained:

> cor(data$Cesarean, data$FOOD.SECURITY)

[1] -0.4212634

There is a week, negative, linear relationship between cesarean and food security.

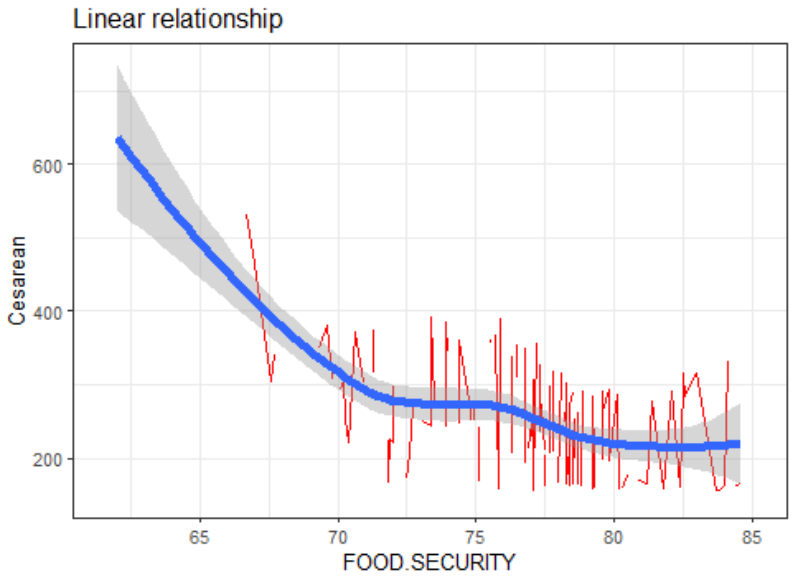


Fig. 3.16 The graph of the relationship between cesarean and food security

H4e. There is a notable relationship among infant vaccination rate and FS:

```
Coefficients:
                Estimate Std. Error z-value Pr(>|z|)
(Intercept)   52.681227  21.754541  2.4216  0.01545 *
FOOD.SECURITY -0.068026   0.282721 -0.2406  0.80986
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is no significant relationship between infant vaccination rate and FS. That is to say, the higher the food security, the more the rate of vaccination of infants does not change.

Using the cor function in R software, the correlation between infant vaccination rate and food security was obtained:

> cor(data$Influenza.vaccination.rates, data$FOOD.SECURITY)

[1] 0.129544

There is no relationship, between infant vaccination rate and food security.

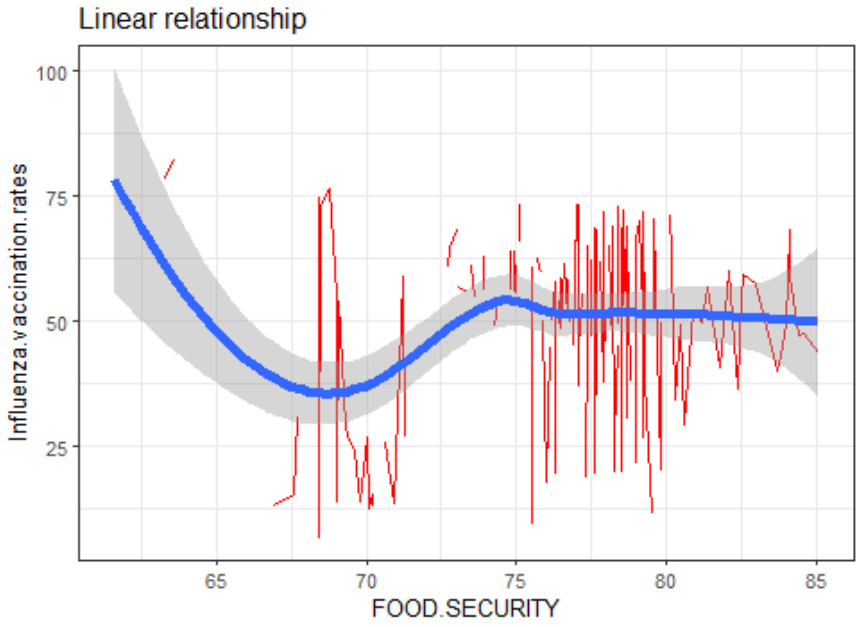


Fig. 3.17 The graph of the relationship between infant vaccination rate and food security

H4f. There is a significant connection among length of hospital stay and FS:

```
Coefficients:
               Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   10.238722   1.210819   8.456 < 2.2e-16 ***
FOOD.SECURITY -0.047196   0.014800  -3.189  0.001428 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a notable connection among length of stay in hospital and FS. In other words, the greater the food security, the shorter the hospital stay.

Using the cor function in R software, the correlation between duration of hospitalization and FS was obtained:

> cor(data$length.of.hospital.stay, data$FOOD.SECURITY)

[1] -0.009729969

There is no relationship, between length of hospital stay and food security.

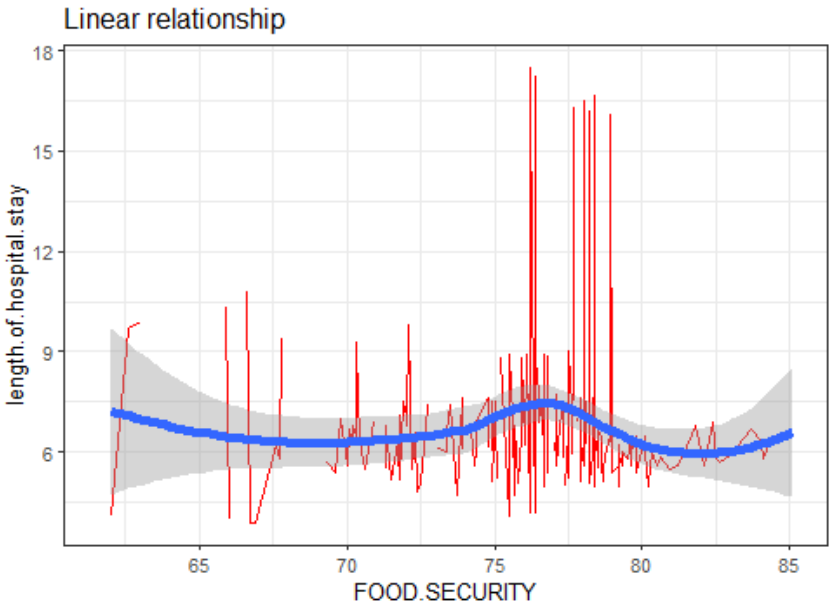


Fig. 3.18 The graph of the relationship between length of hospital stay and food security

H4g. There is a meaningful relationship among hospital discharge rate and FS:

```
Coefficients:
                Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   21951.150   2696.437  8.1408 3.927e-16 ***
FOOD.SECURITY   -93.530     33.409 -2.7996  0.005117 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Based on the output of the R software obtained using the panel model, the result was:

• There is a notable relationship between hospital discharge rate and FS. In other words, the higher the food security, the lower the hospital discharge rate.

Using the cor function in R software, the correlation between hospital discharge and food security was obtained:

> cor(data$hospital.discharge.rates, data$FOOD.SECURITY)

[1] 0.2749564

There is a very week positive, linear relationship between hospital discharge and food security.

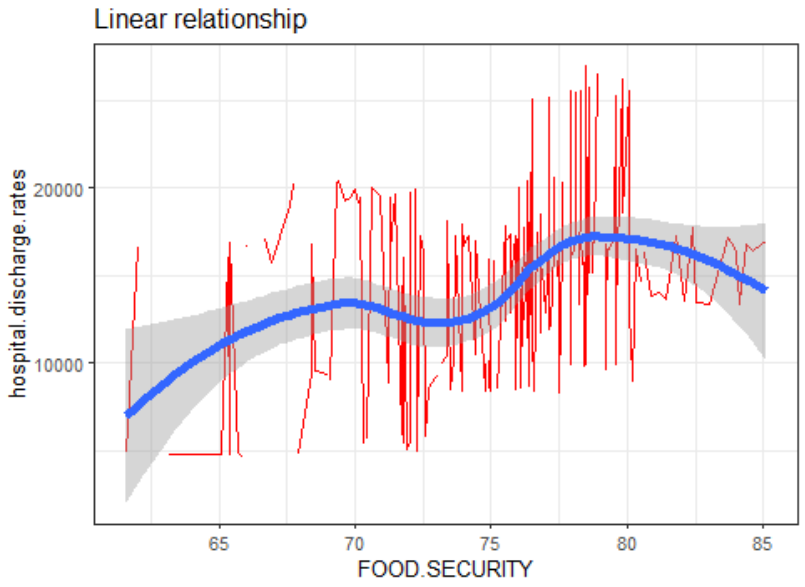


Fig. 3.19 The graph of the relationship among hospital discharge and FS

H5: There is a meaningful connection between FS scores and Gross Domestic Product.

5. Regarding the fifth hypothesis:

In the fifth hypothesis, it wants to examine whether Gross Domestic Product has a significant connection with the FS variable in OECD nations.

```
Coefficients:
                Estimate Std. Error z-value  Pr(>|z|)
(Intercept)   -65841.21   14661.00 -4.4909 7.092e-06 ***
FOOD.SECURITY   1415.17     192.99  7.3329 2.252e-13 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

• The outcomes show that GDP in OECD countries has a significant relationship with FS. That is to say, the higher the food security, the higher the GDP.

Using the cor function in R software, the correlation between GDP and food security was obtained:

> cor(data$Gross.Domestic.Product, data$FOOD.SECURITY)

[1] 0.7329731

There is a fairly strong positive relationship between GDP and food security.

