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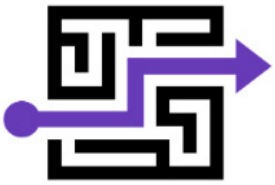


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Prof. Dr. Çetin YAMAN
Baş Editör

Değerli okurlar, kıymetli bilim insanları,

Uluslararası Hakemli Akademik Spor Sağlık ve Tıp Bilimleri Dergisi'nin bu yeni sayısında sizleri selamlamaktan büyük mutluluk duyuyorum. Bu sayıda, Fiziksel Hareketsizlik ile Obezitenin Türkiye Sağlık Harcamaları Üzerindeki Etkisi, Pandemi Sırasında ilk Kez Klinik Uygulamaya Çıkan Hemşirelik Öğrencilerinin Stres Düzeyleri Ve Problem Çözme Becerileri Arasındaki İlişki ve Centella Asiatica'nın, Farklılaşmış Sh-Sy5y Hücrelerinde 6-Ohda Kaynaklı Oksidatif Stres Üzerindeki Nöroprotektif Etkisi konulu üç araştırma ve uygulama çalışmaları ile spor sağlığı ve tıp alanındaki son gelişmeleri, araştırmaları ve inovatif uygulamaları sizlerle paylaşmak için bir araya geldik.

Dergimizin amacı, spor sağlığı ve tıp disiplinlerindeki bilimsel çalışmaları desteklemek, bu alandaki bilgi birikimini artırmak ve sağlıklı spor pratiklerini teşvik etmektir. Bu çerçevede, dergimizde yayımlanan her makale, titiz bir hakem değerlendirmesinden geçmiş olup, alanında uzman hakemler tarafından incelenmiş ve onaylanmıştır.

Bu sayımızda yer alan makaleler ile spor sağlığı ve tıp alanında son dönemde elde edilen bilimsel ilerlemeleri yansıtmış olması nedeniyle literatüre kazandırılmış kaynak olması nedeniyle bu makalelerin uluslararası düzeyde akademik çevrede değerlendirilmesini ve paylaşılmasını sağlamaktan da onur ve mutluluk duyuyoruz.

Bu sayımızda yer alan farklı konularda hazırlanan çalışmalarını bizlerle paylaşarak siz değerli okurlara ulaştırılılmasına katkı sağlayan başta yazar(lar)ımıza ve sayının hazırlanmasında emeği geçen çalışmalara bilgi ile görüşlerini katarak sizlere ulaşmasını sağlayan hakemlerimize, dergi yönetimi, yayın kurulu ve sistem yöneticilerine de ayrıca teşekkürlerimi ve saygılarımı sunuyorum.

Dergimizin gelecekte de bu alandaki araştırmalara ışık tutmaya devam etmesini diliyor ve tüm bilim dünyasına ve alanda çalışan bilim insanlarının çalışmalarında başarılar temenni ediyorum.

Saygılarımla,

(Dergimizde etik kurul raporu gerektiren her türlü çalışmada yazar(lar) editörlüğe ve derginin sistemine yayın yüklerken gerekli etik kurul rapor bilgilerini girmekle yükümlüdür. Hiçbir koşul ve şartlardaoluşan ya da oluşacak bir sorunda problemde dergimiz, yayın kurulu, imtiyaz sahibi, yazı

işleri, hakem vebilim kurulları sorumluluk kabul etmez. Yazar(lar) bu bilgiyi dergiye yazılı olarak vermekle yükümlüdür.Bu konuda tüm sorumluluk yazar(lar) a aittir).

Basın Yayın Kanunun "5187" gereğince basılı eserler yoluyla işlenen fiillerden doğan maddi ve manevizarar m-13-14 kapsamında dergimizde yayınlanan yayınların içeriği ve hukuki sorumluluğu tek taraflıolarak yazar(lar) a aittir. Dergimiz, yönetim, hakem, editör, bilim ve imtiyaz sahibi bu yükümlülüklerikabul etmez. Dergimizde bilimsel içerikli, literatüre katkı yapan, bilimsel anlamda değer ifade eden çalışmalar kabul edilir ve yayınlanır. Bunun dışında siyasi, politik, hukuki ve ticari içerikli fikri sınai haklarkanununa aykırılık içeren yayınlara yer verilmez. Olası bir olumsuzluk durumunda yazar(lar) doğabilecekher türlü maddi ve manevi zararı peşinen kabul etmiş ve yüklenmiştir. Bu nedenle ikinci üçüncü ve diğerşahıs ile kurumlar konusunda dergimiz yönetimi ve kurulları hiçbir sorumluluğu kabul etmez. Bu yöndedergimiz ve kurulları üzerinde bir hukuki yaptırım uygulanması söz konusu olamaz. Eserlerin içeriği vemevcut durumu yazar(lar) ait olup dergimiz bu yayınların sadece yayınlanması ve literatüre kazandırılmasıaşamasında görev üstlenmiştir. Tüm okuyucu, kamuoyu ve takipçilerine ilanen duyurulur.

Prof. Dr. Çetin YAMAN
Chief Editor

Dear readers, precious scholars,

I am very pleased to greet you in this new issue of the International Refereed Academic Journal of Sports, Health and Medical Sciences. In this issue, we have come together to share with you the latest developments, research and innovative applications in the field of sports health and medicine with three research and application studies on the Effect of Physical Inactivity and Obesity on Health Expenditures in Turkey, the Relationship Between Stress Levels and Problem Solving Skills of Nursing Students Who Go into Clinical Practice for the First Time During the Pandemic, and the Neuroprotective Effect of Centella Asiatica on 6-Ohda-Induced Oxidative Stress in Differentiated Sh-Sy5y Cells.

The aim of our journal is to support scientific studies in sports health and medicine disciplines, to increase knowledge in this field and to promote healthy sports practices. In this context, each article published in our journal has undergone a rigorous peer review process and has been reviewed and approved by expert referees in the field.

With the articles in this issue, we are also honoured and happy to ensure that these articles are evaluated and shared in the academic environment at the international level, as they reflect the recent scientific advances in the field of sports health and medicine.

I would like to express my gratitude and respect to our author(s) who have contributed to the delivery of this issue to you, our esteemed readers, and to our referees, journal management, editorial board and system administrators who have contributed to the preparation of the issue by adding their knowledge and opinions to the studies that have contributed to the preparation of the issue.

I hope that our journal will continue to shed light on research in this field in the future and I wish success to the whole scientific world and scientists working in the field.

Best regards,

(In any kind of study requiring ethical board report in our journal, author(s) is/are obliged to enter the data of necessary ethical board report while uploading their publication in editorship and journal system. Our journal, publication board, grant holder, editorial office, referee and science boards do not undertake any responsibility for a problem to occur under any circumstances and conditions.

Author(s) is/are obliged to give this information to journal in written. All liability in this issue belongs to author(s).

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THE IMPACT OF PHYSICAL INACTIVITY AND OBESITY ON HEALTH EXPENDITURES IN TÜRKİYE[1-2]

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 arttırmaktadır. 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

[1] Sorumlu Yazar, Corresponding Author: Ali Serdar YÜCEL, Faculty of Sport Sciences, Department of Sports Management, asyucel@firat.edu.tr, *Geliş Tarihi / Received: 09.04.2023, Kabul Tarihi / Accepted: 21.09.2023, Makalenin Türü: Type of Article: (Araştırma – Uygulama; Research - Application) Çıkar Çatışması, Yok – Conflict of Interest, None, Conflict of Interest, None, Etik Kurul Raporu veya Kurum İzin Bilgisi Ethical Board Report or Institutiınal Approval, Yok / None "Bu çalışma panel veri analizi ve literatür derlemesi ile gerçekleştirilmiş olması nedeniyle etik kurul getirmediği yazarlar tarafından beyan edilmiştir. Since this study was conducted with panel data analysis and literature review, it was declared by the authors that there is no ethics committee."*
[2] Çalışma, araştırma ve yayın etiğine uygun olarak hazırlanmıştır. / The study was prepared in accordance with research and publication ethics.

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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,

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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.

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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, under-utilization 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,

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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

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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 &

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

Abdominal obesity is a risk factor that can lead to various health problems (Błaszczyk-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).

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- **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

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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.

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- **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.

