

## THE IMPACT OF PHYSICAL INACTIVITY AND OBESITY ON HEALTH EXPENDITURES IN TÜRKİYE<sup>1-2</sup>

### FİZİKSEL HAREKETSİZLİK İLE OBEZİTENİN TÜRKİYE SAĞLIK HARCAMALARI ÜZERİNDEKİ ETKİSİ

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**Abstract: Aim:** The aim of this study is to analyse the relationship between physical inactivity and abdominal obesity and public health expenditures among adults in Türkiye. The main objective of the study is to assess the potential impact of physical inactivity and obesity on Türkiye's health expenditures.

**Scope:** TurkStat and OECD data from 2010 to 2020 were used as the sample. Health expenditures are categorized under the headings of medical expenditures, laboratory tests, medicines and general expenditures.

**Method:** In this research, Descriptive statistics consisted of median and interquartile range (IR) values. Kruskal-Wallis test was used to compare independent groups and Mann-Whitney test was used as a post-hoc test when necessary. Categorical variables were expressed as proportions and compared using the chi-square test. Significant associations identified by the chi-square test were further analysed using binary logistic regression, which produces odds ratio and 95% confidence interval values.

**Conclusion:** In many countries such as Türkiye, obesity and physical inactivity lead to an increase in health problems. Obesity increases the risk of a number of chronic diseases, which puts more burden on the health system. In addition, obesity and physical inactivity have a high potential impact on health expenditures. These include factors such as increased expenditures for the treatment of obesity-related diseases and obesity-related job losses. Likewise, physical inactivity is a major cause of many health problems. In Türkiye, obesity rates are increasing and physical inactivity is widespread. Sedentary and abdominally obese patients were found to have higher expenditure rates than patients with only abdominal obesity. There is a parallel relationship between abdominal obesity and physical inactivity, which has a significant impact on overall health expenditures.

**Keywords:** Physical Inactivity, Obesity, Health Expenditures, Chronic Diseases, Health Costs, Public Health

**Öz: Amaç:** Bu çalışmanın amacını Türkiye'de yetişkinlerde fiziksel hareketsizlik ve abdominal obezite ile kamu sağlık harcamaları arasındaki ilişkiyi analiz etmektir. Fiziksel hareketsizlik ve obezitenin Türkiye'nin sağlık harcamaları üzerindeki potansiyel etkilerini değerlendirmesi ise çalışmanın temel amacıdır.

**Kapsam:** Örneklem olarak, 2010 – 2020 yılları arası TÜİK ve OECD verileri kullanılmıştır. Sağlık harcamaları medikal harcamalar, laboratuvar testleri, ilaçlar ve genel harcama başlıklar altında sınıflandırılmıştır.

**Yöntem:** Bu çalışmada tanımlayıcı istatistik, medyan ve çeyrekler arası aralık (IR) değerlerinden oluşturulmuştur. Bağımsız grupların karşılaştırılmasında Kruskal-Wallis testi ve gerektiğinde post-hoc testi olarak Mann-Whitney testi kullanılmıştır. Kategorik değişkenler oran olarak ifade edilmiş ve ki-kare testi kullanılarak karşılaştırılmıştır. Ki-kare testi ile tespit edilen önemli ilişkiler, olasılık oranı ve %95 güven aralığı değerleri üreten ikili lojistik regresyon kullanılarak ayrıca analiz edilmiştir.

**Sonuç:** Türkiye gibi birçok ülkede obezite ve fiziksel hareketsizlik, sağlık sorunlarının artmasına neden olmaktadır. Obezite, bir dizi kronik hastalığın riskini artırmaktadır, bu da sağlık sistemine daha fazla yük getirmektedir. Ayrıca, obezite ve fiziksel hareketsizliğin sağlık harcamaları üzerindeki olası etkilerini yüksek oranda artırmaktadır. Bu etkiler arasında obezite ile ilişkilendirilen hastalıkların tedavisi için yapılan harcamaların artması ve obeziteye bağlı iş kayıpları gibi faktörler bulunmaktadır. Aynı şekilde, fiziksel hareketsizlik de birçok sağlık sorununun başlıca nedenlerinden birisini oluşturmaktadır. Türkiye'de obezite oranlarının arttığı ve fiziksel hareketsizliğin yaygın olduğu görülmektedir. Sedanter ve abdominal obez hastaların, sadece abdominal obez hastalara göre daha yüksek harcama oranı bulunmuştur. Abdominal obezite ile fiziksel hareketsizlik arasında paralel bir ilişki bulunmakta olup bu durum genel sağlık harcamaları üzerinde kayda değer bir etki yaratmaktadır.

**Anahtar Kelimeler:** Fiziksel Hareketsizlik, Obezite, Sağlık Harcamaları, Kronik Hastalıklar, Sağlık Maliyetleri, Halk Sağlığı

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<sup>2</sup> Çalışma, araştırma ve yayın etiğine uygun olarak hazırlanmıştır. / The study was prepared in accordance with research and publication ethics.





## INTRODUCTION

Worldwide, obesity and physical inactivity are among the most important public health problems leading to increased health problems. These problems increase the risk of many chronic diseases and place a great burden on health systems. Türkiye is one of the leading countries affected by these global problems and is taking important steps in the fight against obesity. However, the effects of obesity and physical inactivity on Türkiye's health expenditures are still not clearly understood.

This study aims to draw attention to the prevalence and effects of obesity and physical inactivity in Türkiye, to investigate the potential impact of these problems on health expenditures, and to provide data for health policy makers to make better decisions.

## OBJECTIVE

The main objective of this study is to analyse the relationship between physical inactivity and abdominal obesity and public health expenditures among adults in Türkiye. In this context, the focus of the study is to assess the potential impacts of physical inactivity and obesity on Türkiye's health expenditures. Understanding the levels of obesity and physical inactivity in Türkiye is important to determine the cost of these problems to the health system and to shape future health policies. By focusing on these important public health problems, this study aims to examine the factors that may affect health expenditures. In this way, it aims to provide data for Türkiye to more effectively plan and

direct resources to combat obesity and physical inactivity.