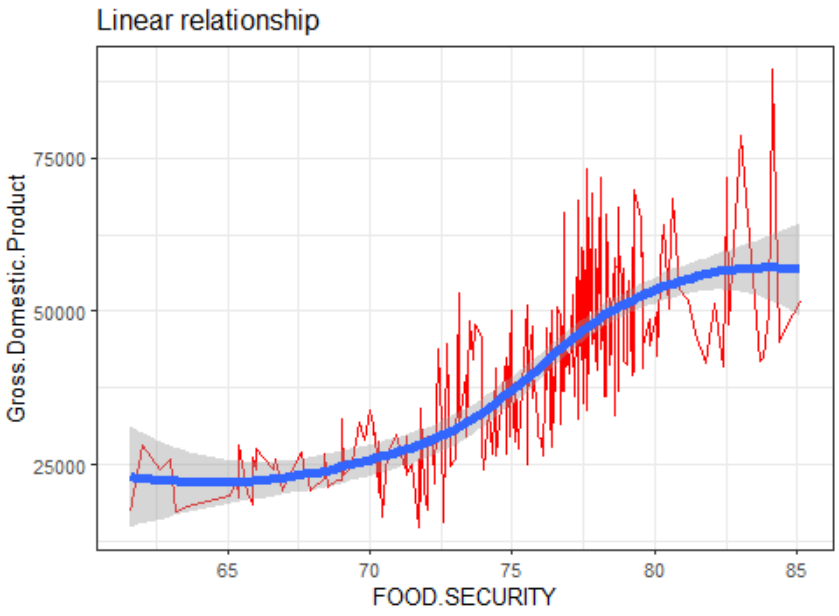


Fig. 3.20 The graph of the relationship between GDP and food security

H6: There is a meaningful connection between FS scores and Gross National Income.