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- **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).
- **Buproprion and Naltrekson (Contrave):** Buproprion 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).
- **Buproprion and Naltrekson (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,

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especially in individuals with insulin resistance (Nasri & Rafieian-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

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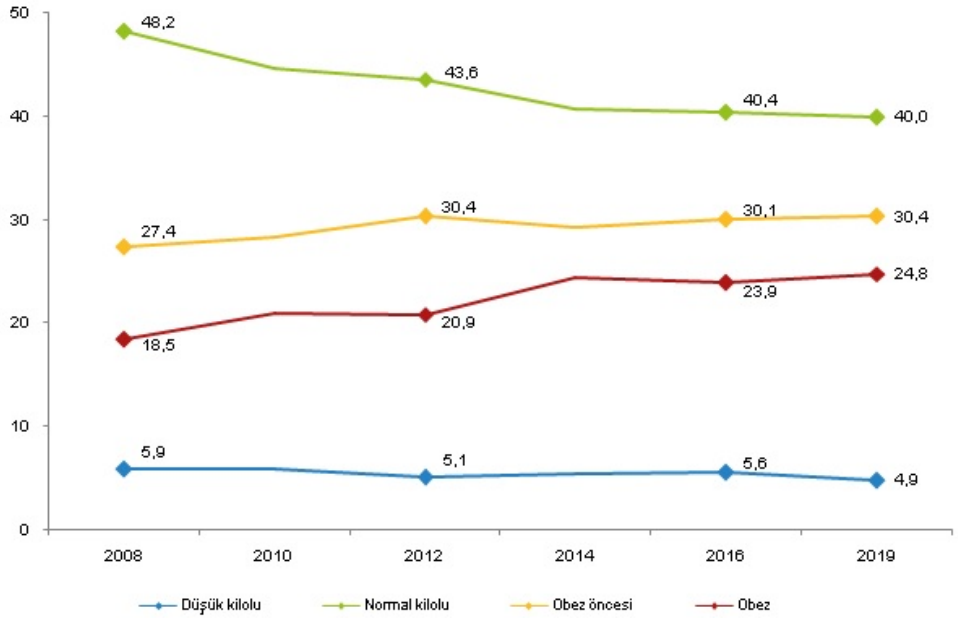
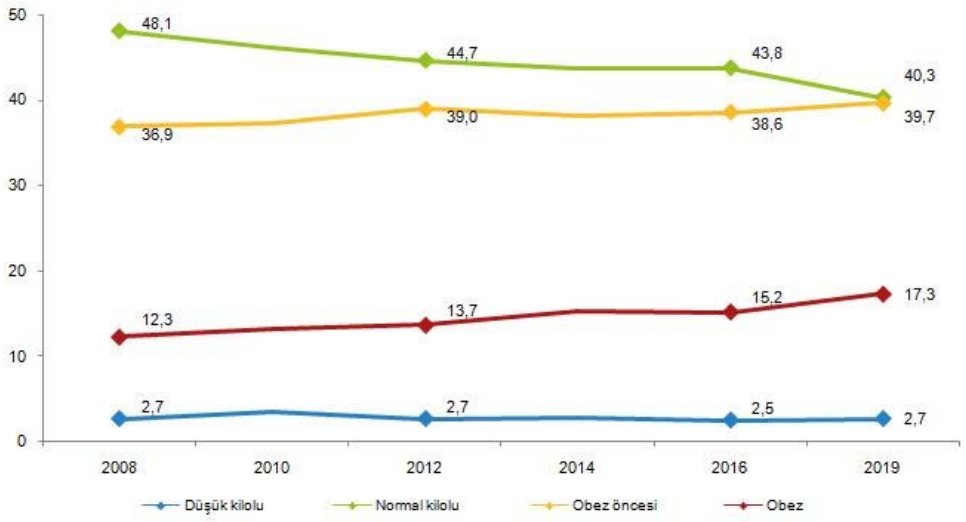
using height and weight values is analysed; while the proportion of obese individuals aged 15 years and over was 19.6% in 2016, it was 21.1% in 2019. In 2019, 24.8% of women were obese and 30.4% were pre-obese, while 17.3% of men were obese and 39.7% were pre-obese.



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

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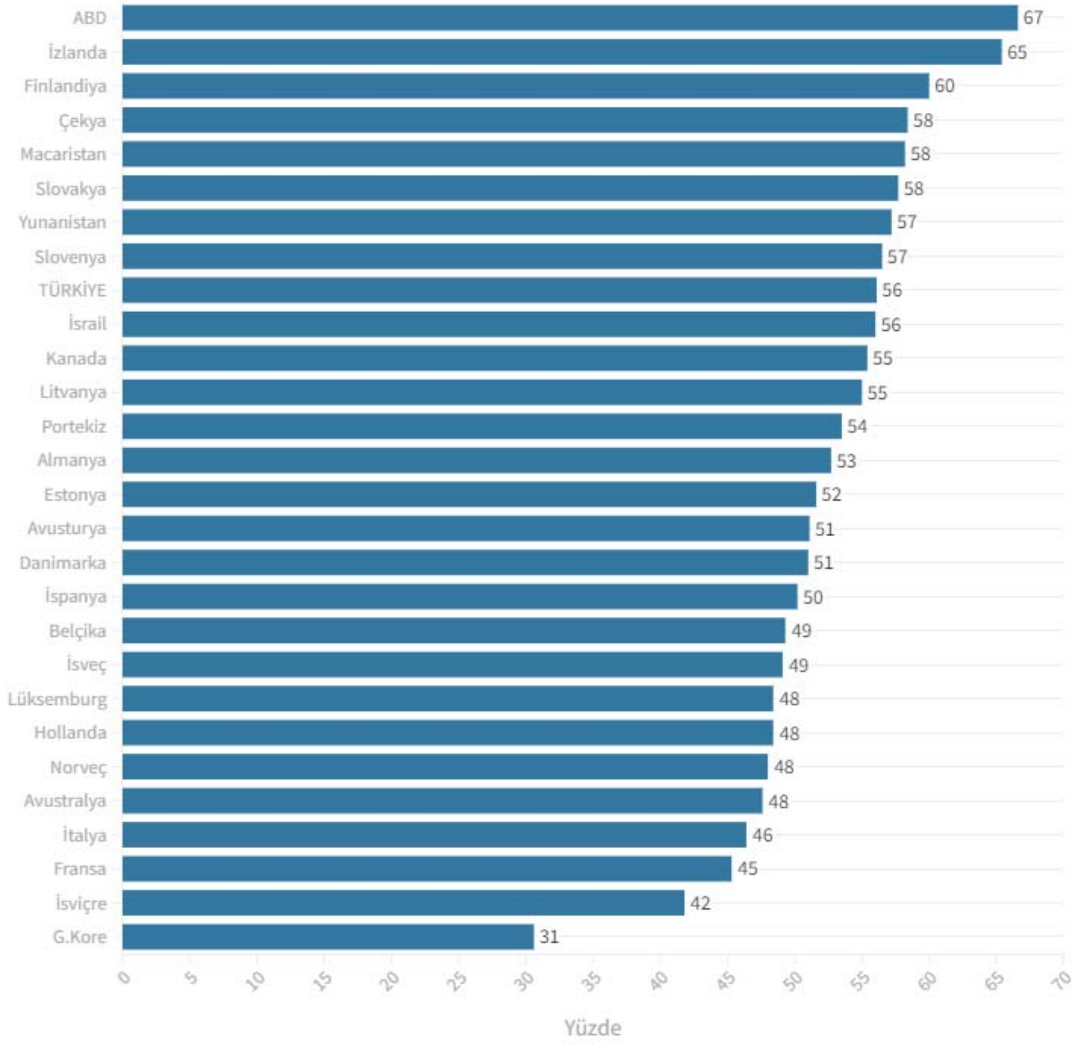
percent), Finland (60 percent) and the Czech Republic (58 percent). Türkiye ranks 9th among 28 countries. In Türkiye, 56 percent of the population over the age of 15 is overweight or obese. Türkiye ranks 9th among 28 countries with this rate. In 26 out of 28 countries, this rate is above 45 percent, 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%,

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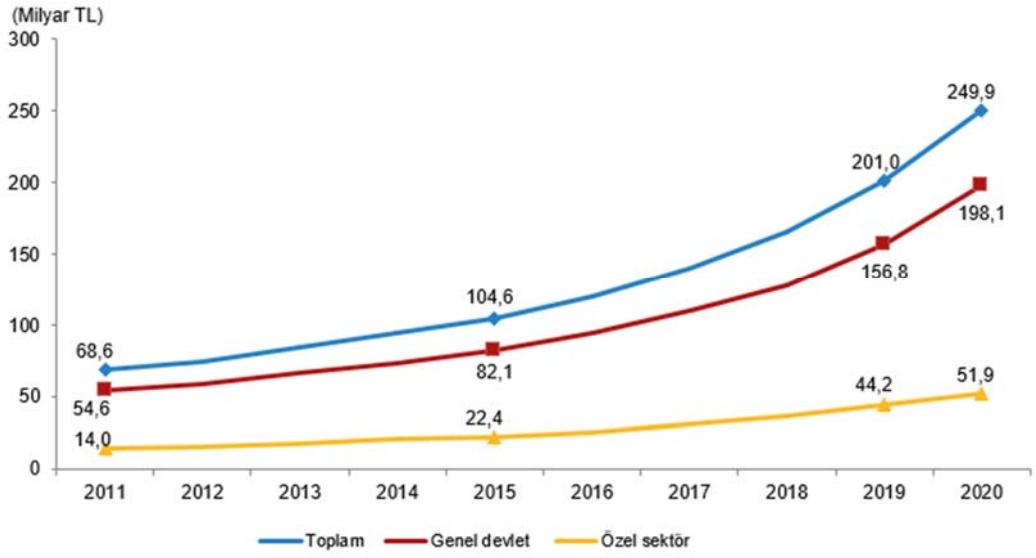
households 16.0%, insurance companies 2.6%, non-profit organisations and other enterprises serving households 2.1%, and local administrations 0.7%.