## SCOPE

The scope of this study is "The Impact of Physical Inactivity and Obesity on Health Expenditures in Türkiye". The main objective of the study is to analyse the relationship between physical inactivity and abdominal obesity among adults in Turkey and public health expenditures. In this context, the focus of the study is to assess the potential impact of obesity and physical inactivity on Türkiye's health expenditures. Understanding the levels of obesity and physical inactivity in Türkiye is important to determine the cost of these problems to the health system and to shape future health policies. This study aims to examine the factors that may affect health expenditures by focusing on obesity, one of the major public health problems. In this way, it aims to provide data for Türkiye to plan its campaign against obesity and physical inactivity in a more effective way and to direct its resources.

## METHOD

### Descriptive Statistics

We used the median and interquartile range (IR) values to examine the central tendency and dispersion properties of the data. This provides an overall summary of our data.

### Independent Group Comparisons

To assess differences between groups, we used the Kruskal-Wallis test, which is a method used to determine statistical significance between groups. We also used the Mann-Whitney test for post-hoc analysis,



which helps to examine the differences between groups in more detail.

### **Categorical Variables**

We used the chi-square test to express the proportions of categorical variables. This test was used to determine the relationship between categorical variables.

### **Binary Logistic Regression**

To further examine the significant associations identified by the chi-square test, we used binary logistic regression. This analysis was preferred and used to assess the impact of independent variables on the dependent variable.

These statistical analyses help us to understand the results and findings of the study more clearly. They are therefore very important for the reliability of our data and the meaningfulness of our results.

### **RESEARCH LIMITATIONS**

The limitations of our study are very important for the reliability of our research and the interpretability of the results. The limitations of our study titled "The Impact of Physical Inactivity and Obesity on Health Expenditures in Türkiye" are stated as follows.

#### **Data Utilization**

Within the scope of the study, data between 2010 and 2020 were used. However, the absence or unavailability of more recent data may affect the relevance of the results. Health problems such as obesity and physical inactivity can change over time and these

changes can be better understood based on up-to-date data.

#### **Data Sources**

We used data from the Turkish Statistical Institute (TurkStat) and the Organization for Economic Cooperation and Development (OECD). The accuracy and full reliability of these data cannot always be guaranteed. The accuracy of the data sources may have an impact on the reliability of the results.

#### **Conceptual Constraints**

Our research addresses the relationship between physical inactivity and obesity and their impact on health expenditures. However, the conceptual complexity of such studies and the inclusion of various variables may prevent a more detailed examination of some relationships.

#### **Measurement Constraints**

Health expenditures are classified under different headings such as medical expenditures, laboratory tests, medicines and general expenditures. This classification is suitable for examining different areas of health expenditures, but does not allow for a more detailed measurement.

#### **Relative Assessment**

If a relative assessment is made in this type of research, then it should be examined in terms of ratios and relationships rather than absolute values. This may result in some important contexts being ignored. This should be carefully considered by researchers and should not be ignored.

Being aware of these limitations, it is important for researchers and authors to be careful when interpreting and generalizing the results of their research. In addition, future research could focus on studies based on larger and more recent data to address these limitations.

### RESEARCH PROBLEM

The problem of our research is titled "The Impact of Physical Inactivity and Obesity on Health Expenditures in Türkiye". This problem refers to the problem of understanding the relationship between physical inactivity and abdominal obesity and public health expenditures among adults in Türkiye. In particular, the main objective of the study is to examine and evaluate the potential effects of obesity and physical inactivity on Türkiye's health expenditures.

This problem lays the foundation for a study that attempts to measure the impact of obesity and physical inactivity on public health in Türkiye in the context of health expenditures. Health problems such as obesity and physical inactivity are thought to increase health expenditures. Therefore, this problem is important to understand the burden of these factors on the health system in Türkiye and to shape future health policies.

The research problem aims to determine the impact of these factors on health expenditures by using current data on obesity and physical inactivity and data on health expenditures. In this context, the problem will contribute to the development of strategies and health policies to combat obesity and physical inactivity.

### PHYSICAL INACTIVITY

Physical inactivity refers to an individual's inadequate physical activity in daily life or spending too much time sitting (Thivel et al., 2018). This can lead to negative effects such as insufficient movement of the body, underutilization of muscles and inadequate functioning of the cardiovascular system (Nystoriak & Bhatnagar, 2018). Physical inactivity is a risk factor that can lead to health problems and increases the risk of chronic diseases such as obesity, heart disease, diabetes and hypertension (Panahi & Tremblay, 2018). Physical inactivity has increased with modern lifestyles and technological advances (Woessner et al., 2021). Habits such as sedentary work, prolonged computer use, watching television and traveling by car cause people to move less. This can have a negative impact on the overall health of the population.

Physical activity means moving the body and expending energy (Caspersen et al., 1985). Regular physical activity helps to strengthen muscles, improve the functioning of the cardiovascular system and keep body weight under control (Pinckard et al., 2019). Physical activity is a range of sporting activities, including walking, jogging, cycling, swimming, dancing, yoga, and other activities.

Avoiding physical inactivity and engaging in regular physical activity is an important part of a healthy lifestyle (Orhan, 2019). Experts recommend at least 150 minutes of moderate-intensity physical activity per week (Can, 2019). Physical activity can help maintain overall health and reduce the risk of chronic diseases (Anderson & Durstine,

2019). Therefore, encouraging physical movement and making lifestyles more active is important for healthy living and body integrity.

## THE RELATIONSHIP BETWEEN OBESITY AND PHYSICAL MOVEMENT

The relationship between obesity and physical movement interacts in a complex way (Uranga & Keller, 2019). There are some important points that explain the relationship between obesity and physical movement. We can summarize these points under the following headings.

- **Physical Inactivity and Obesity Risk:** Physical inactivity increases the risk of obesity (Gray et al., 2018). Individuals who do not engage in regular physical activity have difficulty in maintaining energy balance (Chaput et al., 2011; Hill et al., 2013). This causes weight gain in individuals.
- **Physical Activity and Calorie Expenditure:** Physical activity increases the body's calorie expenditure and supports weight control (Van Baak, 1999). People who exercise regularly are more resistant to gaining excess weight (Cox, 2017; Swift et al., 2014).
- **Muscle Mass and Metabolism:** Regular physical activity increases and maintains muscle mass (Goodpaster et al., 2008). Muscles burn more calories, even at rest. This speeds up metabolism, making it easier to control weight (McPherron et al., 2013).
- **Combating Emotional Eating:** Physical activity helps control emotional eating

habits by reducing stress. This reduces the risk of overeating and obesity (Frayn et al., 2018).