6. Regarding the sixth assumption:

In the sixth hypothesis, it wants to examine whether Gross National Income has a significant connection with the FS variable in OECD countries.

```
Coefficients:
                Estimate Std. Error z-value Pr(>|z|)
(Intercept)   -60340.03   13699.37 -4.4046 1.06e-05 ***
FOOD.SECURITY   1334.49     180.06  7.4114 1.25e-13 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

The outcomes show that Gross National Income in OECD countries has a significant relationship with FS. That is to say, the higher the food security, the higher the Gross National Income.

Using the cor function in R software, the correlation between Gross National Income and food security was obtained:

> cor(data$Gross.National.Income, data$FOOD.SECURITY)

[1] 0.7053245

There is a strong positive relationship between Gross National Income and food security.

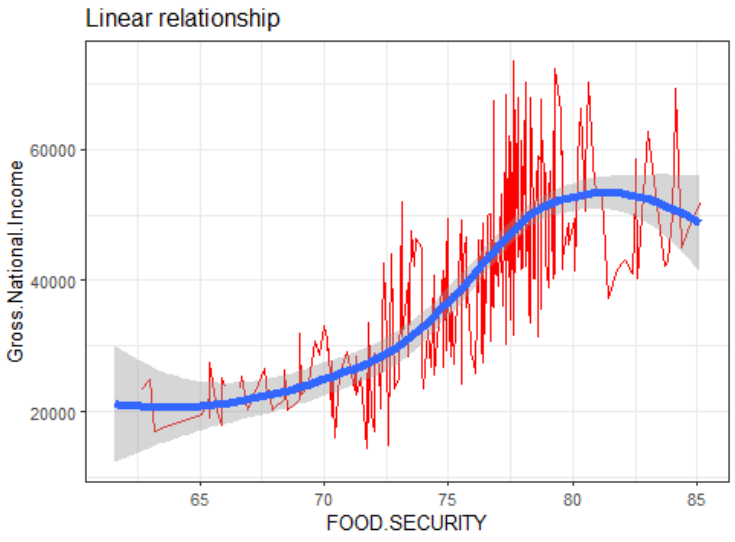


Fig. 3.21 The graph of the connection among Gross National Income and FS

The results of separate regressions for each hypothesis show that only 7 hypotheses have no strong statistical relationship with Food Security (FS), includings; life expectation at 65, obese population, nurses per 1000 population, doctors consultations, MR exams, Cesarean and Infant vaccination rates.

In general, variables life expectancy at birth, GDP and GNI have a strong direct relationship with FS, also, in the correlation graph, the connection between these variables and FS are consistent with the panel regression results. In other words, the greater the food security, the higher the life expectancy at birth. Also, the growth of GDP and GNI in different societies has increased FS over the years.

On the other hand, the increase in FS causes a relatively strong decrease in variables neonatal mortality rates, Years Potentially Lost and pharmaceutical spending. It also causes a significant decrease in daily smokers, alcohol consumption, lack of social support, duration of hospitalization and discharge from the hospital variables. In the results of the statistical analysis, we can also see the slight effect of increasing food security on reducing deaths from cancer. Also, there is a significant relationship between health spending, doctors per 1000, CT exams and FS. In other words, the higher the food security, the higher these variables. Table 3.3. below represents the hypotheses and decision.

Table 3.3 Hypotheses and Decision

		Rejected	Accepted (1)	RS (2)
Health Status	Life expectation at birth		***	M
	Life expectation at 65	×		N
	Infant mortality rates		***	S
	Potential years of life lost		***	M
	Deaths from cancer		*	VW
Health Risks	Daily smokers		**	VW
	Alcohol consumption		***	W
	Overweight	×		N
	Lack of social support		***	W
Health Resources	Health spending		***	M
	Pharmaceutical spending		***	M
	Doctors per 1000 population		***	W
	Nurses per 1000 population	×		N
healthcare Use	Doctors' consultations	×		N
	CT exams		**	W
	MR exams	×		N
	Cesarean	×		N
	Infant vaccination rates	×		N
	Length of hospital stays		**	VW
	Hospital discharge		**	VW
Gross Domestic Product (GDP)			***	S
Gross National Income (GNI)			***	S

(1) Signif. codes, Pr (>|z|) : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.01 ' ' 1

(2) Relationship Strength : Absolute Value of r (r < 0.3, None or very weak), (0.3 < r <0.5, Weak), (0.5 < r < 0.7, Moderate), (r > 0.7, Strong)

4. DISCUSSION

In general, the findings of this research are consistent with prior research in most hypotheses, while some results were unexpected. In the analysis results of a systematic review, no association was found between the dangers of being overweight in children under the age of 18 and food insecurity (Pormutabbed et al., 2020). In contrast to other analyses, there is a direct association between young people aged 12-18 reside in developed nations, but with inferior economic standing and greater likelihood of getting overweight. Despite the overall low prevalence of childhood obesity in Korea, Bae and colleagues' 2021 study indicated a favorable connection between food insecurity and the risk of obesity among 2–17-year-old females but not boys.

In summary, there is strong evidence linking FI with unfavorable health consequences. Medical screening is effective in combating FI and improving cardiovascular, mental health, and hospitalization outcomes. The pandemic of COVID-19 effects on food insecurity shows the need of addressing this problem (Melissa et al., 2021).

FI and hunger are associated with malnutrition, multiple infectious diseases, chronic illnesses, poor physical and mental health, learning difficulties, conflict in society, increasing social and economic disparities, and preventative options, etc., and can have adverse effects on health and society of general developmental activities in children and teenagers (Ke J et al., 2015 and, Hamelin AM et al., 1999).

Most studies have concentrated on FI and obesity, while Moradi's 2018 systematic evaluation and by meta-analysis method also revealed that those with drastic food insecurity had a higher likelihood of being underweight than overweight (49% in vs. 29% increased danger) (Moraadi et al., 2018). Conversely, Rasmussen discovered that those with low or extremely low food insecurity had a higher chance of becoming obese and suffering binge eating problems. Habits like

disordered eating might be the cause of the link between FI and obesity (Rasmussen et al., 2018).

People who live in the food-insecure family circles may go through periods of food scarcity and/or both times of underconsumption and periods of overconsumption to make up for those times when resources were few (Brown et al., 2017). Like this, Nettle postulated a method of evolutionary adaptation they referred to as the "insurance hypothesis," wherein the stores of body extra fat during periods of sporadic entry to a reliable food source (Nettle et al., 2017).

Additionally, Seligman and associates propose a "substitution" effect, where lower-quality, higher-calorie foods take the place of better-quality, lower-calorie meals as they are more affordable and durable. The association between FI and body weight is most likely explained by a mix of these ideas and effects. To investigate the probable processes behind these correlations, longitudinal studies that are well-designed to ascertain the temporal associations between food insecurity and body mass are required (Seligman et al., 2010).

Health expenses, psychological well-being, and type 2 diabetes results are all negatively impacted by food insecurity. Schroeder and colleagues in 2019 shown that people who have type 2 diabetes and food insecurity was related to the likelihood of visiting the ER (OR=1.40, 95% CI 1.15-1.72) and being hospitalized (OR=1.41, 95% CI: 1.15-1.72, % CI: 1.11-1.78). Food insecurity was linked negatively to Taking care of oneself, perceived tension, A1C levels, sadness, diabetes fatalism and diabetic discomfort, according to another study (Walker et al., 2019).

According to research published in 2021, individuals who criticized having food insecurity has a 58% higher death risk compared to individuals who did not (Banerjee et al., 2021). In order to enhance patient-centered care and lessen disparities in the field of maternity care, the American College of Obstetricians and Gynecologists' Committee on Health Care for Disadvantaged Women recommends that obstetricians and gynecologists take patient access to wholesome food and water, as well as additional social factors that affect health, into consideration. They

also urge them to research and document these issues (ACOG, 2000). The social determinants of health affect all demographic groups, and while the first recommendations for food insecurity screening concentrated on the psychological problems that pregnant women faced, an increasing number of organizations have begun to urge FI screening. Also, it is recommended to include children throughout their lives (Gottlieb et al., 2017). The socioeconomic determinants of health were the most current of the five American Healthy Individuals 2030 objectives, with a particular community target aimed at lowering family food insecurity (DHHS, 2020). Screening for FI is critical additionally to addressing Social factors that affect health because food insecurity can conceal underlying medical conditions, result in incorrect diagnoses, reduce drug compliance in the treatment of chronic diseases, boost the usage of ambulance services and emergency rooms, lengthen hospital stays, and increase in medical expenses. As a result, there are several good reasons to incorporate food insecurity screening into a medical visit. The papers that follow discuss difficulties that doctors have encountered while screening for food insecurity as well as possibilities for helping those who test positive by offering them information and assistance (Berkowitz et al., 2018).