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.

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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 Obesity and 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

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Medical Expenditure (B TL)	39 (19.4)	49 (28.4)	.004	18 (20.7)	.532	36 (24)	.737
Laboratory Tests (B TL)	39 (19.4)	46 (27.8)	.231	21 (24.1)	.456	35 (23.3)	.667
Medication (B TL)	34 (16.9)	30 (24.8)	.001	21 (24.1)	.001	56 (37.3)	.001
General (B TL)	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				
Medical Expenditure (B TL)	4,15	8,57	4,23	5,22	.001
Laboratory Tests (B TL)	2,71	4,84	0,68	1,52	.001
Medication (B TL)	5,33	7,87	1,91	8,14	.001
General (B TL)	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,

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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

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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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DETERMINATION OF THE RELATIONSHIP BETWEEN STRESS LEVELS AND PROBLEM-SOLVING SKILLS OF NURSING STUDENTS ENTERING CLINICAL PRACTICE FOR THE FIRST TIME DURING THE PANDEMIC[1-2]

PANDEMİ SIRASINDA İLK KEZ KLİNİK UYGULAMAYA ÇIKAN HEMŞİRELİK ÖĞRENCİLERİNİN STRES DÜZEYLERİ VE PROBLEM ÇÖZME BECERİLERİ ARASINDAKİ İLİŞKİ

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Abstract: Aim: This study was conducted to examine the relationship between the stress levels, problem solving skills of nursing students who attended the clinic for the first time during the pandemic period. Method: the sample consisted of 168 students who went to clinical practice for the first time during the pandemic. Data were collected using the "Sociodemographic Information Form", "Clinical Stress Questionnaire (CSQ)" and "Problem Solving Inventory (PSI)".

Results: 57% of the students who participated in the study stated that they thought they might experience clinical stress due to reasons such as thinking that their professional knowledge and skills were not sufficient for practice, 61% thought of making mistakes, 79% feared harming the patient, and 58% feared Covid-19 transmission during clinical practice. The mean KSA total score was 26.15±8.46 and the mean PCE total score was 79.65±17.77. There was a statistically significant and moderate negative correlation between the mean KSA scores and the mean PCI scores ($p<0.05$).

Conclusion: As a result of the study, it was found that the stress levels of nursing students who went into clinical practice for the first time during the pandemic period were low and their problem-solving skills were at a moderate level, and it was observed that as the stress levels of the students decreased, their problem-solving skills increased.

Keywords: Nursing, Student, Clinical Practice, Pandemic, Stress, Problem Solving Skills

Öz: Amaç: Bu araştırma pandemi döneminde ilk kez kliniğe çıkan hemşirelik öğrencilerinin stres düzeyleri ve problem çözme becerileri arasındaki ilişkiyi incelemek amacı ile yapıldı. Yöntem: Araştırma tanımlayıcı ve ilişki arayıcı türde bir araştırmadır. Araştırmanın evrenini, bir üniversitenin hemşirelik bölümü 2020-2021 eğitim-öğretim yılında, ilk kez klinik uygulamaya çıkan, ikinci, üçüncü ve dördüncü sınıf öğrencileri oluşturmuşturken (n=196); örneklemini ise pandemi sırasında ilk kez klinik uygulamaya çıkan, 168 öğrenci oluşturmuştur. Araştırma verileri "Sosyodemografik Bilgi Formu", ''Klinik Stres Anketi (KSA)'' ve "Problem Çözme Envanteri (PÇE)" ile toplanmıştır.

Bulgular: Çalışmaya katılan öğrencilerin %57'si mesleki bilgi ve becerilerinin uygulama için yeterli olmadığını düşünme, %61 'i hata yapma düşüncesinde olma, %79'u hastaya zarar verme korkusu yaşama, %58'i klinik uygulama sırasında Covid-19 bulaş korkusu gibi sebeplerden dolayı klinik stres yaşayabilme düşüncesinde olduklarını belirtmişlerdir. Öğrencilerin KSA toplam puan ortalaması 26,15±8,46 ve PÇE toplam puan ortalaması 79,65±17,77 olarak saptanmıştır. Öğrencilerin KSA puan ortalamaları ile PÇE puan ortalamaları arasında istatistiksel olarak anlamlı ve orta düzey negatif yönlü bir ilişki bulunmaktadır ($p<0.05$).

Sonuç: Araştırma sonucunda pandemi döneminde ilk kez klinik uygulamaya çıkan hemşirelik öğrencilerinin stres düzeylerinin düşük ve problem çözme becerilerinin orta düzeyde olduğu saptanmış, öğrencilerin stres düzeyleri azaldıkça problem çözme becerilerinin de arttığı görülmüştür.

Anahtar Kelimeler: Hemşirelik, Öğrenci, Klinik Uygulama, Pandemi, Stres, Problem Çözme Becerisi

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

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INTRODUCTION

Covid-19, which was reported as a global pandemic by the World Health Organization (WHO) on 11 March 2020, has negatively affected the education system, especially the health system. (Çiçek et al., 2020; Kürtüncü and Kurt, 2020). In this process, educational institutions were temporarily closed in more than 150 countries to avoid the spread of the virus. (Toguero, 2020; Kürtüncü and Kurt, 2020; Sahu, 2020; Çevirme and Kurt 2020). As the pandemic became more widespread, students continued to study through distance education (Pokhrel, 2021; Kürtüncü and Kurt, 2020; Taş and Dalcalı, 2021). Nursing education, which consists of theoretical, laboratory and clinical practice components, was also negatively affected by the pandemic process (Savcı et al., 2019; Çevirme and Kurt 2020). In the studies, it has been stated that these negative factors are disruption of clinical practices, inability to perform basic skills in the laboratory environment, and being away from hospitals and patients (Cao et al., 2020; Kürtüncü and Kurt, 2020; Sahu, 2020). In particular, clinical practices enable students to gain competence in the use of values, attitudes, knowledge and skills related to the profession. Although touching the patient, understanding him/her, enabling him/heraltun to come from one stage to another stage, teaching nursing students roles and responsibilities and enabling them to gain professional competence (Çevirme and Kurt 2020; Altundal et al., 2022), clinical practice-based learning is among the situations that cause the most stress and anxiety in nursing students (Moridi et al., 2014). In the studies conducted, it has been stated that nursing students who will begin clinical practice for the first time experience stress due to reasons such as fear of making mistakes and harming the patient, anxiety about not being able to perform the practices expected from them, hesitation to touch the patient, and concerns about not being able to communicate effectively with patients and health professionals (Savcı et al., 2019; Açıksöz et al., 2016; Özşaban and Bayram, 2020; Cantekin et al., 2021; Tosunöz et al., 2021; Taş and Dalcalı, 2021). In addition to these sources of stress experienced by students, it is thought that the Covid 19 pandemic period process further increased clinical stress. Studies have shown that nursing students studying with distance education experience clinical stress owing to reasons such as having difficulty in attending classes during the online education process and experiencing anxiety about not being able to transfer the theoretical knowledge they have learned to clinical practice, feeling isolated from the social environment, encountering the deficiencies of preventive measures in the hospital against pandemic-induced contamination during clinical practice, and carrying Covid-19 infection from the clinic to the family and social environment (Savitsky et al., 2020; Cooke et al., 2020; Deo et al., 2020; Cao et al., 2020; Majrashi et al., 2021).