- **Minimizing Health Problems:** Physical activity reduces the risk of heart disease, type 2 diabetes, hypertension and other obesity-related health problems (Dhuli et al., 2022).
- **Fat Distribution:** Physical activity affects the distribution of body fat. Individuals who are more active reduce the risk of abdominal obesity (fat accumulation in the abdomen) (Paley & Johnson, 2018).
- **Long Term Health:** Regular physical activity offers long-term health benefits and positively influences the ageing process (Szychowska & Drygas, 2022).

Therefore, a combination of physical activity and a healthy diet is important to prevent or treat obesity. Both are important components of a healthy lifestyle and help reduce the risk of obesity.

## OBESITY AND CHRONIC DISEASES

Obesity is known as a health problem closely associated with many chronic diseases. When the results of many scientific studies are examined, it is stated that obesity causes the formation of chronic diseases or the progression of chronic diseases in a more negative direction (Pati et al., 2023; Wilborn et al., 2005). There are some important points explaining the relationship between obesity and chronic diseases. These are;

- **Type 2 Diabetes:** Obesity increases the risk of type 2 diabetes. Adipose tissue in the

body leads to insulin resistance, which causes blood sugar to rise (Wondmkun, 2020).

- **Heart Diseases:** Being overweight is closely associated with high blood pressure, high cholesterol levels and cardiovascular diseases (Akil & Anwar Ahmad, 2011).
- **Hypertension (High Blood Pressure):** Obesity increases the risk of hypertension and causes excessive weight gain and increases blood pressure. This causes adverse effects on the cardiovascular system (Shariq & Mckenzie, 2020).
- **Cancer:** Obesity has been associated with some types of cancer. Many scientific studies have shown that obesity has significant effects on the risk of breast, uterine, colon, kidney and pancreatic cancer (Berger, 2014).
- **Sleep Apnoea:** Obesity causes the risk of sleep apnoea. This condition creates negativities regarding the irregularity and stopping of breathing during sleep (Jehan et al., 2017).
- **Fatty Liver:** Obesity increases the risk of fatty liver disease and adversely affects liver health.(Fabbrini et al., 2010)
- **Osteoarthritis:** Excess weight puts extra stress on the joints and increases the risk of osteoarthritis (King et al., 2013).
- **Digestive Problems:** Obesity also has an effect on the risk of digestive problems such as reflux disease, gallbladder disease and abdominal hernia (Nam, 2017).

- **Mental Health Problems:** Obesity leads to mental health problems such as depression, anxiety and low self-esteem (Nemiary et al., 2012).

- **Respiratory Problems:** It is also among the results of many scientific studies that obesity poses a risk for respiratory problems such as asthma and chronic obstructive pulmonary disease (COPD) (Poulain et al., 2006).

Obesity is therefore a serious health problem that can increase the risk of many chronic diseases. Preventing or treating obesity can help reduce the risk of such health problems. Adopting a healthy lifestyle, regular physical activity and developing a balanced diet are important steps to keep obesity under control.

## ABDOMINAL OBESITY

Abdominal obesity is a term that refers to the accumulation of fat in the body, especially in the abdomen. The fat accumulated in the abdominal area is usually located around the internal organs and deep in the abdominal cavity. This type of obesity is also known as abdominal obesity or android obesity (Dhawan & Sharma, 2020).

Abdominal obesity represents a specific type of body fat distribution and is different from other types of obesity (Pou et al., 2009). The accumulation of body fat in certain areas increases health risks (Frank et al., 2019). Fat accumulation in the abdominal area puts pressure on the internal organs (liver, intestines, pancreas, etc.) and prevents the proper functioning of these organs (Chait &



Den Hartigh, 2020; Foster & Pagliassotti, 2012).

Abdominal obesity is a risk factor that can lead to various health problems (Błaszczuk-Bębenek et al., 2019). These health risk problems include many negative factors. These risk groups include type 2 diabetes, heart diseases, hypertension (high blood pressure), liver problems, cancer, respiratory problems, digestive and mental health problems (Martín-Timón et al., 2014).

Excess calorie intake increases the fat in the waist and abdomen. However, lifestyle factors also affect this process. Unhealthy eating habits, sedentary life, ageing and genetic factors play an important role in increasing abdominal fat (Kumar et al., 2022; Lin & Li, 2021).

In order to reduce the negative effects of fat around the abdomen and waist on health, it is an important lifestyle to adopt healthy eating habits, to do regular physical activity and to keep portions under control. Especially limiting saturated fat intake, increasing fruit and vegetable consumption, turning to foods with high fibre content, avoiding processed and packaged foods are among the most effective practices in this process (Skerrett & Willett, 2010).

The health effects of adiposity in certain areas of the body are an important health problem as mentioned above. This health problem causes the emergence of many different health problems and the loss or reduction of individual life comfort. Fat around the abdomen and waist is among the most important risk groups, especially for heart

health. Therefore, adopting a healthy lifestyle and exercising regularly is an important way of life in preventing and controlling this problem. It is possible to prevent or treat abdominal obesity by adopting a healthy lifestyle, doing regular physical activity and developing a balanced eating habit (Bennasar-Veny et al., 2013; Lobstein et al., 2004; Ströhle & Worm, 2014).

## **OBESITY-RELATED HEALTH EXPENDITURES**

Obesity is an important factor affecting health expenditures as it increases the risk of many chronic diseases (Pi-Sunyer, 2009). There are some important aspects of obesity-related health expenditures. These are;

- **Treatment and Care Costs:** Obesity increases the risk of type 2 diabetes, heart disease, hypertension, joint problems and other health problems. The treatment and care of these diseases requires significant resources and costs to the health system (Fruh, 2017; Leitner et al., 2017).
- **Pharmaceutical and Medical Device Expenditures:** Drugs and medical devices are frequently used in the treatment of health problems associated with obesity. The contribution of such treatments to health expenditures is quite high (Biener et al., 2017; Li & Cheung, 2009).
- **Surgical Interventions:** Surgical interventions such as bariatric surgery may be required in cases of extreme obesity. Such operations lead to significant health expenditures and increase health costs (Gulliford et al., 2017; Padwal et al., 2011).