Food instability and FI are keys contributor to recurrent episodes of severe hypoglycemia in diabetics. On the other hand, hypoglycemia is one of the most common side effects of medication that leads to visits to the emergency department and hospitalization, even though most cases of hypoglycemia never go to the doctor. Hypoglycemia may induce traumatic events, cognitive impairment, and mortality, depending on its degree and length. It can also lower quality of life (HCR, 2011).

5. CONCLUSION AND RECOMMENDATIONS

In this section, the conclusion of the study is carried out, and it provides recommendations that can serve as a guide for governments and policymakers across OECD countries in paying greater attention to the food security impact on individuals' health and lowering the charge of the healthcare industry. The results of this research also emphasize SDGs, especially goals number 2 and 3.

This study analyzes the association of food security as an independent variable with health parameters in 31 OECD countries for the period 2012-2019 using the panel model and the plm-package.

This study includes 22 response variables: health status, health risks, health resources, healthcare use, GDP per capita, and GNI per capita. This study for the first time examined the relationship between food security and response variables and their effects in some selected countries.

The outcomes showed that the strongest connection and positive effect of food security on 3 health response variables of life expectancy at birth, GDP and GNI. Also, the increase in food security causes a relatively strong decrease in variables pharmaceutical spending, potential years of life lost and infant mortality rates. It also causes a substantial drop in daily smokers, alcohol consumption, lack of social support, hospital discharge and length of stay in the hospital variables.

The correlation function was calculated for all the hypotheses and its results were consistent with the panel regression, especially for all the variables that had a strong relationship. This shows that the effect of country and time does not apply to these variables, or, to put it another way, the impact of food security on these health variables, including potential years of life lost, rates of neonatal mortality, life expectancy at birth, alcohol consumption, lack of social support and pharmaceutical spending, are of particular importance regardless of the country and any time.

This section includes recommendations by results as well as general recommendations. It starts with recommendations based on results and then moves on to general recommendations

One of this study's most crucial conclusions is that the increase in GDP and GNI has a direct positive correlation with food security in OECD countries, and with their increase, food security also increases. Hence, this study suggests that policymakers and governments implement programs and policies that can consistently increase GDP and GNI per capita.

Other dependent variables that are significantly related to food security in this study are years of productive life wasted, infant mortality rates and pharmaceutical spending. The results of all specifications show that increasing food security has a strong negative effect on these variables. Therefore, governments and policymakers in both food security and health issues through policies such as food support for low-income and homeless people, food subsidies, or food tax reductions and more careful monitoring of previous programs to reduce these variables

The results of the findings of this research and previous studies, while highlighting to stakeholders the value of FS in the healthcare industry, also provide an opportunity for governments and other organizations to take a deep look at other factors that can significantly affect the health of communities in relation to food security that has an effect and causes the growth of human resources, as well as adjusts health costs.

ÖZET

Gıda Güvenliği ve Sağlıkla İlgili Seçilmiş Göstergeler Arasındaki İlişki

Son 20-30 yılda ister hanehalkı düzeyinde olsun ister ulusal düzeyde olsun gıda güvensizliğine yönelik çeşitli önlemler alınmaya başlanmıştır. Bazıları gıda güvencesinin belirleyicileri üzerinde yoğunlaşırken, bazıları daha çok gıda güvensizliğinin sonuçlarını vurgulamaktadır. Bu çalışma, sağlıkla ilgili değişkenler ile gıda güvenliğinin arasındaki ilişkiyi tartışacaktır. Çalışma iki bölümden oluşacaktır. İlk bölüm, PubMed, Web of Science, Ebscohost ve Scopus gibi farklı arama portallarını kullanarak gıda güvenliği ve sağlık durumu, sağlık riskleri, sağlık kaynakları ve sağlık hizmetleri ile ilgili makaleleri bir araya getirecek sistematik bir inceleme olacaktır. Uygun bir literatür taramasından sonra, bu sistemik inceleme amacı için yalnızca bu çalışmayla ilgili makaleler seçilecektir.

Çalışmanın ikinci bölümünde, OECD ve partner ülkelerinin gıda güvenliği ile sağlık durumu, sağlık riskleri, sağlık kaynakları ve sağlık hizmeti kullanımı arasındaki ilişkiye bakılacaktır. Bu çalışmanın bağımlı değişkenini Economist Intelligence Unit (EIU) tarafından oluşturulan toplumun erişimine açık Küresel Gıda Güvenliği Endeksi'nin (GFSI) gıda güvenliği puanları, bağımsız değişkenlerini ise yine toplumun erişimine açık olan OECD sağlık veri tabanından seçilen sağlıkla ilişkili değişkenler (Doğumda yaşam süresi, 65 yaşında yaşam beklentisi, bebek ölüm oranları, kaybedilen potansiyel yaşam yılları, kanserden ölümler, intihar oranları), sağlık riskleri (Her gün sigara içenler, alkol tüketimi, aşırı kilolu veya obez nüfus, sosyal desteğin olmaması), sağlık kaynakları (sağlık harcaması, ilaç harcaması, 1000 kişiye düşen hekim sayısı, 1000 kişiye düşen hemşire sayısı), sağlık hizmeti kullanımı (hekim konsültasyonları, BT tetkikleri, MR tetkikleri, sezaryen sayıları, bebek aşılama oranları, hastanede kalış süresi, hastaneden taburcu olma) ve Gayri Safi Yurtiçi Hasıla (GSYİH) ve Gayri Safi Milli Gelir oluşturacak.

Sonuçlar, gıda güvenliğinin en güçlü ilişkisinin doğumda beklenen yaşam süresi, GSYİH ve GSMG arasında olduğunu göstermiştir. Ayrıca, gıda güvenliğindeki artış, ilaç harcamalarında ve bebek ölüm oranlarında nispeten güçlü bir düşüşe neden olmaktadır. OECD ve partner ülkelerde kişi başına GSYİH ve GSMH ile gıda güvenliği arasında doğrudan pozitif bir yönde bir ilişiki bulunmuştur. Düşük gelirli ve evsiz insanlar için gıda desteği, gıda vergisi indirimleri, gıda güvenliği ve sağlık bakım maliyetlerinin düşürülmesine yardımcı olabilir. Bu çalışmanın sonuçları, yetkililerin gıda güvenliğine etkili bir yaklaşım seçme kararları üzerinde yararlı olabileceği ve aynı zamanda gelecekteki araştırmalar için bir giriş niteliğinde olabilieceği düşünülmektedir.

Anahtar Sözcükler: gıda güvenliği, gıda güvensizliği, sağlık durumu, sağlık riskleri, sağlık kaynakları, sağlık hizmeti kullanımı

SUMMARY

The Relationship between Food Security and Selected Health Related Indicators

Several measures of food insecurity, whether at the household or at the national level, have been introduced during the past two or three decades. Some concentrate on the determinants of food security while other emphasize more the consequences of food insecurity. This study will discuss the status of food security in relation with health related variables. The study will consist of two parts. The first part will be a systematic review which will gather articles related to food security and health status, health risks, health resources and healthcare using different search portals like PubMed, Web of Science, Ebscohost and Scopus. After a proper literature review, only articles that are related to this study will be chosen for this systemic review purpose.