Stress is a factor that arises due to different sources and can be perceived positively or negatively, affecting the life and harmony of

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the individual (Cantekin et al., 2021). In this sense, it is very important for individuals not to experience stress negatively or to know the methods of coping with stress in order to overcome stress and to develop problem solving skills. (Taşdelen and Zaybak, 2013; Cantekin et al., 2021). When the studies are examined, it is stated that nursing students generally have low and moderate problem solving skills level and problem solving skills decrease as the stress level increases (Durmaz et al., 2007; Tezel et al., 2009; Olgun et al., 2010; Üstündağ et al., 2018; Uysal and Manavoğlu, 2019; Barutçu, 2019). In addition, since it is among the basic roles and responsibilities of nurses to understand the challenging processes experienced by patients, to help them cope with their stress and to develop problem solving skills; nursing students who face this challenging process such as pandemic should firstly recognise their own stress levels and develop problem solving skills to cope with this stress (Yıldırım and Bağsürer, 2019; Olgun et al., 2010).

AIM

This study was conducted to determine the relationship between stress levels and problem solving skills of nursing students who went into clinical practice for the first time during the pandemic period when uncertainty and fear were experienced.

Research Questions:

1.What is the stress level of. nursing students who went into. clinical practice for the first time. during the pandemic?

2.What is the level of problem. solving skills of nursing students who. have clinical practice for the first. time during the pandemic?

3. Is there a relationship between the. stress levels and problem solving. skills of nursing students who first. started clinical practice during the pandemic?

MATERIAL AND METHOD

The study was conducted as a descriptive and correlational research. The population of the study consisted of students studying in the nursing department of a university located in the Central Anatolia region of Turkey (n=300). The sample of the study consisted of second-, third- and fourth-year students (n=196) who started clinical practice for the first time in the autumn and spring years of the 2020-2021 academic year. Using the random sampling method, the data collection process was completed with 168 students who volunteered to participate in the study.

Inclusion Criteria:

- Volunteering to participate in the research

- Being in clinical practice for the first time

- Reading and writing Turkish

Nursing students were informed about the study just before the clinical practice in the conference hall of the hospital where the clinical practice would take place. Student nurses who volunteered to participate in the study were informed about the data collection tools and asked to answer the questionnaire and scale questions. The

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duration of answering the questions was approximately 15-20 minutes.

Data Collection Form

The data of the study were collected with "Sociodemographic Information Form", "Clinical Stress Questionnaire (CSQ)" and Problem Solving Inventory (PSI).

Sociodemographic Information Form: By utilizing the literature by the researchers (Atay and Yılmaz, 2011; Tosunöz et al., 2021, Açıksöz et al., 2016) The developed form includes a total of 13 questions to determine the sociodemographic and descriptive characteristics of the students such as age, gender, marital status, information about the characteristics related to the choice of nursing profession (willingly choosing the nursing department, reason for choosing the profession, satisfaction with studying in the nursing department, weighted grade point average).

Clinical Stress Questionnaire (CSQ): The Clinical Stress Questionnaire (CSQ) is a Likert-type self-assessment scale developed by Pagana in 1989 to determine the baseline value of stress that threatens or requires student nurses to cope with during their first clinical practice experience. The scale, which consists of a total of 20 items, includes four sub-dimensions. The threat sub-dimension of the scale consists of "6" (questions 1, 7, 9, 12, 15, 19) (upset, worried, overwhelmed, emotional, intimidated, scared), struggle sub-dimension consists of "7" (questions 2, 4, 6, 8, 10, 14, 18) (stimulated, cheered up, hopeful, pleased, enthusiastic, excited, happy), harm sub-dimension consists of "5" (questions 3. , 5th, 11th, 13th, 17th question) (I felt angry, sad, guilty, disgusted, disgusted, disappointed), benefit sub-dimension consists of "2" items (16th question, 20th question) (I felt relieved, trusted). In the evaluation of the five-point Likert-type scale, each item is scored between "0" and "4" points. Based on the score given for each item, a minimum score of "0" and a maximum score of "80" can be obtained from the questionnaire. A low score indicates a low level of stress, while a high score indicates a high level of stress. The Turkish validity and reliability study of the CSQ was conducted by Şendir and Acaroğlu (2006). The Cronbach's alpha coefficient of the scale was found to be 0.70 (Şendir and Acaroğlu, 2006). In this study, the Cronbach's alpha coefficient of the scale was 0.79.

Problem Solving Inventory (PSI): Problem Solving Inventory (PSI), The scale was developed by Heppner and Petersen (1982) to assess how individuals perceive their own problem-solving behaviors and approaches and consists of 35 Likert-type items with six sub-dimensions. These sub-dimensions consist of "hasty approach" (9 questions), "avoidant approach" (4 questions), "thinking approach" (5 questions), "confident approach" (6 questions), "evaluative approach" (3 questions) and "planned approach" (4 questions). In the evaluation of the scale, each item is scored between "1" and "6" points. Items 9, 22 and 29 are excluded from the scoring of the scale. Some items in the scale (1, 2, 3, 4, 11, 13, 14, 14, 15, 17, 21, 25, 26, 30, 34) are reverse scored. The total score that can be obtained from the

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scale varies between 32-192. Higher total scores indicate that the individual perceives himself/herself as inadequate in problem solving skills, while lower scores indicate that he/she perceives himself/herself as adequate. The validity and reliability of the Turkish version of the scale was conducted by Şahin and Heppner (1993) and the Cronbach's alpha coefficient was found to be 0.88. In this study, the Cronbach's alpha coefficient was 0.84.

Data Analysis

IBM SPSS 25 programme was used to evaluate the data. The conformity of the numerical data to normal distribution was evaluated by Shapiro-wilk test. Descriptive statistics such as number, percentage, mean, standard deviation, minimum and maximum were used in the analysis of the data. The relationship between two continuous variables was evaluated by Pearson's correlation coefficient and Spearman's correlation coefficient when parametric test prerequisites were not met. Statistical significance level was accepted as $p<0.05$.

Ethical Consideration

Ethical permission with decision number 2021/006 was obtained from XXXX University Faculty of Medicine, Drug and Non-Medical Device Research Ethics Committee and permission was obtained from the institution where the research would be conducted. Student nurses were told that they could leave the study at any time they wanted, and the consent of the participants was obtained.

RESULTS

The mean age of the students who participated in the study was 21.04±0.06 years. 83% of the students were women, 70% were from Anatolian high school, 57% were in the second year, and 79% had chosen the department willingly. It was found that 44% of the students chose the department because they were interested in the nursing profession and 34% chose the department because it was a profession with high employment opportunities. The general weighted Grade Point Average (GPA) of 64% of the students was in the range of 3.1-4, and 34% of the students defined patients, 22.9% nurses, 21.2% physicians and 21.7% academic staff as stress factors for themselves (Table 1).

Table 1. Determination of Sociodemographic and Descriptive Characteristics of the Nursing Students Participating in the Study (n=168)

	Ort±SD (Min.-Maks)		
Age	21.04±0.06 (19-23)		
		n	**%**
Gender	Female	139	83
	Male	29	17
Marital status	Married	2	1
	Single	166	99

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Graduated high school	Health vocational high school	41	24
	Anatolian high school	117	70
	High school	10	6
Classroom	2. Classroom	63	38
	3. Classroom	57	34
	4. Classroom	48	29
Place of residence	Dormitory	17	10
	Home	58	35
	With family	93	55
Reason for choosing the profession	Job opportunities are high	57	34
	University exam score	15	9
	Being interested in nursing profession	74	44
	Random choice	7	4
	The desire of the family for the Nursing profession	15	9
Coming to the department willingly	Yes	132	79
	No	36	21
GPA	1.1-2	4	2
	2.1-3	57	34
	3.1-4	107	64
***Individuals with stress factors causing stress in the clinic**	Nurses	82	23
	Doctors	76	21
	Patients	122	34
	Teaching staff	78	22

Summary statistics are given as Number (Percentage) values. *More than one answer was given.

When the situations that caused stress in students were evaluated, it was determined that students experienced stress mostly because they were afraid of harming the patient (79%), afraid of making mistakes (61%), afraid of Covid-19 transmission (58%), thought that their professional knowledge and skills were not sufficient due to online education during the pandemic process (57%), and feared that they could not transfer the knowledge they learned at school to the workplace due to online education during the pandemic process (49%) (Table 2).

Table 2. Determination of Clinical Stress Causing Conditions of the Nursing Students Participating in the Study (n=168)

		n	%
Fear of harming the patient	Yes	133	79
	No	35	21
Thought of making a mistake	Yes	102	61
	No	66	39
Fear of Covid-19 transmission during clinical practice	Yes	97	58
	No	71	42
The idea that professional knowledge and skills are not sufficient for practice due to online education during the Covid-19 pandemic process	Yes	95	57
	No	73	43

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Fear of not being able to transfer the knowledge learnt at school to the workplace due to online education during the Covid-19 pandemic process	Yes	83	49
	No	85	51
Fear of being evaluated by lecturers	Yes	63	38
	No	105	63
Fear of failing clinical practice	Yes	51	30
	No	117	70
Thinking that you will have difficulty in communicating with other health professionals	Yes	42	25
	No	126	75
Thinking that you will have difficulty in communicating with the patient	Yes	38	23
	No	130	77
Lack of self-confidence	Yes	36	21
	No	132	79
Difficulty in communicating with lecturers	Yes	24	14
	No	144	86

Summary statistics are given as Number (Percentage) values.