- **Hospitalisations:** Hospitalisations are increasing due to obesity-related health problems and this leads to an increase in hospital expenditures (Atella et al., 2023; Musich et al., 2016).
- **Chronic Care:** Chronic health problems associated with obesity require patients to receive continuous care and treatment. Individuals who have been diagnosed with obesity and have overweight problems must receive external support services in order to meet their daily standard needs by receiving support services. This increases personal health expenditures and increases health expenses. In addition, many overweight individuals require more than one support service provider due to physical health problems (Hall & Kahan, 2018; Wharton et al., 2020).
- **Mental Health Services:** Obesity is a condition that has psychological effects as well as physical health problems (Sarwer & Polonsky, 2016). Research shows that there is a linear relationship between obesity and low self-worth (Byth et al., 2022). This suggests that obese individuals are generally more likely to experience psychological problems such as depression, anxiety disorders, sexual dysfunctions, sleep problems and personality disorders (Sarwer & Polonsky, 2016). Obesity can be a condition that is often stigmatised (Sánchez-Carracedo, 2022) in society and this negatively affects individuals' self-esteem (Puhl & Heuer, 2009). Furthermore, health problems and limitations associated with obesity may also affect psychological well-being. Therefore, obesity management

should consider not only physical health but also psychological well-being (Puhl & Heuer, 2010; Sarwer & Polonsky, 2016). In the battle against obesity, not only focusing on weight loss, but also psychological support and strategies that will increase the self-worth of the individual should not be ignored. Obesity leads to mental health problems and this situation increases the necessity of services such as psychotherapy and counselling (Devlin et al., 2000). In the treatment of mental health problems, long-term treatment techniques and protocols are applied with both psychiatry and psychologist. This process creates a significant cost on the public and insurance companies in terms of health expenditures of the individual.

- **Health Insurance Costs:** Obesity may increase health insurance premiums. Because obese individuals need more health services and are subject to higher cost treatments (Bhattacharya & Bundorf, 2009; Bhattacharya & Sood, 2011).
- **Public Health Programmes:** The main task of political powers is to create a basis for consensus and social cohesion by taking into account the wishes and needs of different segments of society. This is realised through the formulation and implementation of public policies. Public policies are the strategies determined by the state on how to proceed in a particular field or issue. These strategies are formulated in order to respond to various needs of the society, solve problems and increase the welfare of the people (Nacak, 2016). The success of public policies depends on their





ability to produce fair and effective results for a wide segment of the society. It is of utmost importance that political powers are sensitive to the problems and wishes of the public while formulating public policies. This means understanding the needs of the public, listening to them and finding solutions. In addition, the participation of various social actors in the policy-making process plays a critical role. This is the basis of a democratic process and increases the legitimacy of policies (Ökde & Tekbaş, 2023). Public policies are an important tool for increasing the welfare of the society and ensuring cohesion. The sensitivity of political powers to the problems of the people and the creation of a basis for consensus play a critical role in the formulation of effective and sustainable policies. This is important in creating a better, fairer and more balanced social structure by increasing the general welfare of the society. Obesity-related health problems have an important place in public health programmes and health insurance systems (Güneş, 2013). This situation shows that it is very important not to ignore the phenomenon of public health problem that requires public policies to emphasise. In the implemented and to be implemented public health policies, it is necessary to effectively manage public spot applications to reduce obesity and to understand the perception of obesity as a public health problem. Another important point is that it should never be forgotten that unhealthy food and beverages should be controlled and referred in a way that prioritises community and public health apart from commercial rant

(Adak, 2020). If these public policies to be implemented are not effective and continuous, health expenses due to obesity-related problems will bring additional financial burden on the public and insurances (Demir, 2011; Sandalcı, 2019).

Therefore, obesity can cause significant health expenditures at both individual and societal levels. Preventing and treating obesity can help reduce such health expenditures and increase the sustainability of health systems. Healthy lifestyle changes, regular physical activity, balanced nutrition, and co-operation with health professionals to address obesity-related health problems are important steps in reducing obesity-related health expenditures.

#### **MEDICAL EXPENDITURE**

Medical expenditures refer to the expenditures of individuals and society for health services. These expenditures are usually incurred in various areas such as the provision of health services, medical treatment, medicines, medical devices, hospitalisations and health insurance premiums. Medical expenditures occupy an important place in the budgets of both individuals and governments and include the financing of health services (Kılavuz, 2010). Medical expenditures have some basic elements (İlgün, 2021; Yıldız, 2018). These are;

- **Health Services:** It includes the cost of health services such as doctors' examinations, laboratory tests, X-rays, ultrasounds, surgeries.

- **Medicines:** Prescribed medicines and the cost of medicines account for a large proportion of medical expenditure.
- **Medical Devices:** The purchase and maintenance of medical devices such as heart monitors, blood pressure monitors and medical imaging devices increase medical expenditures.
- **Hospitalisations:** Hospitalisation, care and treatment of patients under the supervision of a doctor leads to medical expenditure.
- **Health Insurance:** Health insurance premiums finance access to health care for individuals and families and are an important component of medical expenditure.
- **Physical Therapy and Rehabilitation:** Rehabilitation and physiotherapy after injury or surgery also include medical expenses.
- **Mental Health Services:** Mental health services such as psychotherapy, psychiatric treatment and counselling are also part of medical expenditure.

Medical expenditures have a major impact on a country's health system and economy. Especially factors such as the increase in chronic diseases, population ageing and the development of medical technology increase medical expenditures. Therefore, cost-effective management and financing of health services is an important part of health policies. Sustainability and effectiveness of health expenditures are the focal points of health policies of many countries (Bektaş Akpınar & Aşkın Ceran, 2019; Kılavuz, 2010).