The second part of the study will look at the relationship between food security and health status, health risks, health resources and healthcare use of OECD and partner countries. The food security scores of the Global Food Security Index (GFSI) open to public and introduced by the Economist Intelligence Unit (EIU) will be used as a dependable variable and the independent variables will be taken from the OECD health database which will be health status (life expectation at birth, life expectation at 65, infant mortality rates, potential years of life lost, deaths from cancer, suicide rates), health risks (Daily smokers, alcohol consumption, overweight or obese population, lack of social support), health resources (health spending, pharmacetical spending, doctors per 1000 population, nurses per 1000 population, health expenditures), healthcare use (doctors consultations, CT exams, MR exams, Ceserean, Infant vaccination rates, lenght of hospital stay, hospital dischagre, healthcare utilization), and Gross Domestic Product (GDP), and Gross National Income. The results of this study can have a significant impact on the decisions of the authorities in choosing an effective approach to food security and will also be a new idea for future research.

The outcomes showed that the strongest connection and positive effect of food security on 3 health response variables of life expectancy at birth, GDP and GNI. Also, the increase in food security causes a relatively strong decrease in variables pharmaceutical spending and infant mortality rates. GDP and GNI per capita have a direct positive correlation with food security in OECD and partner countries. Food support for low-income and homeless people, food subsidies and food tax reductions could help reduce food security and health care costs. The results of this study can have a significant impact on the decisions of the authorities in choosing an effective approach to food security and will also be an introduction for future research.

Keywords: food insecurity, food security, healthcare use, health resources, health risks, and health status

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country	year	FOOD SECURITY	Infant mortality	DEATH CANCER	Life expectancy at birth	potential years of life lost	life expectation at 65	alcohol consumption	Daily smokers	lack of social support	overweight	Doctors per1000 popolation	Health spending	Nurses per1000 popolation	pharmaceutical spending	Cesarean	CT exams	doctors consultations	hospital discharge rates	length of hospital stay	MR exams	GDP per capita	GNI per capita
Australia	2012	72.4	3.30	193.10	82.10	3617.00	22.00	10.00	13.00	6.20		3.31	3854.19	10.22	15.31		95.30	6.90	17256.20	4.80	24.50	43879.18	42787.76
	2013	73.7	3.60	192.30	82.20	3605.00	22.10	9.90	13.00	6.20		3.37	4092.62	11.12	14.98		100.10	7.10	17231.70	4.70	26.00	47761.21	46511.41
	2014	75.7	3.40	187.80	82.40	3633.10	22.20	9.70	13.00	6.20	63.40	3.45	4190.27	11.28	14.39		105.10	7.30	17387.70	4.70	33.60	47644.76	46670.84
	2015	76.2	3.20	190.50	82.50	3669.80	22.30	9.80	13.00	6.20		3.51	4380.99	11.39	14.50		108.40	7.40	17785.60	4.20	39.10	47317.25	46197.65
	2016	76.4	3.10	185.20	82.50	3542.50	22.30	9.50	12.40	6.20		3.58	4605.95	11.57	14.73		107.80	7.60	17995.70	4.20	40.60	50237.79	48870.63
	2017	75.5	3.30	179.80	82.60	3503.30	22.30	9.50	12.40	6.20	65.20	3.68	4710.62	11.68	13.83		113.50	7.70	17887.00	4.10	42.90	50853.62	49241.21
	2018	76.8	3.10	188.12	82.80	3595.12	22.60	9.73	12.40	6.20		3.75	4964.53	11.92			121.20	7.80			46.10	53083.30	51390.09
	2019	73.1	3.29	188.12	82.44	3595.12	22.26	9.73	12.40	6.20		3.52	5187.42	11.31			127.00	7.40			49.30	53078.97	51971.32
Austria	2012	78.5	3.20	201.90	81.00	4132.00	21.30	12.40	24.30	9.00		4.90	4588.34	6.65	12.06	288.40		6.80	27029.60	6.50		46477.66	46524.59
	2013	78.9	3.10	197.10	81.20	4012.20	21.50	12.40	24.30	9.00		4.99	4767.08	6.69	11.89	287.80		6.80	26556.70	6.50		47936.68	48065.98
	2014	79.8	3.00	197.20	81.60	3945.00	21.80	12.80	24.30	9.00		5.05	4858.33	6.79	12.14	293.00		6.80	26260.80	6.50		48813.53	48877.88
	2015	80.1	3.10	192.10	81.30	3906.60	21.30	11.90	24.30	9.00		5.09	4944.77	6.80	12.29	286.90	35.60	6.60	25552.90	6.50	69.60	49942.06	49450.32
	2016	79.6	3.10	187.30	81.70	3774.10	21.70	12.10	24.30	9.00		5.13	5195.36	6.77	11.97	291.80	36.10	6.60	25310.00	6.40	71.80	52665.09	52661.12
	2017	78	2.90	184.70	81.70	3660.30	21.50	12.10	24.30	9.00		5.18	5360.42	6.85	12.08	292.40	40.80	6.50	24925.60	6.40	81.30	54185.34	53677.23
	2018	78.9	2.70	193.38	81.80	3905.03	21.60	12.20	24.30	9.00		5.24	5538.35	6.87	12.01	290.10	43.80	6.60	24701.80	6.30	90.90	57068.53	56549.36
	2019	78.6	3.01	193.38	81.47	3905.03	21.53	12.27	24.30	9.00		5.08	5851.06	6.77				6.67	25762.49	6.44		58664.72	58957.28
Belgium	2012	75.6	3.80	207.00	80.50	4587.70	21.30	10.10	18.90	9.20		2.93	4244.04	10.02	14.40	202.30	0.00	6.70	17022.40	7.00	0.00	42290.48	43271.82
	2013	76.3	3.50	205.00	80.70	4436.30	21.40	10.30	18.90	9.20		2.96	4436.02	10.30	14.19	207.10	0.00	6.70	16889.70	6.90	0.00	43672.71	44748.59
	2014	77.8	3.40	199.40	81.40	4226.20	21.90	10.60	18.90	9.20	51.00	2.98	4521.51	10.58	13.97	207.60	0.00	6.70	16926.70	6.90	0.00	44929.93	45872.68
	2015	76.8	3.30	197.50	81.10	4209.80	21.50	10.40	18.90	9.20		3.02	4653.81	10.83	14.36		0.00	6.80		6.80	0.00	46201.69	46855.56
	2016	76.8	3.20	193.90	81.50	4078.20	21.90	9.40	18.90	9.20		3.07	4777.09	10.96	14.33	210.30	0.00	6.90	16931.50	6.70	0.00	48599.20	49065.36
	2017	77.5	3.60	200.56	81.60	4307.64	21.90	9.40	18.90	9.20		3.08	5013.99	11.22	14.16	209.60	0.00	7.00	16825.30	6.60	0.00	50442.95	50898.62

	2018	77.1	3.80	200.56	81.70	4307.64	21.90	9.40	15.40	9.20	55.40	3.13	5103.20		14.58	211.30	0.00	7.20	16833.30	6.60	0.00	52662.77	53182.13
	2019	76.8	3.51	200.56	81.21	4307.64	21.69	9.94	15.40	9.20		3.02	5427.96				0.00	6.86		6.79	0.00	54709.35	55374.58
Canada	2012	74.8	4.80	205.60	81.50	4148.90	21.80	8.30	16.10	7.40		2.51	4300.73	9.40	17.53	263.60	2.00	7.00	8360.60	7.60	6.00	42290.88	41540.47
	2013	74.9	5.00	203.00	81.70	4125.50	21.90	8.20	14.90	7.40	60.30	2.57	4397.18	9.54	17.08	263.40	2.00	6.90	8455.10	7.50	6.30	44298.51	43623.83
	2014	73.9	4.70	208.80	81.80	4112.30	22.00	8.00	14.00	7.40		2.62	4533.30	9.81	16.57	262.80		6.90	8439.90	7.60		45753.78	45014.46
	2015	72.7	4.50	196.80	81.90	4098.60	22.00	8.00	13.10	7.40	64.10	2.67	4610.17	9.91	16.74	268.80		6.90	8466.10	7.40		44670.05	43985.74
	2016	74.9	4.50	196.30	82.00	4164.30	22.00	8.10	12.50	7.40		2.69	5020.60	9.96	16.63	269.90		6.80	8467.30	7.50		46472.37	45904.59
	2017	73.5	4.50	192.60	82.00	4169.00	22.10	8.20	12.00	7.40	59.10	2.73	5155.35	10.00	16.53	277.30		6.70	8499.50	7.40		48316.72	47702.26
	2018	75	4.70	200.52	82.00	4136.43	22.10	8.20	11.30	7.40		2.78	5287.41	9.95	16.36			6.70	8410.90	7.50		50239.99	49391.65
	2019	76.6	4.67	200.52	81.84	4136.43	21.99	8.14	13.41	7.40		2.80	5418.38	9.80	16.23			6.70	8442.77	7.50		50660.59	50011.08
Switzerland	2012	77.5	3.60	177.70	82.80	3288.20	22.30	9.90	20.40	7.50		3.92	5565.32	15.57	12.00			3.90	16636.30	7.50		59933.62	61142.15
	2013	77.3	3.90	175.90	82.90	3268.80	22.40	9.80		7.50		4.04	5923.91	15.91	11.80				16698.60	7.40		62225.11	63433.94
	2014	77.6	3.90	172.90	83.30	3118.30	22.70	9.50		7.50		4.13	6158.68	16.16	11.61	332.60			16819.70	7.30		64103.01	64214.21
	2015	76.8	3.90	174.30	83.00	3166.00	22.40	9.50		7.50		4.20	6467.53	16.58	11.70	329.30			16976.90	7.20		66020.21	67433.11
	2016	77.3	3.60	171.80	83.70	2990.30	22.90	9.30		7.50		4.25	6807.81	17.02	11.93	327.80			17226.60	7.10		68105.14	68443.99
	2017	77.8	3.50	174.52	83.60	3166.32	22.80	9.20	19.10	7.50		4.30	7037.02	17.23	12.03	318.60		4.30	17092.80	7.00		69103.57	67870.58
	2018	78.1	3.30	174.52	83.80	3166.32	23.00	9.10		7.50		4.34	7279.79	17.59	12.28	316.20			16958.00	6.90		71705.60	70233.54
	2019	77.6	3.67	174.52	83.30	3166.32	22.64	9.47		7.50		4.17	7732.41	16.58					16915.56	7.20		73114.49	73615.62
Chile	2012	68.5	7.40	201.80	79.20	5488.80	20.90	8.30		20.50			1485.28					3.30	9576.30			21446.54	20324.55
	2013	68.8	7.00	196.30	79.40	5448.80	21.00	7.20		20.50			1658.11					3.50	9494.30			22352.53	21221.91
	2014	68.4	7.20	193.90	79.60	5397.40	21.10	7.90		20.50			1754.99					3.40	9333.20			22687.93	21818.64
	2015	69	6.90	193.20	79.80	5320.50	21.30	7.90		20.50			1841.26					3.50	9298.40			22603.77	21922.84
	2016	69.1	7.00	230.20	80.00	5068.20	21.40	7.90	24.50	20.50	74.20		1857.80					3.60	9012.20			23349.68	22621.06
	2017	71.2	7.10	226.00	80.20	4895.20	21.60	7.84		20.50			2029.92					3.80	8888.30			24402.01	23392.79
	2018	72.8	6.60	206.90	80.40	5269.82	21.70	7.84		20.50			2125.95						8903.90			24686.14	23568.99
	2019	73	7.03	206.90	80.60	5269.82	21.90	7.84		20.50			2159.35						9215.23			25856.99	24922.27