The mean scores of the CSQ and its subscales and the mean scores of the Problem Solving Inventory (PSI) and its subscales are given in Table 3. CSQ The mean total score was 26.15±8.46, with the highest mean score in the struggle sub-dimension (18.33±7.22) and the lowest mean score in the benefit sub-dimension (1.24±1.60). The mean PSI total score was 79.65±17.77, with the highest mean score in the impetuous approach subscale (30.65±7.87) and the lowest mean score in the evaluative approach subscale (6.17±3.01) (Table 3).

Table 3. CSQ and PSI Total Score and Subscales Mean Scores (n=168)

		Ort±SS	Min.-Maks
CSQ	**Total Score**	26.15±8.46	0-50
	Struggle	18.33±7.22	0-32
	Threat	7.82±4.33	0-24
	Harm	1.60±2.22	0-9
	Benefit	1.24±1.60	0-7
PSI	**Total Score**	79.65±17.77	39-124
	Hasty Approach	30.65±7.87	10-50
	Thinking Approach	10.93±3.73	5-26
	Avoidant Approach	8.39±3.94	4-22
	Evaluative Approach	6.17±3.01	3-18
	Confident Approach	14.39±4.86	6-31
	Planned Approach	9.12±3.35	4-23

Summary statistics are given as mean ± standard; minimum and maximum, values.

The relationship between students' clinical stress levels and problem solving skills is given in Table 4. It was seen that there was a moderate negative and statistically

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significant relationship between the mean clinical stress scores of the students and their mean problem solving skills scores (r=-0.379, p=0.001). There was a low level negative correlation between the mean CSQ total score and PSI hasty approach (r=-0.232, p=0.002), thinking approach (r=-0.239, p=0.002), avoidant approach (r=-0.298, p=0.001), planned approach (r=-0.230, p=0.003) and a statistically significant relationship was found between the mean scores of the self-confident approach (r=-0.342, p=0.001) sub-dimension at a low level and between the mean scores of the self-confident approach (r=-0.342, p=0.001) sub-dimension at a moderate level (Table 4).

Table 4. Determination of the Relationship Between Students' CSQ and PSI Score Means (n=168)

		CSQ				
		Total Score	**Struggle**	**Threat**	**Harm**	**Benefit**
PSI	**Total Score**	**-0.379 (p=0,001) ****	**-0.454 (p=0,001) ****	0.019 (p=0,812)	0.096 (p=0,215)	0.036 (p=0,643)
	Hasty Approach	**-0.232 (p=0,002) ****	**-0.330 (p=0,001) ****	0.097 (p=0,213)	**0.183 (p=0,017) ***	0.092 (p=0,237)
	Thinking Approach	**-0.239 (p=0,002) ****	**-0.251 (p=0,001) ****	-0.049 (p=0,529)	0.021 (p=0,784)	0.020 (p=0,800)
	Avoidant Approach	**-0.298 (p=0,001) ****	**-0.353 (p=0,001) ****	0.007 (p=0,928)	0.079 (p=0,31)	0.048 (p=0,541)
	Evaluative Approach	-0.132 (p=0,089)	-0.127 (p=0,101)	-0.045 (p=0,56)	-0.020 (p=0,798)	-0.044 (p=0,575)
	Confident Approach	**-0.342 (p=0,001) ****	**-0.385 (p=0,001) ****	-0.026 (p=0,734)	-0.038 (p=0,622)	-0.103 (p=0,184)
	Planned Approach	**-0.230 (p=0,003) ****	**-0.267 (p=0,001) ****	-0.003 (p=0,965)	0.036 (p=0,641)	0.086 (p=0,268)

*p<0.05; **p<0.01; Correlation Coefficient

DISCUSSION

With this study, results were obtained regarding the relationship between the stress levels and problem solving skills of nursing students who went into clinical practice for the first time during the pandemic period.

In this study, when the situations leading to clinical stress were evaluated, it was determined that students experienced stress mostly due to reasons such as harming the patient (79%), making mistakes (61%), fear of Covid-19 transmission (58%), thinking that their professional knowledge and skills were not sufficient due to online education

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during the pandemic process (57%) and fear of not being able to transfer the knowledge learned at school to the workplace due to online education during the pandemic process (49%) (Table 2). When the studies conducted before the Covid 19 pandemic were examined, it was determined that students mostly experienced stress due to making an incorrect application (Bahadır Yılmaz, 2016; Açıksöz et al., 2016; Tosunöz et al., 2021), lack of professional knowledge and skills (Chan et al., 2009) and harming the patient (Atay and Yılmaz, 2011; Arabacı et al., 2014; Açıksöz et al., 2016; Savcı et al., 2019). In addition to these sources of stress, when the studies conducted during the Covid-19 pandemic period are examined, it is reported that students also experience stress due to being infected with Covid 19, experiencing a lack of personal protective equipment, facing distance education difficulties during the pandemic period, and lack of preventive measures in clinical education (Savitsky et al., 2020; Cooke et al., 2020; Deo et al.,2020; Cao et al., 2020; Majrashi et al., 2021; İlter and Ovayolu, 2023). The Covid-19 pandemic is one of the biggest challenges that education systems have ever faced. In addition to the characteristics of nursing education, it is thought that major and important changes in the education process due to Covid-19, such as the transition to online education and the difficulties in maintaining online education, create stress on students. Traditionally, nursing education is about utilizing cognitive, sensory and psychomotor learning domains (Nashwan et al., 2020). In addition to theoretical courses, the nursing education curriculum mainly includes professional skills. After students develop their practical skills in the laboratory, they receive clinical practice training. Clinical practice education aims to integrate theoretical knowledge and practice. However, face-to-face training, which is thought to be more effective in increasing clinical practice skills, could not be conducted due to the pandemic. In this context, since theoretical and practical trainings were carried out online during the pandemic process, it is thought that the fear of harming the patient while doing the first clinical applications caused stress in students. In addition, during the application, students' fear of Covid19 transmission may be a source of stress due to the fact that the personal protective equipment available in hospitals to protect themselves from infection is mostly used by healthcare professionals and accordingly, students may think that these protective equipment may be missing or insufficient for themselves, and the fear of transmitting Covid-19 to both themselves and their immediate environment due to this lack of equipment.

In this study, it was found that the mean CSQ total score of student nurses was at a low level. When the studies conducted in the literature to examine the stress levels of nursing students during the first clinical experience before the pandemic were examined, it was found that the stress levels of student nurses were at a low level. (Taşdelen and Zaybak, 2013; Karagözoğlu et al., 2014; Mankan et al., 2016; Savcı et al., 2019) In contrast to the findings of this study, Zheng et al. (2022) found that the

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stress levels of student nurses were moderate in their meta-analysis study on the stress levels of student nurses. During the pandemic period, in the study conducted by Deo et al (2020) to determine the factors associated with perceived stress, anxiety, depression, insomnia during the Covid-19 outbreak in nursing students, it was determined that almost all of the students experienced moderate stress. In the study conducted by Temiz (2020) to determine the anxiety levels and coping strategies of nursing students during the Covid-19 pandemic, it was reported that students had moderate anxiety, while Savitsky et al (2020) reported that nursing students had high levels of anxiety. As stated in previous studies, our findings differ from the literature. Due to reasons such as the suitability of the technical infrastructure of the private university to which the students participating in this study were affiliated, the courses could be conducted as Hybrid during the pandemic period. Hence, those students who desired were able to improve their fundamental and clinical skills through in-person laboratory practices while adhering to social distancing and mask regulations. It is thought that the fact that the majority of the students reside in the same province as the university increases the rate of face-to-face participation in the courses. It can be said that the reason why the stress levels of the students participating in this study were found to be low during clinical practice was due to the fact that the majority of the students participated in face-to-face laboratory practices during the pandemic.