## OBESITY AND LABORATORY TESTS

Obesity describes the condition in which a person's body fat accumulates at a higher than normal level (Köse et al., 2012). There are many laboratory tests and medical examinations for the evaluation and management of obesity (Panuganti et al., 2023). These include;

- **Body Mass Index (BMI) Measurement:** BMI is an index calculated by dividing weight by the square of height and is commonly used to assess the risk of obesity. BMI values are placed in the categories of normal weight, overweight, obese or extremely obese.
- **Blood Pressure Measurement:** High blood pressure (hypertension) is often associated with obesity. Blood pressure measurements are therefore carried out regularly.
- **Blood Lipid Profile:** This test measures fat levels in the blood. Values such as cholesterol, triglycerides and high-density lipoprotein (HDL) are important for assessing the risk of heart disease.
- **Blood Sugar Tests:** Tests such as fasting blood glucose, oral glucose tolerance test and HbA1c are performed to assess the risk of diabetes. Obesity increases the risk of type 2 diabetes. For this reason, blood glucose tests are a type of test frequently performed in patients diagnosed as obese.
- **Liver Function Tests:** Obesity increases the risk of fatty liver disease or non-alcoholic fatty liver disease. These tests are very important in assessing liver health.

- **Thyroid Function Tests:** Levels of thyroid hormones may be associated with obesity. Thyroid function tests are performed to assess the health of the thyroid gland.
- **Inflammation Markers:** Obesity increases inflammation. Therefore, markers of inflammation such as CRP (C-reactive protein) can be measured.
- **Vitamin and Mineral Levels:** Obesity increases the risk of deficiency of certain vitamins and minerals. Levels such as vitamin D, vitamin B12 and iron can therefore also be checked.
- **Hormone Levels:** Obesity affects hormone levels. In particular, hormones such as insulin, leptin and ghrelin are associated with obesity, so this test is often performed in cases diagnosed as obese.

These tests are used for the assessment and management of obesity. It is also important to assess other health problems and risk factors associated with obesity. Health professionals determine treatment plans with their patients based on the results of these tests and make recommendations on healthy lifestyle changes. Managing obesity can involve a range of approaches such as diet, exercise and, where necessary, medical treatment (Apovian et al., 2015; Beechy et al., 2012).

## OBESITY AND MEDICINE USE

Medicines are used in the treatment of obesity when lifestyle changes and diet are inadequate or to help manage obesity-related health problems (Tchang et al., 2021). Some medicines used in the treatment of obesity

and information on how these drugs work are described below.

- **Orlistat:** Orlistat is a medicine that blocks the absorption of fat. It promotes weight loss by reducing the absorption of fat in the body. It is usually taken before meals containing high fat and is used under the supervision of a doctor (Varol et al., 2009).
- **Phentermine and Topiramate (Qsymia):** This medicine helps weight loss by reducing appetite and increasing the feeling of fullness. Phentermine suppresses appetite, while topiramate creates a feeling of satiety (Erdoğan Erden et al., 2023).
- **Bupropion and Naltrexon (Contrave):** Bupropion may reduce appetite and increase energy levels. Naltrexone suppresses appetite. The combination of these two medicines promotes weight loss (Sherman et al., 2016).
- **Liraglutide (Saxenda):** Liraglutide regulates insulin levels and may suppress appetite. It is given into the body through an injection (Mehta et al., 2017).
- **Phentermine-Topiramate ER (Qsymia):** This medicine can reduce appetite and create a feeling of satiety. It is a combination of phentermine and topiramate (Lonneman et al., 2013).
- **Bupropion and Naltrexon (Contrave):** This medicine can reduce appetite and help weight loss (Ornellas & Chavez, 2011).
- **Metformin:** Metformin is a medication used for the management of type 2 diabetes. In some cases, it may also help treat obesity,

especially in individuals with insulin resistance (Nasri & Rafeian-Kopaei, 2014).

- **Sibutramine (Reductil):** Sibutramine, which is banned in some countries, is a drug that reduces appetite. It is recommended by experts to be used with caution due to its side effects (Araujo & Martel, 2012).

These medicines can help treat obesity, but each works through different mechanisms and may have different side effects. Obesity medications should only be used for overweight or obese individuals and with the advice of a doctor. Furthermore, medications may be more effective when used in combination with lifestyle changes, diet and exercise. Obesity treatment requires a personalised approach, so it should be done under the supervision of a health professional (Kayar & Utku, 2013).

## OBESITY AND SURGICAL PROCEDURES

Obesity surgery is a treatment option that includes a range of surgical procedures used to manage obesity and achieve weight loss. Obesity surgery helps to manage and improve obesity-related health problems (Wolfe et al., 2016). There are different techniques and surgical procedures for obesity surgery. These include;

- **Stomach Reduction Surgery (Sleeve Gastrectomy):** Sleeve gastrectomy involves removing a large part of the stomach, which causes the stomach to remain in the shape of a smaller tube. This helps you eat less food and lose weight. It can also contribute to the regulation of certain hormones (Kheirvari et al., 2020).

- **Roux-en-Y Gastric Bypass Surgery (RYGB):** This process involves separating the upper part of the stomach and connecting it with the small intestine. This causes food to be digested in the small intestine, bypassing a large part of the stomach. This both reduces the volume of the stomach and reduces the absorption of food (Seeras, Acho, & Lopez, 2023).

- **Laparoscopic Adjustable Gastric Band (Lap-Band):** In this method, a band is placed on the upper part of the stomach, which means that the upper part of the stomach is in a smaller cross-section. The band can then be adjusted for tightness, so that the passage of food through the stomach is controlled (Seeras, Acho, & Prakash, 2023).

- **Biliopancreatic Diversion (BPD):** This process involves removing part of the stomach and reconnecting it with the small intestine. This significantly reduces the absorption of food (Harris et al., 2019).