Costa Rica	2012	71.7	8.50	158.70	79.40	5456.70	19.70	3.50	7.20	13.80		1174.88		14.37	203.50	18.50	2.40	5955.10	6.30		14852.93	14387.33
	2013	72.6	8.70	157.20	79.60	5394.40	19.80	3.60	6.70	13.80		1193.92		13.51	205.20	18.50	2.40	5779.30	6.10		15542.37	14976.25
	2014	70.4	8.10	156.00	79.80	5408.20	19.90	3.60	6.20	13.80		1265.61		14.75	219.70	20.10	2.30	5634.30	6.30		16615.97	15930.14
	2015	72	7.70	151.70	79.90	5484.60	19.90	3.70	5.80	13.80		1333.25		14.54	222.00	21.10	2.30	5506.90	7.10		17649.31	16894.14
	2016	71.8	7.90	152.20	80.10	5721.20	21.10	3.80	5.20	13.80		1362.84		13.61	223.00	22.40	2.20	5423.90	7.10		19119.34	18312.99
	2017	70.3	7.90	148.90	80.20	5631.60	21.20	3.80	4.70	13.80		1393.86		16.23	227.70	25.30	2.20	5318.00	6.50		20368.23	19303.60
	2018	71.9	8.13	154.12	80.40	5516.12	21.30	3.80	4.20	13.80		1495.55		18.39	226.50	28.30	2.20	5083.60	7.50		20988.16	19868.35
	2019	72.3	8.13	154.12	79.91	5516.12	20.41	3.69	5.71	13.80		1317.13				32.20	2.30	5009.60	6.60		21759.38	20487.09
Czech Republic	2012	76	2.60	236.60	78.20	5359.10	15.70	11.60	22.90	10.90	3.67	2090.49	8.06	21.50	243.90	5.10	7.30	20054.50	6.20	8.60	29258.90	27377.54
	2013	76.3	2.50	229.80	78.30	5222.90	15.70	11.50	22.20	10.90	3.69	2448.53	7.99	18.14	248.70	5.20	7.40	20377.30	6.00	9.00	30828.53	28870.33
	2014	77.3	2.40	225.80	78.90	4944.00	16.10	11.90	22.30	10.90		2564.61	7.93	17.27	254.40	5.20	7.40	20627.40	6.00	9.50	32504.22	30272.96
	2015	77.6	2.50	220.50	78.70	4928.60	15.90	11.50	18.20	10.90		2545.51	8.01	17.46	253.60	6.70	8.00	20347.40	5.90	9.90	33909.31	31583.66
	2016	78.3	2.80	219.80	79.10	4832.40	16.20	11.70	19.60	10.90		2670.88	8.07	17.43	237.50	5.80	8.00	19994.60	5.90	10.40	36101.29	33665.79
	2017	77.3	2.70	215.60	79.10	4803.30	16.20	11.60	18.40	10.90		2891.44	8.06	16.98	235.80	5.70	8.00	19813.60	5.80	10.80	38842.90	36643.67
	2018	79	2.60	224.68	79.10	5015.05	16.20	11.80	21.10	10.90	4.04	3170.67	8.07	16.03	231.00	5.30	8.20	19589.80	5.80	11.50	41147.63	38888.32
	2019	78.5	2.59	224.68	78.77	5015.05	16.00	11.66	20.67	10.90		3427.91	8.03				7.76	20114.94	5.94	9.96	43015.81	40422.55
Denmark	2012	76.9	3.40	246.10	80.10	4223.00	17.50	9.30		5.80	3.84	4315.13	9.96	7.42	211.80	0.00	4.70	15346.00		0.00	44808.55	45820.39
	2013	78.5	3.50	238.30	80.40	4112.90	17.70	9.40	17.00	5.80	3.85	4455.75	9.95	6.93	223.50	0.00	4.60	15173.40		0.00	46742.94	48223.00
	2014	78.4	4.00	233.40	80.80	4074.30	18.10	9.50		5.80	3.88	4536.24	9.93	6.85	215.40	0.60	4.50	15156.30		6.10	47905.48	49648.02
	2015	78.2	3.70	230.40	80.80	3926.30	18.00	9.30		5.80	3.93	4674.50	9.92	6.77	210.90	2.30	4.40	14775.20		15.60	49058.14	50564.07
	2016	77.5	3.10	237.05	80.90	4084.13	18.20	9.40		5.80	4.00	4849.60	9.95	6.61	203.60	1.80	4.30	14491.70		16.80	51967.02	53244.42
	2017	77.7	3.80	237.05	81.20	4084.13	18.20	9.10	16.90	5.80	4.11	5107.21	10.03	6.33	205.90	1.10	4.30			11.00	55356.49	56568.22
	2018	78.7	3.70	237.05	81.00	4084.13	18.00	9.70		5.80	4.19	5294.51	10.10	6.40	191.80	0.70	3.80			10.40	57459.17	59051.67
	2019	77.4	3.60	237.05	80.74	4084.13	17.96	9.39		5.80	3.97	5567.90	9.98				4.37			8.56	60308.07	62089.60
Spain	2012	73.1	3.10	194.10	82.50	3571.30	22.80	9.40		8.00	3.82	2728.98	5.24	15.80	251.50	4.60		9905.50	6.10	14.80	31724.63	31470.89
	2013	74.8	2.70	190.80	83.20	3409.00	23.40	9.20		8.00	3.81	2764.27	5.14	16.28	251.60	4.50		9947.30	6.10	15.20	32452.66	32235.94

	2014	74.9	2.80	185.80	83.30	3365.40	23.50	9.50	23.00	8.00		3.80	2858.07	5.15	15.61	250.40	4.10	7.60	10154.00	6.00	17.60	33544.35	33421.37
	2015	73.9	2.70	184.20	82.90	3332.00	23.00	10.40		8.00		3.85	3020.48	5.29	15.30	245.10	4.30		10220.00	6.10	15.10	34929.21	34921.37
	2016	75	2.70	184.70	83.40	3280.50	23.60	10.80		8.00		3.82	3148.72	5.51	15.88	245.60	4.60		10422.60	6.00	15.90	37313.63	37405.83
	2017	73.4	2.70	180.90	83.40	3253.10	23.40	10.80	22.10	8.00		3.88	3322.37	5.74	15.47	244.10	4.90	7.30	10435.70	6.00	17.20	39580.19	39594.94
	2018	74.4	2.70	186.75	83.50	3368.55	23.50	10.40		8.00		4.02	3429.80	5.87	15.31	245.40	5.10		10470.50	6.00	18.20	40780.29	40854.62
	2019	73.6	2.77	186.75	83.17	3368.55	23.31	10.07		8.00		3.86	3616.46	5.42					10222.23	6.04	16.29	42211.81	42274.85
Finland	2012	82.4	2.40	176.50	80.70	4574.70	17.80	9.30	17.00	8.10	58.00	3.07	3786.19	14.20	12.16	161.90	0.60	4.20	17747.70	6.90	13.70	40872.85	41063.97
	2013	81.8	1.80	175.80	81.10	4324.70	18.00	9.10	15.80	8.10		3.15	3933.24	14.18	12.01	158.00	0.60	4.20	17315.20	6.80	14.60	41492.92	41663.30
	2014	83.7	2.20	172.30	81.30	4192.40	18.20	8.80	15.40	8.10		3.21	3955.76	14.26	11.81	157.70	0.60	4.20	17202.40	6.70	14.40	41749.86	42167.77
	2015	83.8	1.70	174.87	81.60	4363.93	18.30	8.50	17.40	8.10			3993.51		12.14	157.00	0.50	4.30	16894.40	6.60	20.00	42490.21	42908.11
	2016	84.4	1.90	173.10	81.50	4005.60	18.20	8.40	15.00	8.10			4103.42		12.57	164.00	0.50	4.30	16806.00	6.50	19.90	44934.49	45139.00
	2017	84.6	2.00	170.90	81.70	3980.40	18.40	8.40	13.00	8.10	67.60		4221.84		12.24	164.90	0.50	4.40	16423.50	6.40	20.50	47570.27	47594.02
	2018	84	2.10	173.91	81.80	4240.29	18.60	8.40	14.00	8.10			4331.46		12.39	163.90	0.50	4.40	16385.60	6.40	21.70	49749.06	49948.74
	2019	85.1	2.01	173.91	81.39	4240.29	18.21	8.70	13.00	8.10			4578.42					4.29	16967.83	6.61	17.83	51556.59	51800.79
France	2012	78.6	3.50	201.20	82.10	4394.00	19.10	12.20		9.60		3.32	4305.46	9.10	14.54	200.40	72.40	6.70	16839.40	5.70	45.90	37684.20	38508.15
	2013	79.2	3.60	196.30	82.30	4283.60	19.30	11.60		9.60		3.33	4557.48	9.38	13.98	199.80	63.90	6.40	16614.80	5.60	48.10	39528.47	40413.87
	2014	79.3	3.50	196.80	82.80	4125.10	19.70	12.00	28.50	9.60		3.33	4645.37	9.62	13.96	196.80	65.30	6.30	16466.40	5.60	52.30	40144.06	41014.14
	2015	79.6	3.70	197.70	82.40	4166.90	19.40	11.90		9.60	49.00	3.34	4678.71	9.93	13.63	197.30	67.40	6.20	16363.00	5.60	57.80	40829.89	41711.65
	2016	78.5	3.70	196.80	82.70	4066.60	19.60	11.70	29.40	9.60		3.35	4934.85	10.21	13.37	197.80	70.00	6.10	18821.20	5.50	62.00	42855.94	43762.50
	2017	79.8	3.90	197.76	82.70	4207.24	19.60	11.70	26.90	9.60		3.37	5056.85	10.48	13.20	197.00	71.00	5.90	18609.10	5.40	65.30	44480.72	45486.05
	2018	76.8	3.80	197.76	82.80	4207.24	19.70	11.60	25.40	9.60		3.37	5154.12	10.79	13.03	195.00	73.80		18553.00	5.40	69.70	46456.11	47483.75
	2019	76.7	3.80	197.76	82.54	4207.24	19.49	11.81		9.60		3.34	5375.70	9.93					17466.70	5.54	57.30	49225.56	50245.99
Germany	2012	76.5	3.30	201.60	80.60	4162.00	17.80	11.30		9.30	60.00	3.95	4742.71	11.96	14.11	308.90	72.60	9.70	25093.10	7.80	94.20	43359.54	44399.89
	2013	77.1	3.30	204.80	80.60	4238.30	17.80	11.10	20.90	9.30		4.04	4948.70	12.34	13.98	306.60	73.80	9.90	25224.30	7.70	102.30	44993.67	46035.53
	2014	77.9	3.20	200.90	81.20	4084.00	18.20	11.10		9.30		4.11	5148.74	12.55	14.33	308.20	78.70	9.90	25602.30	7.60	108.20	47011.28	47953.17

	2015	78.3	3.30	199.60	80.70	4184.10	17.90	11.10		9.30		4.14	5294.55	12.65	14.34	302.10	75.90	####	25534.30	7.60	115.10	47609.56	48694.52
	2016	77.7	3.40	200.30	81.10	4139.00	18.10	10.90		9.30		4.19	5667.77	12.82	14.41	299.00	77.70	####	25685.90	7.50	119.00	50579.48	51834.22
	2017	78.1	3.30	194.70	81.10	4001.10	18.10	10.80	18.80	9.30		4.25	6010.56	13.13	14.22	301.70	79.80	9.90	25478.40	7.50	124.60	52952.90	54209.20
	2018	78.3	3.20	200.32	81.00	4134.75	18.00	10.80		9.30		4.31	6223.79	13.22	14.20	296.20		9.90				54954.69	56444.65
	2019	78.1	3.29	200.32	80.90	4134.75	17.99	11.01		9.30		4.14	6645.76	12.67				9.90				55891.16	57410.65
Greece	2012	71.5	2.90	198.20	80.70	4289.80	18.10	7.50		25.70			2145.54	3.34	29.00		114.10		19645.60	5.20	59.90	24912.13	25120.57
	2013	71.7	3.70	200.40	81.40	4141.90	18.70	7.40		25.70			2067.17	3.29	27.80				14415.10	5.60		25947.87	25944.87
	2014	74.3	3.70	199.00	81.50	4132.30	18.80	7.00	27.30	25.70			2016.56	3.23	26.90				13805.30	5.60		26642.23	26810.77
	2015	74.8	4.00	199.50	81.10	4306.00	18.50	6.60		25.70			2081.38	3.21	26.87							26720.91	26692.45
	2016	75.2	4.20	199.20	81.50	4233.30	18.90	6.40		25.70			2220.79	3.25	26.70							27471.22	27328.21
	2017	75.1	3.50	199.26	81.40	4220.66	18.60	6.40	35.00	25.70			2238.58	3.31	27.60			3.50				28644.98	28490.13
	2018	74.9	3.50	199.26	81.90	4220.66	19.10	6.10		25.70			2265.90	3.37	26.24			3.30				29680.90	29329.34
	2019	74.8	3.64	199.26	81.36	4220.66	18.67	6.77		25.70			2383.63	3.29								30869.25	30616.41
Hungary	2012	67.7	4.90	293.30	75.20	7767.50	14.30	11.10		12.20		3.09	1766.54	6.32	32.58	340.10		####	20268.00	5.80		23206.26	22233.32