In this study, the mean PSI total score of the students was found to be at a moderate level. In studies conducted to determine the problem-solving skills of nursing students before the Covid-19 pandemic, similar to the results of this study, it was reported that student nurses had moderate problem-solving skills. (Durmaz eet al., 2007; Tezel et al.,2009; Olgun et al., 2010; Üstündağ et al., 2018; Uysal and Manavoğlu, 2019; Barutçu, 2019). When the studies conducted during the Covid-19 pandemic period were examined, no study evaluating the total score and sub-dimensions of the PSI was found. However, in another study conducted by Huang et al (2020) to evaluate nursing students' emotional reactions and coping strategies during the Covid-19 pandemic, it was reported that student nurses were more willing to adopt problem-focused coping. When the PSI sub-dimensions of the student nurses were evaluated in this study, it was found that the mean total score of the "hasty approach" sub-dimension, in which the individual acts according to the first thought that comes to mind without thinking about problem solving, was the highest, and the "evaluative approach" sub-dimension, which compares the method applied to solve the problem with the method planned, had the lowest score (Table 3). The results of the study conducted by Uysal and Manavoğlu (2019) to determine the problem solving skills of nursing students support the results of this study. When any problem is encountered in hospital settings, it is very important to make a decision quickly by evaluating the available evidence, although it is positive. In addition, helping and

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counseling patients to solve problems is among the roles and responsibilities of the nursing profession. Considering that problem solving skill is an ability and a learned behavior, it is thought that it would be beneficial to empower nursing students in terms of problem solving skills to fulfill their roles and responsibilities.

In this study, it was determined that there was a moderate, negative and statistically significant relationship between the mean clinical stress scores of the students and their mean problem solving skills scores (Table 4). Similar to the results of this study, it has been reported in the literature that there is a negative relationship between students' problem solving skills and stress levels. (Hamaideh et al., 2017; Al Gamal et al., 2018; Onieva Zafra et al., 2020). No study evaluating the relationship between stress and problem solving skills during the pandemic was found. Nurses need to be able to manage their own stress in order to understand the challenging processes experienced by patients and to plan their care. At the same time, it is thought that it is important to develop problem solving skills in order to implement the nursing care plan, which is closely related to the problem solving process. In this direction, it is important for student nurses, who are the nurses of the future, to first recognize their own stress levels and develop problem-solving skills to cope with this stress in this challenging process, which is thought to cause increased stress such as the pandemic.

Limitations of the Study

The fact that the data of the study were obtained from nursing students of an institution during the pandemic period shows that our findings cannot be generalized for all nursing students.

CONCLUSION

As a result of the research, it was found that the stress level of nursing students who went to clinical practice for the first time during the pandemic was low and the problem-solving skills were moderate, and it was seen that the problem-solving skills of the students increased as their stress levels decreased. It is a desirable result that the stress level of the nursing students participating in our research is low. However, it is recommended that academicians carry out improvement studies to increase the problem-solving skills of the students in their education programs in order to make it a way of life for students to cope with stress against the possibility of encountering uncertainty and challenging conditions such as the pandemic in the future. In the training programs, it is thought that it will be useful for students to include scenario-based case discussions before clinical applications and webinars or face-to-face trainings within the faculty about the pandemic period.

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CENTELLA ASIATICA NEUROPROTECTIVE EFFECT ON 6-OHDA-STIMULATED OXIDATIVE STRESS IN DIFFERENTIATED SH-SY5Y CELLS[1-2]

CENTELLA ASİATİCA'NIN, FARKLILAŞMIŞ SH-SY5Y HÜCRELERİNDE 6-OHDA KAYNAKLI OKSİDATİF STRES ÜZERİNDEKİ NÖROPROTEKTİF ETKİSİ

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Abstract: Aim: Parkinson's disease is qualified by advancing the loss of dopaminergic neurons and depletion of dopamine. However, the pathophysiological mechanisms need new perspectives for therapeutic strategies that alleviate and abolish neurodegenerative. The last searches have demonstrated that Centella Asiatica is commonly used in conventional medicine. The aim of our study is to reveal the neuroprotective effect of Centella Asiatica, which we will use in the treatment, on the neurotoxicity stimulated by 6 OHDA.

Method: First, the SH-SY5Y cell line was grown in prepared media. Then, 25-50-75 and 100 µg/ml concentrations of Centella Asiatica were supplemented to the wells that reached 85% confluence 2 hours before (except for the control and 6-OHDA groups). Afterward, 200 µM 6-OHDA was added to the wells (except for the control group) and incubated for 24 hours. Then, IL-1β, GSH, MTT, LDH, GPx, TNF-α, SOD, MPO, CAT, and MDA analyses were performed. One-way analysis of variance was performed using the IBM SPSS 22.0 package program. The results were compared with the control and 6-OHDA groups, and values below p<.05 were considered statistically significant.

Results: It was found that Centella Asiatica demonstrated a dose-dependent rise in the vivacity rate and the cell vivacity was 92% at the highest concentration. Moreover, antioxidant parameters (GSH, GPx, SOD, CAT) correlated with MTT and LDH assay. In IL-1β, TNF-α, MPO, and MDA activities, it was observed that the oxidant amount reduced depending on the concentration.

Conclusion: These findings revealed that Centella Asiatica exerts a neuroprotective effect opposite 6-OHDA induction by rising cell viability and reducing oxidative stress.

Keywords: Centella Asiatica, Parkinson Model, SH-SY5Y Cell Line

Öz: Amaç: Parkinson hastalığı, dopaminerjik nöronların progresif kaybı ve dopamin tükenmesi ile karakterizedir. Bununla birlikte, patofizyolojik mekanizmalar nörodejeneratifi hafifleten ve ortadan kaldıran terapötik stratejiler için yeni perspektiflere ihtiyaç duymaktadır. Son araştırmalar, Centella Asiatica'nın geleneksel tıpta yaygın bir şekilde kullanıldığını göstermiştir. Çalışmamızın amacı, tedavide kullanacağımız Centella Asiatica'nın 6-OHDA ile oluşturulan nörotoksisite üzerindeki nöroprotektif etkisini ortaya koymaktır.

Yöntem: Başlangıçta SH-SY5Y hücre hattı hazırlanmış besiyerlerinde büyütüldü. Ardından, %85 konflense ulaşan kuyucuklara 2 saat öncesinden Centella Asiatica'nın 25-50-75 ve 100 ug/ml dozları eklendi (kontrol ve 6-OHDA grubu hariç). Sonrasında kuyucuklara (kontrol grubu hariç) 200 µM 6-OHDA ilave ederek 24 saat boyunca inkübasyona bırakıldı. Ardından IL-1β, GSH, MTT, LDH, GPx, TNF-α, SOD, MPO, CAT ve MDA analizleri yapıldı. Elde edilen veriler IBM SPSS 22.0 paket programı kullanılarak tek yönlü varyans analizi yapıldı. Sonuçlar kontrol ve 6-OHDA grupları ile karşılaştırılarak p<.05'in altındaki değerler istatiksel olarak anlamlı kabul edildi.

Bulgular: Canlılık oranında Centella Asiatica'nın konsantrasyona bağlı olarak bir artış gösterdiği ve en yüksek konsantrasyonda hücre canlılığı % 92 oranında bulundu. Ayrıca antioksidan parametreleri (GPx, SOD, GSH, CAT), MTT ve LDH testi ile benzerlik gösterdi. IL-1β, TNF-α, MPO ve MDA aktivitelerinde ise doza bağlı olarak oksidan miktarının azaldığı gözlendi.

Sonuç: Bu bulgular, Centella Asiatica'nın hücre canlılığını artırarak ve oksidatif stresi azaltarak 6-OHDA indüksiyonuna karşı nöroprotektif bir etki gösterdiğini ortaya koydu.

Anahtar Kelimeler: Centella Asiatica, Parkinson Model, SH-SY5Y Hücre Hattı

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

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INTRODUCTION

Parkinson's disease (PD) is the second best common neurodegenerative illness after Alzheimer's illness, qualified by progressive loss of dopaminergic neurons and depletion of dopamine (Masato et al., 2019; Del Din et al., 2021). However, the pathophysiological mechanisms are not yet fully understood to pave the way for new perspectives for therapeutic strategies that alleviate or even abolish the neurodegenerative phenomenon (Ioghen et al., 2023). An accessible, inexpensive, and widely used in vitro model for PD is culturing immortalized cell lines (Cetin et al., 2022). Neurotoxicity-induced SH-SY5Y models serve as a starting point to study the protective effect of different compounds (Ioghen et al., 2023). Since 6-OHDA is similar to catecholamines, it enters cells using their transporters. Thus, it induces mitochondrial dysfunction, increases oxidative stress, and produces neuronal cell death (Falkenburger et al., 2016; Xicoy et al., 2017). It has also been used in an in vivo model of PD by inducing cell death of dopaminergic neurons (Zeng et al., 2018).

Many studies show that mostly natural phenols have a certain antioxidant effect, offering big occasions in the prevention and treatment of neurodegenerative phenomena because of their security and low side effects (Ioghen et al., 2023). This effect of phenols maintains the oxidation/redox balance in the nervous system and fights opposite the oxidative injury (Park & Ellis, 2020).