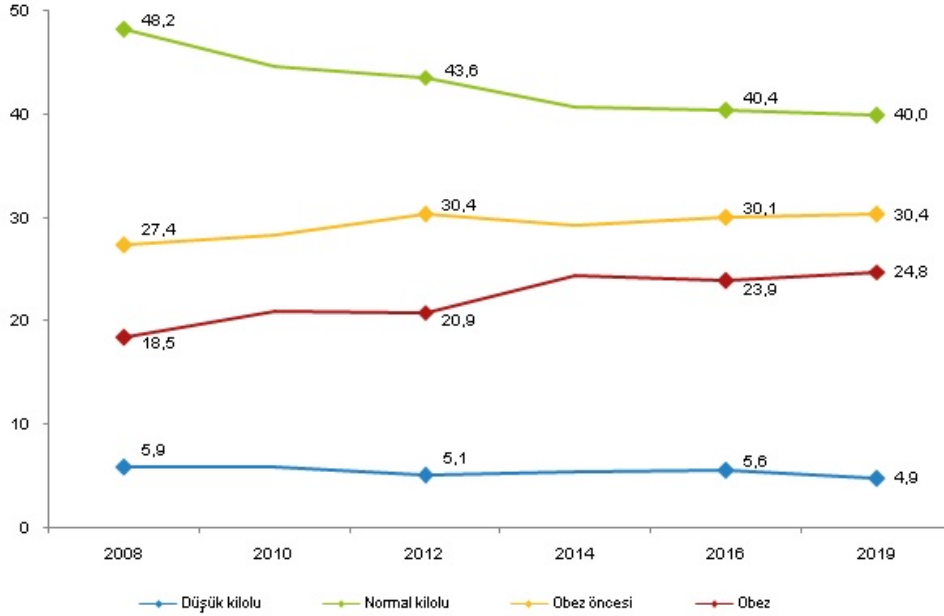
These surgical procedures are considered the last resort in the treatment of obesity and are usually used in combination with diet, exercise and lifestyle changes. Each method has advantages and risks. Obesity surgery can accelerate weight loss and help fix the health problems associated with obesity. However, these procedures involve a serious surgical intervention and require careful follow-up and lifestyle changes.

## RESULTS

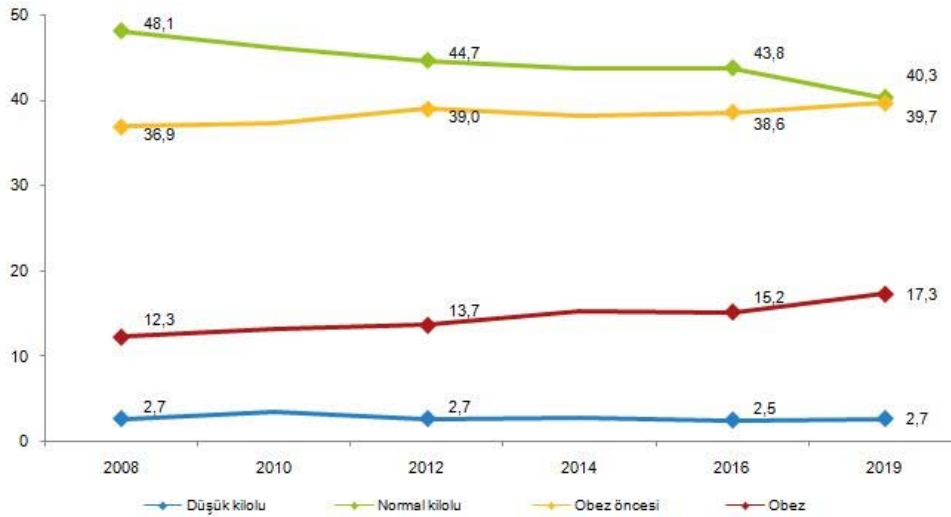
According to Turkey Health Survey 2019 data, when the body mass index calculated

using height and weight values is analysed; while the proportion of obese individuals aged 15 years and over was 19.6% in 2016, it was 21.1% in 2019. In 2019, 24.8% of women

were obese and 30.4% were pre-obese, while 17.3% of men were obese and 39.7% were pre-obese.



**Graph 1.** Body Mass Index Distribution of Women (%), 2008-2019



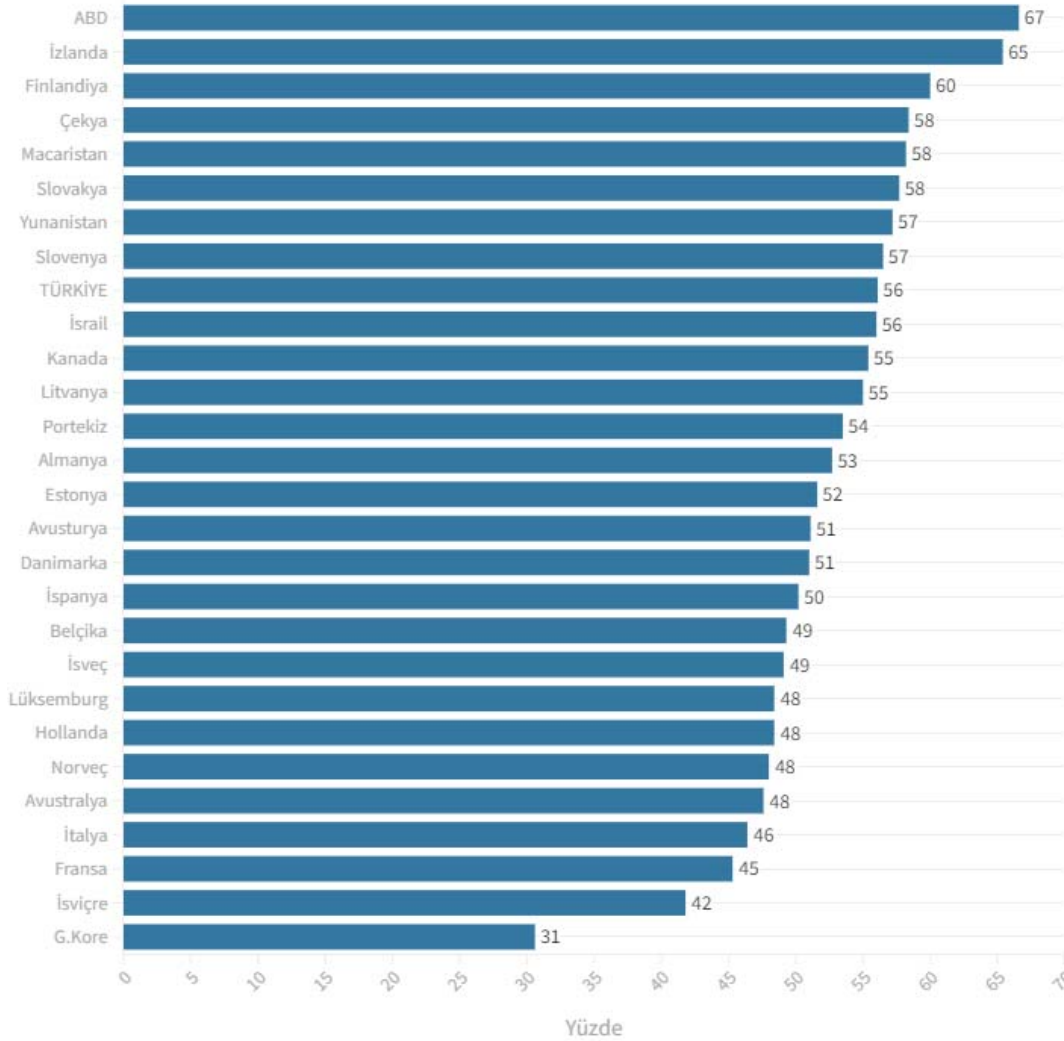
**Graph 2.** Body Mass Index Distribution of Men (%), 2008-2019