	2013	69.3	5.00	286.30	75.70	7356.10	14.50	10.60		12.20		3.21	1821.58	6.43	30.29	349.10		####	20207.40	5.70		24498.66	23805.21
	2014	69.4	4.50	282.70	75.90	7237.90	14.60	10.90	25.80	12.20	62.30	3.32	1863.75	6.41	30.11	356.70		####	20396.10	5.60		25642.56	24535.17
	2015	70.6	4.20	280.10	75.70	7256.90	14.50	10.80		12.20		3.10	1891.73	6.47	29.80	372.10		####	20061.20	5.50		26777.47	25568.40
	2016	72.2	3.90	278.80	76.20	6942.30	14.60	11.10		12.20		3.21	1999.62	6.44	29.47	370.80		####	19941.50	5.50		27911.66	27204.38
	2017	71.3	3.50	275.40	75.90	6939.90	14.50	10.70		12.20		3.32	2029.31	6.51	27.87	373.00		####	19494.40	5.50		29465.13	28310.49
	2018	69.6	3.30	282.77	76.20	7250.10	14.60	10.87		12.20		3.38	2149.72	6.62	26.87	380.30		####	19254.70	5.40		31831.98	30664.30
	2019	70	4.19	282.77	75.83	7250.10	14.51	10.87		12.20		3.23	2222.43	6.46					19946.19	5.57		33956.82	33069.19
Ireland	2012	81.4	3.50	228.70	80.90	4079.10	17.80	11.50		4.20		2.71	4373.29	12.99	14.36	277.40			13623.50	5.90		46274.53	37301.30
	2013	82.6	3.60	227.00	81.00	3928.40	18.10	10.60		4.20		2.67	4302.34	12.55	13.54	284.80			13456.80	5.70		47924.39	40431.56
	2014	82.1	3.30	226.70	81.40	3785.00	18.40	10.80		4.20		3.01	4251.48	12.18	13.06	290.40			13566.40	5.60		51212.51	43244.16
	2015	82.5	3.40	219.20	81.50	3656.30	18.40	10.70	19.00	4.20	61.00	3.12	4296.89	12.35	13.05	303.30		5.70	13488.10	5.80		69133.72	53142.69
	2016	82.5	3.00	225.40	81.70	3862.20	18.60	11.20	19.00	4.20		3.19	4544.70	11.56	13.01	315.90		5.70	13539.50	5.80		71793.29	58514.60

	2017	83	3.00	225.40	82.20	3862.20	19.00	11.00	18.00	4.20	62.00	3.26	4742.98	12.16	12.85	316.80		5.70	13344.20	5.90		78739.40	62702.54
	2018	84.1	2.90	225.40	82.30	3862.20	19.10	11.00	17.00	4.20		3.28	4911.85	12.88	12.42	331.40		5.00	13372.90	5.90		85027.00	66946.93
	2019	84.1	3.24	225.40	81.57	3862.20	18.49	10.97	14.00	4.20	61.00	3.34	5275.54	12.38				5.80	13484.49	5.80		89561.46	69290.08
Israel	2012	72.5	3.60	183.80	81.80	3496.20	18.50	2.90		12.20		2.97	2223.35	4.82	13.25	171.90	20.50		16337.10	5.10	2.10	31706.19	30889.52
	2013	71.8	3.10	179.80	82.10	3437.10	18.50	2.90	16.20	12.20		2.94	2238.46	4.86	12.96	168.50	20.10		16072.20	5.20	2.60	34167.04	33472.67
	2014	74.9	3.10	178.80	82.20	3392.00	18.50	2.70	17.10	12.20		2.98	2237.58	4.86	12.86	168.50	21.20		15937.50	5.10	2.90	34282.24	34074.56
	2015	75.1	3.10	177.10	82.10	3367.00	18.90	2.70		12.20	50.90	3.07	2310.57	4.88	13.40	167.00	25.10		15849.60	5.20	4.20	35487.89	35183.49
	2016	77.5	3.10	171.40	82.50	3311.50	19.20	2.70	19.60	12.20		3.08	2520.29	4.99	13.09	160.40	32.20		15560.80	5.20	5.20	37806.43	37463.67
	2017	75.8	3.10	168.70	82.60	3236.10	18.90	3.00	16.90	12.20		3.14	2714.66	5.08		157.90	34.70		15346.40	5.10	5.70	38849.91	38652.82
	2018	76.7	3.00	176.60	82.90	3373.32	19.40	3.00		12.20		3.22	2825.78	5.03		148.50	25.60		15295.50	5.00	7.50	40351.27	40321.73
	2019	77.9	3.16	176.60	82.31	3373.32	19.20	2.84		12.20		3.06	2931.93	4.93					15771.30	5.13		41964.74	41766.39
Italy	2012	75.7	2.90	205.40	82.30	3480.40	20.30	7.50	22.10	11.70		3.87	3071.61	6.41	16.63	368.40			12878.30	6.80		36002.91	35958.90
	2013	75.5	2.90	199.30	82.80	3356.10	20.75	7.30	21.10	11.70		3.90	3042.93	6.14	17.06	361.40		6.80	12376.70	6.80		36067.71	36005.20
	2014	77.2	2.80	195.90	83.20	3195.30	18.90	7.30	19.70	11.70		3.88	3036.86	6.15	17.01	357.00			12003.50	6.80		36194.92	36198.08
	2015	76.5	2.90	194.40	82.60	3262.40	19.10	7.10	19.80	11.70		3.84	3089.71	6.11	17.86	352.80			11856.20	6.90		36899.40	36644.30
	2016	76.8	2.80	191.40	83.30	3132.30	19.30	7.10	20.00	11.70		3.95	3273.92	6.54	17.65	349.40			11670.80	6.90		39926.97	40041.61
	2017	76.3	2.70	197.28	83.00	3285.30	19.40	7.40	19.90	11.70		3.99	3399.20	6.71	17.61	338.20			11597.10	6.90		41581.13	41808.60
	2018	76.3	2.80	197.28	83.40	3285.30	19.60	7.80	19.20	11.70		3.98	3484.94	6.73	17.90	332.40			11414.60	7.00		43097.26	43566.17
	2019	76.4	2.83	197.28	82.94	3285.30	19.60	7.36		11.70		4.02	3649.21	6.40	17.96				11971.03	6.87		44397.56	44784.58
Japan	2012	76.2	2.20	181.10	83.20	3433.70	21.35	7.20	20.70	10.50	23.70	2.29	3970.77	10.54	18.89			####		17.50		37213.84	38210.65
	2013	76.4	2.10	179.00	83.40	3335.80	21.55	7.40	19.30	10.50	24.10		4308.25		18.85			####		17.20		39008.36	40317.89
	2014	76.2	2.10	176.60	83.70	3262.80	17.20	7.10	19.60	10.50	24.70	2.36	4328.36	10.96	18.80			####	12444.60	16.90		39183.47	40593.63
	2015	78	1.90	173.80	83.90	3140.70	17.60	7.20	18.20	10.50	23.80		4516.86		19.74			####		16.50		40398.40	41950.25
	2016	77.7	2.00	171.50	84.10	3076.90	17.90	7.20	18.30	10.50	25.40	2.43	4297.13	11.34	18.57			####		16.30		39983.64	41329.14
	2017	78.2	1.90	167.50	84.20	2994.40	18.20	7.20	17.70	10.50	25.90		4392.91		18.27			####	13356.40	16.20		40992.39	42453.60
	2018	78.9	1.90	174.92	83.75	3207.38	18.40	7.20	17.80	10.50	26.70	2.49	4504.43	11.76						16.10		41724.03	43245.46

	2019	78.4	2.01	174.92	83.75	3207.38	18.60	7.21	18.80	10.50			4822.81							16.67		42239.05	43803.17
Mexico	2012	61.6	14.80	120.20	74.40	8571.80	18.60	3.90	11.80	19.20	71.30	2.12	1003.87	2.56	28.77			3.00	4824.60			17220.07	16887.38
	2013	63.2	14.40	116.10	74.60	8281.70	18.80	3.90		19.20		2.16	1025.27	2.62	27.35			2.80	4776.70			17461.80	16953.79
	2014	63.6	13.60	117.90	74.80	8393.50	18.80	4.00		19.20		2.23	998.58	2.69	27.01			2.60	4756.30			18178.40	17732.10
	2015	65.9	13.60	118.20	75.00	8379.60	18.80	4.40	7.60	19.20		2.33	1067.23	2.77	27.20			2.70	4619.90			18454.80	17978.18
	2016	65.4	13.40	119.50	75.20	8660.70	18.80	4.40		19.20	72.50	2.34	1084.54	2.87	22.72			2.90	4795.00			19516.15	18993.04
	2017	65.1	13.50	117.50	75.40	8849.30	18.80	4.12	7.60	19.20		2.40	1118.97	2.87	22.73			2.80	4819.40			19947.20	19429.29
	2018	65.7	12.90	118.23	75.00	8522.77	18.00	4.12		19.20	75.20	2.44	1144.90	2.87	22.14			2.80	4844.80			20518.58	19964.96
	2019	67.9	13.74	118.23	74.91	8522.77	18.20	4.12		19.20		2.29	1153.58	2.75				2.80	4776.67			20739.31	20142.73
Netherlands	2012	77.1	3.70	235.00	81.20	3786.60	18.90	9.10	18.40	10.70		3.25	4782.37	12.13	8.17	157.80		6.20	11862.80	6.40		47271.97	48081.28
	2013	78.5	3.80	224.30	81.40	3673.70	19.10	8.70	18.50	10.70		3.31	4923.88	12.23	7.67	162.40		6.20	9959.20	6.70		49242.79	49909.71
	2014	77.9	3.60	222.60	81.80	3584.00	19.30	8.40	19.10	10.70			4934.58		7.52	161.60	0.20	8.00	9872.70	6.70	1.30	49233.23	49111.39
	2015	78.4	3.30	223.60	81.60	3518.60	19.40	8.30	19.00	10.70			4928.37		7.73	162.10	0.50	8.20	9753.10	5.00	2.00	50288.35	50326.91
	2016	79.2	3.50	224.60	81.60	3547.30	19.40	8.20	18.00	10.70			5075.48		7.74	159.60	0.10	8.80	9635.70	5.00	1.90	52289.40	51516.14
	2017	80.2	3.60	217.70	81.80	3466.90	19.40	8.30	16.80	10.70			5263.83		7.61	156.70	0.20	8.30	9247.10	5.00	2.40	55089.58	55504.91
	2018	80.2	3.50	224.63	81.90	3596.18	15.40	8.30	15.50	10.70			5436.29		7.44		0.20	9.00	8975.60	5.10	2.20	57899.82	58559.62
	2019	79.6	3.57	224.63	81.61	3596.18	15.50	8.47	17.90	10.70			5765.10		7.46			7.81	9900.89	5.70		59468.67	59701.34
New Zealand	2012	78.6	4.70	209.90	81.20	4327.30	15.70	9.20	16.30	5.10	64.30	2.72	3240.03	10.02		254.00		3.70	15065.50	6.00		32916.91	31546.82
	2013	78.2	5.00	211.40	81.40	4149.90	16.00	9.20	15.60	5.10	64.80	2.83	3388.25	10.07		258.80			14995.00	5.60		36084.87	34662.70
	2014	78.7	5.70	210.20	81.50	4173.00	15.90	9.10	15.70	5.10	65.10	2.90	3500.13	10.12		262.60			15102.80	5.10		37084.79	35591.03
	2015	78.6	4.30	212.20	81.70	4093.00	15.80	8.70	15.00	5.10	65.60	3.05	3521.11	10.28		242.20			15038.80	5.40		37246.95	36011.29
	2016	78.2	4.20	225.40	81.70	3862.20	16.00	8.90	14.20	5.10	66.80	3.14	3762.70	10.32		262.90			14883.00	5.10		39719.04	38440.38
	2017	77.4	4.78	225.40	81.90	3862.20	16.00	8.80	13.80	5.10	66.60	3.29	3820.42	10.23		273.90		3.80	14896.40	5.00		42074.66	40497.70
	2018	78.1	4.78	225.40	81.80	3862.20	17.60	8.80	13.10	5.10	66.80	3.35	4024.55	10.34								43738.11	42175.01
	2019	77.8	4.78	225.40	81.60	3862.20	17.80	8.96	12.50	5.10	65.10	3.04	4203.99	10.20								44612.28	43649.54
r w	2012	79.5	2.60	204.20	81.50	3589.30	18.00	6.20	16.00	7.10		4.23	5209.58	16.53	7.73			4.40	17160.20	5.80		65349.22	65903.79

	2013	78.7	2.40	196.40	81.80	3550.80	18.00	6.20	15.00	7.10		4.31	5485.87	16.67	7.59	164.60		4.20	16924.40	5.50		66956.29	67669.77
	2014	78.3	2.50	198.20	82.20	3382.30	18.30	6.10	13.00	7.10		4.43	5707.38	16.89	7.49	165.50		4.30	16845.10	5.50		65895.67	67979.76
	2015	79.2	2.20	193.20	82.40	3201.00	18.20	6.00	13.00	7.10		4.40	5728.33	17.34	7.68	161.40		4.30	16822.70	6.20		60352.72	62860.80
	2016	78.8	2.20	189.80	82.50	3198.80	18.20	6.00	12.00	7.10		4.51	5904.03	17.49	7.57	161.90		4.40	16793.90	6.10		58923.24	61501.17