Centella Asiatica (CA) Urban, (Apiaceae), familiar as Gotu Kola is used in traditional Chinese and Ayurvedic medicine to enhance memory, cure cognitive function, and inverse cognitive impairments (Shinomol et al., 2011). The neuroprotective and cognitive enhancing effects of CA extracts have been validated in human works (Dev et al., 2009; Tiwari et al., 2008) as well as in preclinical model systems (Veerendra-Kumar & Gupta, 2003; Defillipo et al., 2012). Previous studies have shown that CA can prevent Aβ toxicity in vitro (Gray et al., 2014), without changing plaque load (Soumyanath et al., 2012), and reduce cognitive impairments in a transgenic mouse model of Aβ accumulation. Though the mechanism is unknown, studies in other models of neurotoxicity suggest that CA has antioxidant activity and may change mitochondrial function (Shinomol & Muralidhara, 2008; Prakash & Kumar, 2013). In addition to these effects, CA reduced the neurobehavioral and neurochemical effects of stroke in rodents (Tabassum et al., 2013), accelerated nerve regeneration, protected against oxidative neurotoxicity, and showed anti-inflammatory and antioxidant effects (Haleagrahara & Ponnusamy, 2010).

In this study, we researched the mechanism by which CA preserves opposite 6-OHDA toxicity using the neuroblastoma cell line (SH-SY5Y). These cells are widely used to model the effects of catecholamine 6-OHDA treatment. We investigated the effects of CA on cytotoxicity and antioxidant response in this cellular system.

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METHOD

Cell Culture and Treatment

For our study, SH-SY5Y (ATCC® CRL-2266™) cell line was bought from ATCC. The suspended cells were cultured in a Dulbecco-modified eagle medium containing 10% fetal bovine serum and 1% antibiotic (Thermo Fisher, Germany) and kept at 37°C with 5% CO_2. The medium was refreshed every 2-3 days. The cells were seeded in 96-well plates and stored in an incubator. For toxicity assessment, various dosages (25-50-75, and 100 µg/mL) of CA were added to the medium two hours before 6-OHDA (Sigma-Aldrich) application. After two hours, cells were exposed to 200 µM 6-OHDA for 24 hours. MTT and LDH assays were used to determine cytotoxicity after 24 hours.

Determination of Cytotoxicity

To evaluate the therapeutical potential of CA opposite 6-OHDA toxicity, we assessed the cell vivacity by measuring mitochondrial activity in alive cells by 3-4,5-dimetil-tiyazolil-2,5 difeniltetrazolyum bromür (MTT) quantitative colorimetric analysis. For this, cells were incubated with MTT for 4 hours. Then the medium was removed and the cells were solved with dimethyl sulfoxide. Its absorbance was read at 570 nm. Cell vivacity was stated as a percentage of the worth in the control.

Lactate dehydrogenase (LDH) activity is a test used to measure the leakage of LDH into the cell medium when the plasma membrane integrity of cells is disrupted. LDH activity was appointed in a colorimetric way using an LDH analysis kit (Elabscience, USA) according to the kit procedure. The absorbance was measured at 450 nm in the plate reader.

Measurement of Oxidative Stress Markers

Glutathione peroxidase (GPx), interleukin-1β (IL-1β), malondialdehyde (MDA), tumor necrosis factor-α (TNF-α), superoxide dismutase (SOD), myeloperoxidase (MPO), catalase (CAT), and glutathione (GSH) were determined by ELISA kits (Elabscience, USA). The oxidative injury assays were performed based on the manufacturer's instructions. The absorbance was specified by a spectrophotometer at 450 nm.

Statistical Analysis

The quantitative data were stated as the mean ± standard deviation (SD). Assays were performed by one-way assays of variance with post hoc Tukey's test (IBM SPSS 22.0) ($p<.05$).

RESULTS

Pretreatment with CA Reduced 6-OHDA Stimulated Cytotoxicity SH-SY5Y Cells

We specified whether pretreatment with CA had prophylactic effects opposite 6-OHDA stimulated cell demise by MTT test. After the cells were treated with 25-50-75, and 100 µg/mL CA for two hours, 200 µM 6-OHDA was supplemented for culture for 24 hours. CA stopped 6-OHDA stimulated cytotoxicity in a dose-dependent manner. Cell viability was recovered at 64% (25-CA), 72% (50-CA), 83% (75-CA), and 92% (100-CA) ($p<.001$) according to 6-OHDA (Figure 1).

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LDH activity, which is a metabolic marker of cell viability, is demonstrated in Figure 1. As a result of exposure of cells with simply 6-OHDA 200 µM, LDH activity raised in correlation with the reduction in cell liveliness and it was figured out to be significant compared to the control group (*p<.05*). For neuroprotective activity, LDH levels gradually reduced depending on the concentration in the groups that were administered CA before the 6 -OHDA application (*p<.001*). These data demonstrate that CA significantly decreases the cytotoxic effect of 6-OHDA.

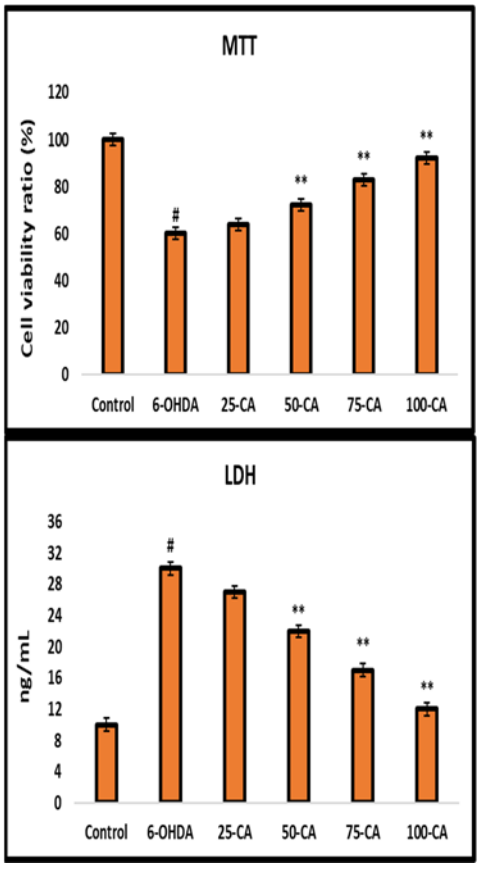

Figure 1: MTT and LDH results of application groups. Data are determined as the means±SD. #*p<.05* values are significant for control group; **p<.05*, ***p<.001* for 6-OHDA.

Pretreatment with CA Suppresses Oxidative Stress in 6-OHDA-Induced SH-SY5Y Cells

As seen in Figure 2, SOD, GPx, GSH, and CAT activities reduced importantly in the 6-OHDA group compared to the control group, while MPO, MDA, IL-1, and TNF-α levels increased significantly (*p<.05*). Due to the raised concentration in the 6-OHDA group, SOD, GSH, GPx, and CAT levels were raised in the CA group, while MDA, MPO, IL-1, and TNF-α was significantly decreased (*p<.001*). The findings support MTT and LDH data (Figure 1).

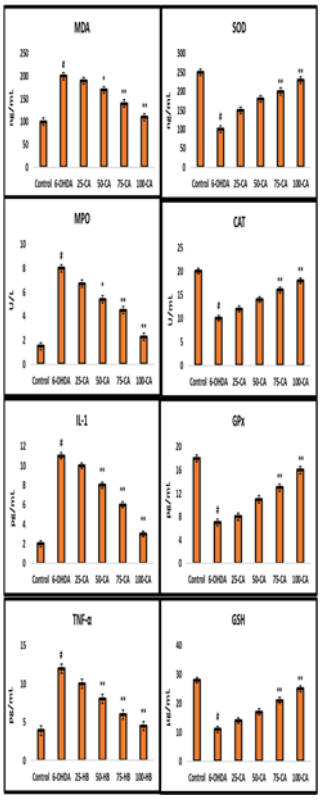

Figure 2: GPx, SOD, GSH, CAT, TNF-α, MPO, MDA, and IL-1 results of thenapplication group. Data are determined as the means±SD. #*p<.05* values are significant for control group; **p<.05*, ***p<.001* for 6-OHDA.

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DISCUSSION

6-OHDA is considered an experimental toxicant to study the mechanisms of PD in vitro (Bove et al., 2005). The results of the current study demonstrated that 24 hours of 6-OHDA treatment reduced differentiated SH-SY5Y cell viability by approximately 60%. The neuroprotective effect of CA in the MTT test paralleled that of the LDH assay.