According to OECD data for 2020, the USA has the highest rate of overweight or obese

population over the age of 15. In this country, 67 percent of the population is overweight or obese. The USA is followed by Iceland (65

percent), Finland (60 percent) and the Czech Republic (58 percent). Türkiye ranks 9th among 28 countries. In Türkiye, 56 percent of the population over the age of 15 is

overweight or obese. Türkiye ranks 9th among 28 countries with this rate. In 26 out of 28 countries, this rate is above 45 percent, which shows how widespread the problem is.



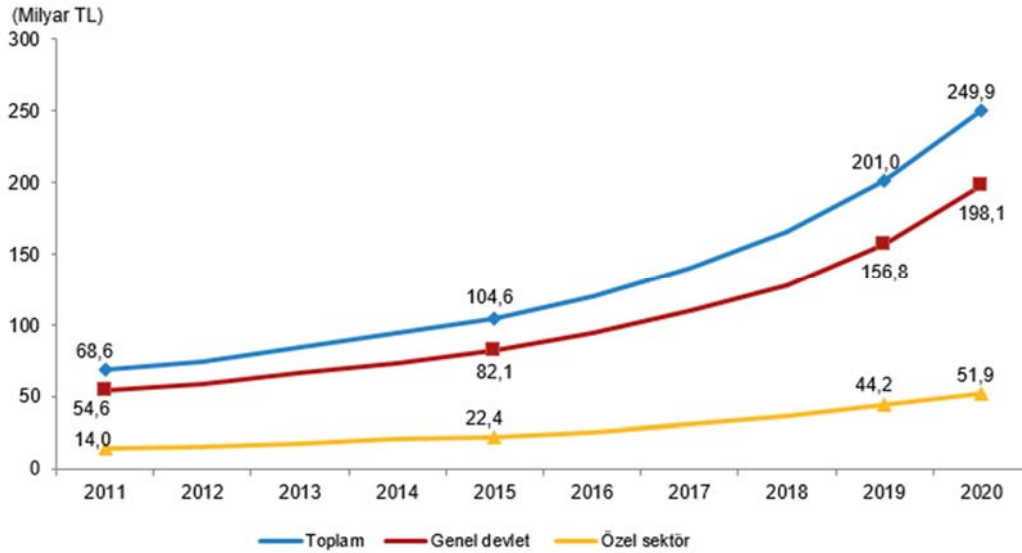
**Graph 3.** Proportion of Overweight or Obese Population in OECD Countries (2020)

Total health expenditure increased by 24.3% in 2020 compared to the previous year and reached 249 billion 932 million TL. General government health expenditure increased by 26.3% and reached 198 billion 62 million TL. Private sector health expenditure is estimated to be 51 billion 869 million TL with

an increase of 17.3%. The ratio of general government health expenditure to total health expenditure was 79.2% in 2020, while private sector health expenditure was 20.8%. Looking at the sub-components of the general government and private sector, in 2020, the Social Security Institution had a share of 51.0%, the central government 27.6%,

households 16.0%, insurance companies 2.6%, non-profit organisations and other

enterprises serving households 2.1%, and local administrations 0.7%.



**Graph 4.** Health Expenditures, 2011-2020

### Sample and Analysis Method Used

This study was carried out with a cross-sectional design using data from Türkiye between 2010 and 2020. Türkiye health survey and health expenditure statistics were used in the study. The data were compiled from TurkStat website. Nonparametric distribution was found for numerical variables. Therefore, descriptive statistics were formed from median and interquartile range (IR) values. Kruskal-Wallis test was used for comparison of independent groups and Mann-Whitney test was used as post-hoc test. Categorical variables were expressed as ratios and compared using the chi-square test. Significant associations identified by the chi-square test were further analysed using binary logistic regression, which produces odds ratio and 95% confidence interval values.

In this multivariate model, health expenditure is treated as the dependent variable and abdominal obesity with physical inactivity as the independent variable. After the raw analysis in the multivariate model (Model - 1), potential variables were simultaneously added to the multivariate model (Model - 2). All statistical analyses were performed using SPSS software (Version 17) and EViews, and statistical significance was set at p-value < .05.

### Statistical Analysis

The general statistical table obtained from the data is given below (Table 1). General data showed that the group with abdominal obesity and physical inactivity were older and had higher medicine use. General health expenditure was higher in the group with abdominal obesity compared to other groups.

Smoking habit and formal education rate are higher in the group with abdominal obesity and physical inactivity. In the analysed data, total expenditure was found to be

approximately 15 billion TL per year. General health expenditure is higher in the abdominal obesity group.

**Table 1.** General Characteristics According to Abdominal Obesity and Physical Inactivity

Independent Variables	Control Group	Abdominal Obesity	Physical Inactivity	Abdominal and Physical Inactivity	Obesity Physical Inactivity	p-value
	Median					
Age	36,9	37,4	42,3	44,5		.001
BMI (kg/m2)	23,2	30,6	24,9	30,6		.001
Medication Use (%)	8,2	12,1	12,4	17,6		.001
General Health Expenditure (B TL)	3,9	4,1	3,3	3,7		.001
Smoking Habits (%)	16,5	11,1	17,1	19,1		.202
Formal Education (≥8 years) (%)	16,4	13,5	14,9	17,3		.226

Table 2 shows the relationship between the groups and general health expenditures.