	2017	80.3	2.20	196.36	82.70	3384.44	18.20	6.00	11.00	7.10		4.66	6075.47	17.67	7.64	159.50		4.50	16521.40	6.00		64050.37	66403.14
	2018	79.3	2.30	196.36	82.80	3384.44	18.20	6.00	12.00	7.10		4.81	6283.17	17.74	7.41	158.30		4.50	16348.80	6.00		69709.38	72328.19
	2019	80.6	2.34	196.36	82.27	3384.44	18.20	6.07	9.00	7.10		4.93	6646.71	17.97	7.12			4.40	16305.30	5.87		68343.74	70327.24
Poland	2012	71.3	4.60	240.60	76.90	7142.60	18.80	10.20		11.40		2.23	1578.60		22.26	315.70		7.00	16423.40	6.80		23455.56	22577.19
	2013	74	4.60	234.70	77.10	6912.10	18.90	10.80		11.40		2.24	1670.78	5.27	21.70	345.70		7.10	16699.00	6.70		24272.84	23452.91
	2014	75.5	4.20	234.00	77.70	6572.90	18.90	10.50	22.70	11.40		2.31	1687.06	5.24	21.47	356.50	33.70	7.20	17134.80	6.60	21.30	25162.88	24220.72
	2015	74.4	4.00	242.70	77.60	6575.80	19.10	10.50		11.40		2.33	1819.34	5.20	21.21	361.70	35.80	7.40	16957.70	6.90	22.30	26534.72	25567.76
	2016	73.9	4.00	236.70	78.00	6438.70	19.20	10.50		11.40		2.42	1959.03	5.16	20.98	385.30	38.00	7.50	17923.40	6.70	23.50	27985.34	26883.34
	2017	73.4	4.00	231.60	77.90	6406.40	19.20	10.60		11.40		2.38	2075.85	5.10	20.33	393.00	40.70	7.60	18151.80	6.60	27.70	29714.59	28489.29
	2018	75.9	3.80	236.72	77.70	6674.75	19.02	10.70		11.40			2113.70		20.79	389.20	42.70	7.60	17301.50	6.50	30.30	31613.69	30304.48
	2019	74.2	4.17	236.72	77.56	6674.75	19.02	10.54		11.40			2229.60					7.34	17227.37	6.69		33858.28	32433.21
Portugal	2012	76.1	3.40	196.70	80.50	4514.70	14.70	9.80		16.70			2345.63	5.99	16.64			4.10	8599.30	8.90		26438.14	25812.30
	2013	76.4	2.90	195.00	80.80	4357.60	15.10	9.50		16.70			2417.04	6.05	15.61				8564.80	8.80		27936.01	27562.56
	2014	75.2	2.90	194.10	81.20	4208.50	15.00	10.20	16.80	16.70			2450.89	6.13	15.40				8453.10	8.80		28742.31	28154.27
	2015	75.9	2.90	194.30	81.20	4107.30	15.30	10.30		16.70	67.60		2540.07	6.29	15.47				8493.00	8.80		29660.85	28865.22
	2016	76.7	3.20	196.00	81.20	4107.60	15.30	10.40		16.70			2822.46	6.47	15.39					8.90		31607.61	30839.80
	2017	75.5	2.70	194.80	81.50	4071.80	15.40	10.40		16.70			2922.42	6.68	14.97					8.90		33044.70	32269.03
	2018	77.5	3.30	195.15	81.40	4227.92	15.13	10.40		16.70			3097.30	6.88	14.69				8319.00	9.00		34931.86	34078.76
	2019	76.8	3.04	195.15	81.11	4227.92	15.13	10.14		16.70			3378.63	6.36						8.87		36871.74	35943.78
Russia	2012	66.6	8.60	205.00	70.20	13827.90	18.50	14.60		12.00		4.03	1338.10	8.51				####		10.80		24303.49	23483.48
	2013	65.9	8.20	203.60	70.70	13342.60	18.50	13.90		12.00		4.02	1409.72	8.79				####		10.30		26073.87	25057.62
	2014	63	7.40	203.50	70.90	13357.60	18.60	13.80		12.00		4.15	1511.32	8.95	23.20			####		9.90		25761.66	24820.12

	2015	62.6	6.50	204.03	71.30	13509.37	18.80	13.00		12.00		3.90	1432.37	8.51	18.59			####		9.70		24085.31	23339.92
	2016	67.8	6.00	204.03	71.80	13509.37	18.60	12.10	30.30	12.00		3.94	1404.90	8.46	19.56			9.70		9.40		24128.08	23352.72
	2017	70.3	5.60	204.03	72.60	13509.37	18.80	11.20	27.50	12.00		4.04	1528.78	8.47	19.61			9.70		9.30		25926.43	25087.02
	2018	70.3	5.10	204.03	72.80	13509.37	18.80	11.20	26.70	12.00		4.09	1707.43	8.46	18.17			9.80		9.10		28681.78	27824.01
	2019	72.1	6.77	204.03	71.47	13509.37	18.90	12.83		12.00		4.02	1476.09	8.59				####		9.79		29188.85	28091.45
Sweden	2012	77.1	2.60	188.30	81.80	3416.10	19.80	7.20	12.80	9.70		3.97	4679.80	10.91	10.34	165.20		2.90		5.60		45432.31	46472.58
	2013	78	2.70	186.20	82.00	3416.80	20.05	7.30	10.70	9.70		4.04	4731.45	10.94	10.03	166.80		2.90	16089.80	5.60		46312.29	47352.42
	2014	78.4	2.20	184.60	82.30	3310.10	20.25	7.20	11.90	9.70		4.11	4865.57	10.93	10.01	172.60		2.90	15764.20	5.60		47184.72	48180.63
	2015	79.2	2.50	184.70	82.30	3329.20	20.20	7.10	11.20	9.70		4.17	5002.14	10.94	10.07	173.10		2.90	15312.00	5.70		49103.06	49495.02
	2016	80.5	2.50	179.60	82.40	3251.10	20.30	7.20	10.90	9.70		4.23	5121.77	10.91	10.21	177.20		2.80	14627.00	5.60		50430.17	50721.16
	2017	81.2	2.40	180.00	82.50	3209.40	20.35	7.00	10.40	9.70		4.27	5318.12	10.88	9.79	166.60		2.80	14014.20	5.60		51947.94	52849.38
	2018	80.9	2.00	183.90	82.60	3322.12	20.40	7.20	10.10	9.70			5433.73		9.83	170.80		2.70	13874.50	5.50		53553.31	54565.70
	2019	80.5	2.41	183.90	82.27	3322.12	20.16	7.17		9.70			5782.29					2.84		5.60		55337.87	56672.32
Slovak	2012	67.6	5.80	254.70	76.20	6822.90	17.90	10.10		8.60		3.36	2097.40	5.82	26.54	303.60	20.90	####	19034.40	6.20	30.60	26973.79	26520.14
	2013	70.2	5.50	260.50	76.50	6586.60	17.90	9.90		8.60		3.39	2153.70	5.75	26.54	307.20	20.90	####		6.20	34.00	28004.53	27795.65
	2014	69.8	5.80	258.60	76.90	6450.60	17.90	10.10	22.90	8.60		3.43	2010.11	5.75	27.03	307.30	29.70	####	19427.40	7.00	39.70	28997.38	28674.79
	2015	70.9	5.10	257.93	76.70	6620.03	18.00	10.20		8.60		3.45	2059.65	5.70	26.87	302.10	43.70	####	19575.40	6.90	44.00	29927.68	29204.48
	2016	72	5.40	257.93	77.30	6620.03	18.00	9.90		8.60		3.47	2039.54	5.74	26.59	297.50	43.60	####	19732.90	6.80	45.70	29659.33	28888.49
	2017	70.2	4.50	257.93	77.30	6620.03	18.10	9.70		8.60		3.42	2048.39	5.65	26.39	296.80	30.20	####	19507.70	6.80	46.60	30082.48	29517.07
	2018	70.1	5.00	257.93	77.40	6620.03	18.10	10.10		8.60		3.52	2142.08	5.70	25.51	292.90	29.20	####	19094.10	6.70	52.70	31509.44	31075.90
	2019	69	5.10	257.93	76.90	6620.03	18.10	10.00		8.60		3.43	2353.65	5.73				####		6.66		32562.55	31987.73
UK	2012	75.1	4.00	225.80	81.00	4169.30	19.70	9.60	20.00	6.20	61.90	2.70	3638.66	7.94		242.70			12998.40	6.00		38296.70	37898.89
	2013	77	3.90	221.90	81.10	4158.80	19.75	9.40	19.00	6.20	62.10	2.71	3694.48	7.94	12.65	250.90			12897.30	6.00		39945.10	39129.68
	2014	78.4	3.90	219.70	81.40	4124.50	20.05	9.40	19.00	6.20	61.70	2.75	3779.80	7.94	12.59	252.10			12903.50	6.00		41292.49	40450.00
UK	2015	80.1	3.90	217.70	81.00	4154.50	19.70	9.50	17.80	6.20	62.90	2.77	3828.28	7.91	12.58	261.30			12835.90	6.00		42571.65	41589.48
	2016	79.6	3.80	216.40	81.20	4185.90	19.95	9.50	16.10	6.20	61.40	2.78	3989.97	7.88	12.36	263.50			12766.70	6.00		44125.53	43054.22

	2017	78.4	3.90	220.30	81.30	4158.60	19.95	9.70	16.80	6.20	64.30	2.81	4126.35	7.83	12.52	273.80				5.90		45757.78	45191.28
	2018	79.2	3.90	220.30	81.30	4158.60	20.00	9.80	16.60	6.20	63.30	2.84	4289.79	7.78	12.27	285.50			12869.40	5.90		47163.17	46549.29
	2019	78.6	3.90	220.30	81.19	4158.60	19.85	9.56		6.20		2.95	4653.06	7.89						5.97		48542.09	47650.43
Turkiye	2012	66.9	9.50	155.50	74.60	5000.80	15.10	1.60	23.80	23.30		1.73	894.74	1.79		479.80		8.20	15762.30	3.90		20627.44	20311.34
	2013	65.3	10.10	166.10	78.00	5480.90	17.85	1.40		23.30		1.76	947.74	1.83		503.60		8.20	16073.90	3.90		22373.14	21996.84
	2014	66	10.20	164.30	78.00	5618.60	17.80	1.50	27.30	23.30		1.76	1006.77	1.85		511.30		8.30	16705.30	4.00		24104.98	23763.58
	2015	66.7	10.00	160.80	78.00	5442.20	17.75	1.40		23.30		1.81	1040.37	1.95		531.00		8.40	17114.80	3.90		25855.91	25422.67
	2016	68.4	9.70	160.60	78.00	5685.20	17.70	1.30	26.50	23.30		1.83	1128.72	1.93		531.50		8.60	16785.70	4.00		26695.91	26218.68
	2017	65.4	9.00	161.46	78.10	5445.54	17.60	1.40		23.30	64.40	1.87	1187.52	2.07		531.40		8.90	16885.50	4.10		28193.06	27567.22
	2018	62	9.20	161.46	78.30	5445.54	17.80	1.40		23.30		1.88	1223.57	2.34		548.90		9.50	16588.10	4.10		28263.24	
	2019	66	9.67	161.46	77.57	5445.54	17.30	1.43		23.30		1.81	1337.17	1.97				8.59	16559.37			27599.83	
USA	2012	79	6.00	192.50	78.80	6192.90	19.20	8.90	14.20	9.40	68.60	2.50	8404.94	11.15	11.63		58.30			5.40	48.40	51548.02	53050.56
	2013	78.6	6.00	191.20	78.80	6213.20	19.20	8.80	13.70	9.40		2.56	8610.60	11.14	11.55		55.40			5.40	51.60	53056.68	54282.11
	2014	79.1	5.80	189.30	78.90	6254.30	19.30	8.80	12.90	9.40	70.10	2.58	9034.17	11.18	12.17		59.40			5.50	52.80	55008.01	56664.16
	2015	78.6	5.90	183.60	78.70	6347.20	19.25	8.80	11.40	9.40		2.58	9498.29	11.31	12.39		49.90			5.50	63.90	56831.65	58257.92
	2016	78.7	5.90	181.90	78.70	6584.50	19.35	8.90	11.80	9.40	71.00	2.59	9880.16	11.63	12.07		50.50			5.50	69.70	58000.89	59004.14
	2017	77.9	5.80	178.30	78.60	6593.10	19.35	8.90	10.50	9.40		2.61	######	11.77	11.78		43.70			5.50	55.40	60091.57	61394.51
	2018	77.6	5.90	186.13	78.70	6364.20	19.40	7.79	10.30	9.40		2.61	######	11.89	11.55		50.80				64.90	63043.05	64091.27
	2019	77.7	5.90	186.13	78.74	6364.20	19.28		12.11	9.40		2.58	######	11.44	11.88		61.20				70.10	65240.38	66022.02

Source: https://impact.economist.com/sustainability/project/food-security-index/download-the-index
https://data.oecd.org/health.htm#profile-Health%20care%20use