Mitochondrial dysfunction and oxidative stress play a crucial role in the pathogenesis of PD (Seaton et al., 1997). In our study, the rising levels of MDA, MPO, IL-1, and TNF-α activity observed in the group exposed to 6-OHDA alone showed that mitochondrial dysfunction and oxidative stress were stimulated by 6-OHDA. The mitochondrial respiratory chain is one of the most significant sites of reactive oxygen types manufacture, and a relatively small level of inhibition is enough to rise reactive oxygen species production. Meanwhile, mitochondria themselves are vulnerable to reactive oxygen species, and an excess of reactive oxygen species can cause mitochondrial damage (Bueler, 2009; Yao & Wood, 2009). CA pretreatment significantly reduced reactive oxygen species production in 6-OHDA-induced SH SY5Y cells, indicating its potential to clean free radicals and protect dopaminergic cells opposite 6-OHDA-stimulated damage.

The neuroprotective effects of CA are well documented, but these effects are generally attributed to the bioactive triterpenes found in the plant (Xu et al., 2012; Zhang et al., 2012). Though the etiology of PD is not exactly figured out, oxidative stress (Trist et al., 2019) and inflammatory responses (Gao et al., 2022) are significant risk links causing PD. Current findings have shown that CA enhances the antioxidant features of the PD pattern by rising CAT, GSH, SOD, and GSH-Px activities and decreasing MDA, MPO, IL-1, and TNF-α levels. SOD, CAT, GSH Px, and GSH activities of the antioxidant defensive system are relatively poor during PD, and improving their activities is a significant approach to preventing PD advance and development (Wang et al., 2018; Chen et al., 2021). SOD is a strong endogenous antioxidant enzyme for Superoxide radicals. It was determined that PD models created with 6-OHDA were significantly reduced both in vitro and in vivo (Soto-Otero et al., 2000). MDA is an oxidative stress signal related to PD damage and is a potential avenue for its clinical treatment (Tamtaji et al., 2019). CA will show beneficial effects in controlling the development of PD by decreasing the injury led to 6-OHDA.

In the brain of PDs, the secretion of proinflammatory cytokines is nearly associated with the exterminate of neurons (Chen et al., 2018). In a model of PD stimulated by the bacterial endotoxin lipopolysaccharide, dopamine neurons suggested a significant role of inflammation in the degeneration of the nigrostriatal path (Milde et al., 2021). Therefore, it is important to control the three proinflammatory cytokines (TNF-α, IL 1β, and IL-6) to prevent PD advancement. (Chen et al., 2021). The current result is that CA decreased the

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inflammatory cytokine (IL-1β and TNFα) levels.

CONCLUSION

CA exhibited protecting effects on 6-OHDA-stimulated toxicity in SH-SY5Y cells. These effects were related to the capability to decrease oxidative stress and preserve mitochondrial membrane potential. Therefore, CA can be thought of as a potential agent for the treatment of neurodegenerative disorders like PD, alone or in combination with other now-used anti-parkinsonism agents.

Conflict of Interest

The authors report that there is no conflict of interest.

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Dergimiz 2011 yılında yayın hayatına başlamıştır. Başta spor bilimleri olmak koşulu ile sağlık bilimleri ve spor bilimlerinin ortak kabul ettiği alandan yayınlar kabul edilmektedir. Günümüz koşullarında teknolojinin getirdiği kolaylık ve bilimsel çalışmalara duyulan ihtiyaç nedeni ile dergimiz bu anlamda duyulan eksikliği bir nebze olmak koşulu ile gidermeye çalışmak amacıyla yayın hayatına girmiştir. Dergimiz başta spor bilimleri, spor eğitimi, sporcu sağlığı, sağlık yönetimi, spor hekimliği, tıp tarihi ve etik, sporcu beslenmesi, spor psikolojisi, spora yönelik tıbbı ve biyolojik bilimler "doping" gibi bilim dallarından yayın kabul etmektedir. Ayrıca bu ana bilim anabilim dallarının alt bilim dallarında yapılan çalışmaları kendi alanında uzman hakemlerin değerlendirmesi ve olumlu sonuç alan çalışmaların yayınını kabul etmektedir. Farmakoloji bilimi içerisinde yer alan fakat sporcu ve sporcu sağılığına yönelik çalışmalar da yine dergimizde kabul edilip değerlendirmeye alınmaktadır. Spor ve sporculara yönelik adli bilimler alanında yapılan çalışmalar da yine dergimiz bünyesinde kabul edilerek değerlendirmeye alınmaktadır. Gerçek anlamda bilimsel nitelik taşıyan, bilim dünyasına bilimsel anlamda hizmet edecek ve katkı sağlayacak çalışmalar ve bu çalışmalara ilişkin araştırma, derleme ve çeviri içerikli yayınları dergimiz kabul etmekte olup bünyesinde yayınlamaktadır.

Dergimiz yılda dört sayı çıkarmakta olup her bir sayı yılın üç ayında bir basılı olarak yayınlanmaktadır. Dergimiz çalışma prensibi doğrultusunda her alana ait çalışmaya eşit ve adil şekilde yer vermektedir. Dergimize gelen çalışmalar iki ayrı alan uzmanı hakem tarafından değerlendirilmekte olup bu değerlendirme süresi hakemlerin iş yoğunluğu kapsamında iki aylık süreci kapsamaktadır. İki ayrı hakemden onay alan çalışmalar dergimizin yayın kurulu onayı ile sıraya alınarak basılı şekilde yayınlanmaktadır. Dergimizde yazım kuralları apa sistemine göre düzenlenmekte olup, örnek bir makale formatı sistemden indirilmek koşulu ile yazarlar tarafından kullanılabilmektedir. Editör makamı derginin her türlü sisteminden sorumlu olup, hiçbir hakem ve yazar yükümlülüğünü taşımamaktadır. Yazarlar kendi hür irade ve bilgileri doğrultusunda yayın yapma hakkına sahip olup yayına kabul edilip yayınlanan çalışmalar konusunda bütün yükümlülüğü kabul etmiş bulunmaktadır. Dergimiz yayıncı ve okuyucu arasında bir köprü vazifesi yüklenmiştir. Dergimiz ve yayınlar hakkında değerlendirme yapan hakemler yayınlanan yayın hakkında hukuki bir yükümlülüğe sahip değildir. Her türlü yükümlülük yazarlara aittir. Dergimiz hiçbir yayın hakkında hakemler üzerinde etki ve zorlayıcı bir yaptırıma sahip değildir. Hiçbir çalışma bir başka çalışmaya karşı öncelik hakkına sahip değildir. Her bir çalışma kendi açısından aynı koşul ve şartlara tabidir. Bir öncelik ve ayrıcalığı bulunmamaktadır. Hiçbir yazar değerlendirme yapan hakem hakkında bilgi sahibi olamaz ve hakemler üzerinde yüküm lülük oluşturamaz. Dergi yönetimi ve editör hiçbir çalışmanın öncelikli olduğunu belirleyemez ve hiçbir yazara öncelik veremez. Sistem her çalışma ve her yazar için aynı koşul ve şartlarda işletilir. Dergimizin yazım dili İngilizce'dir.

Dergimiz uluslararası nitelikte olup bu niteliklere sahip çalışmaları kabul eder. Bir başka dergiye herhangi bir nedenle gönderilmiş çalışmalar dergimizde yayınlanmak amacıyla kabul edilse bile tekzip yayınlanmak koşulu ile red edilir. Dergimize gönderilen her bir çalışmanın hakkı yazar tara ından dergimize verilmiştir. Yazar bunu peşinen kabul etmiştir. Bu durum ve koşullar; yayın dergimizin sistemine yüklendiğinde işletilmeye başlanır. Bunun için yazarlardan özel bir beyan ve imza alınmaz. Oluşan veya oluşabilecek hukuki sorunlarda dergimizin hukuk danışmanları dergimiz ve dergimiz hakemlerini korumak adına her türlü işlemi tek taraflı olarak yapma hakkına sahiptir.

T.C. Üniversitelerarası Kurul Başkanlığı, Sağlık Bilimleri Temel Alanı Doçentlik Sınavı Başvuru koşulu olarak 101 nolu madde getirilmiştir. Bu maddenin, 1-Uluslararası makale bölümünün (b) şıkkında "Uluslararası alan indeksleri tarafından taranan (1a da belirtilen indeksler dışındaki indekslerde yer alan) dergilerde yayımlanmış özgün araştırma makalesi (10 puan) istenmektedir. Uluslararası Spor Sağlık ve Tıp Bilimleri Dergisi (SSTB) alan endeksli dergi kriterlerinde yer almakta ve değerlendirilmektedir

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SSTB - Uluslararası Hakemli Akademik Spor, Sağlık ve Tıp Bilimleri Dergisi

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