- Physical inactivity and drug expenditure (rho= 0.21; p-value= .001) and general expenditure (rho= -0.19; p-value= .041) were found to be correlated in the same direction.
- Abdominal obesity and medical expenditure (rho= 0.49; p-value= .004), medication expenditure (rho= 0.30; p-value= .001) and

general expenditure (rho= 0.43; p-value= .001) were found to be correlated in the same direction.

- Abdominal obesity and physical inactivity were associated with higher expenditure on medication (p-value= .001) and overall expenditure (p-value= .001). Medical expenditures (p-value= .737) and laboratory tests (p-value= .667) expenditures were not related.

**Table 2.** The Relationship Between Health Expenditure, Abdominal Obesity and Physical Inactivity

Independent Variables	Control Group	Abdominal Obesity	p-value	Physical Inactivity	p-value	Abdominal Obesity and Physical Inactivity	p-value





<b>Medical Expenditure (B TL)</b>	39 (19.4)	49 (28.4)	.004	18 (20.7)	.532	36 (24)	.737
<b>Laboratory Tests (B TL)</b>	39 (19.4)	46 (27.8)	.231	21 (24.1)	.456	35 (23.3)	.667
<b>Medication (B TL)</b>	34 (16.9)	30 (24.8)	.001	21 (24.1)	.001	56 (37.3)	.001
<b>General (B TL)</b>	29 (14.4)	43 (27.2)	.001	19 (21.8)	.041	50 (33.3)	.001

The binary logistic regression model determined that abdominally obese (OR= 4.83 [OR95%CI= 4.21-5.35]) or abdominally obese and sedentary (OR= 5.26 [OR95%CI= 5.01-6.67]) groups had higher overall health expenditure. Similarly, the same pattern of

association was observed in relation to medication expenditure: abdominally obese (OR= 7.87 [OR95%CI= 5.82-9.54]) and abdominally obese and sedentary (OR= 5.26 [OR95%CI= 3.87-7.01]) populations had higher medication expenditure.

**Table 3.** Multivariate Relationship Between Health Expenditures and Abdominal Obesity and Physical Inactivity Cluster - Logistic Regression Model

Independent Variables	Control Group	Abdominal Obesity	Physical Inactivity	Abdominal Obesity and Physical Inactivity	P-value
	AVERAGE				
<b>Medical Expenditure (B TL)</b>	4,15	8,57	4,23	5,22	.001
<b>Laboratory Tests (B TL)</b>	2,71	4,84	0,68	1,52	.001
<b>Medication (B TL)</b>	5,33	7,87	1,91	8,14	.001
<b>General (B TL)</b>	3,36	4,83	7,34	5,26	.001

## DISCUSSION

A person with a BMI of 30 or more is considered obese and a person with a BMI of 25 or more is considered overweight (WHO, 2017). When the body mass index calculated using height and weight values is analysed according to Türkiye Health Survey 2019 data, the rate of obese individuals aged 15 years and over was 19.6% in 2016 and 21.1% in 2019. In 2019, 24.8% of women were obese

and 30.4% were pre-obese, while 17.3% of men were obese and 39.7% were pre-obese.

In our study, it was found that the group with abdominal obesity and physical inactivity were older and had higher medication use. General health expenditure was higher in the group with abdominal obesity compared to other groups. General health expenditure was higher in the abdominal obesity group. A positive relationship was found between abdominal obesity and medical expenditures,

medication expenditures and general expenditures. Abdominal obesity and physical inactivity group were associated with higher expenditure on medication and general expenditure. It was determined that abdominal obese or abdominal obese and sedentary masses had higher general health expenditures.

Sandalcı and Tuncer (2020) stated in their study that the costs arising from obesity have reached high levels in the health expenditures of countries, causing a significant increase in the health expenditure items of countries and that the economic costs in Türkiye have reached significant levels due to the increase in obesity rates. However, it has been determined that if effective measures are not taken regarding obesity, economic costs will increase and will bring more burden to the budgets of countries.

Obesity reduces productivity and imposes an economic burden by increasing health expenditures (Bagheri Nabel, 2021). Anderson, Frogner and Reinhardt (2007) found that obesity increases health expenditures, Finkelstein et al. (2009) found that obesity makes a significant contribution to private and public expenditures, Kinge and Morris (2018) found that obesity makes a significant contribution to health expenditures, and Sturm et al. (2013) concluded in their study that obesity and smoking significantly increase health expenditures. At the same time, Agrawal and Agrawal (2015), in their study examining the relationship between health expenditures and obesity, stated that preventive health services and obesity prevention expenditures

are at lower levels than health expenditures made after obesity. In some studies in the literature, it has been determined that obesity causes high costs (Dee et al., 2014; Hammond & Levine, 2010; Klonoff, 2009).

In the report published by the Organisation for Economic Cooperation and Development (OECD), it was determined that obese individuals tend to benefit more from health services and that obese individuals spend approximately 2.5 times more on health expenditures than normal individuals. In the treatment of diseases caused by obesity in OECD countries, total health expenditures have a share of 8.4 percent (Çetinsoy, 2020). In addition, the study estimated that the cost of obesity and related health problems to the European Union will be 6% of the total budget in 2025 (Kanavos et al., 2012).

Studies show that the annual global cost of obesity has reached 2 trillion dollars and this amount corresponds to 2.8% of the annual economic activity. With the rapid increase in obesity in all countries, it is estimated that this amount will increase further and will bring a serious financial burden to the budgets of countries (Sandalcı & Tuncer, 2020).

## CONCLUSION

This analysis aimed to analyse the relationship between abdominal obesity and physical activity and health expenditures for the Turkish public health system. Regardless of other variables, patients with abdominal obesity in addition to those with abdominal obesity and sedentary behaviour were found to have increased health expenditures. In this



study, physical activity was inversely correlated with variables related to abdominal obesity and health expenditures. Sedentary patients did not have higher expenditures than obese and physically active patients. The results show that the protective effect of physical activity practice is mainly a negative relationship on expenditures.

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