

# NEW FRONTIERS IN SPORT SCIENCES

**Editors**

**Assist Prof. Bahadır BAYARSLAN**

**Dr. Tahir Volkan ASLAN**



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Pınar TATLIBAL



## Chapter 1

# Human Resources Management and Applications in Sports Businesses

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## **INTRODUCTION**

Human Resources Management is a very detailed subject. Their main purpose is to provide superiority in today's competitive environment. They utilise the human element to achieve this superiority. Studies show that the result of the harmony between human resources management strategies and competition strategies provides advantage to businesses. Recently, it is a known fact that businesses need a human resources management system in order to achieve a successful result and to function efficiently. The increase in productivity in enterprises can only be realised with a well-planned human resources. Regardless of the position of the individual within the enterprise and his/her education level, he/she falls within the working area of human resources management (Eroglu, 2016). Human Resources is not only responsible for tasks such as personnel selection/recruitment/placement. It is involved in making plans for the future of the business, producing solutions in a possible crisis, strengthening communication within the business and most importantly investing in the future. It has to use the efforts, knowledge and skills of the personnel for the business. Most businesses now attach great importance to the Human Resources unit and it is used by most businesses (Al-Traf, 2022).

While Human Resources Management was initially only concerned with issues such as recruitment and remuneration, it has become a very detailed and important theme and factor over time. Especially its impact on the management area of enterprises is very great. It is inevitable that examining the researches on human resources will contribute to the business in every sense. Recently, many businesses have started to work by realising that Human Resources Management is an extremely important issue in order to achieve success. If we define human resources management briefly; it is a process that provides positive returns to the business by obtaining the human element, developing it over time, providing morale and motivation while providing development (Egal, 2019; Yurtseven et al., 2012).

If we think more comprehensively, the human resources function covers all the practices that aim to ensure that all personnel working in the organisation act together in harmony and make it easier for them to get closer to their goals. The more efficient an organisation has a human force, the easier it is to achieve a successful result. Institutions that fail to do this have just as much failure and cannot fulfil their functions. Sports products are encountered with people at every step of their work. In order to make these products in a good way, certain requirements of the employees must be met. Human resources management is an important issue that will ensure the efficient success of sports services, products and businesses that are developing rapidly (Senyucel, 2003).



While the progress of the services to be carried out related to sports in a more effective way should progress in direct proportion with human resources management, there are few studies in the literature. This situation reveals the idea that there should be more studies on sports services and human resources management.

It is an inevitable fact that there is an intense competitive environment today. We can see and experience competition in most sectors, regardless of private or public. It is known that businesses are in a struggle with other businesses other than themselves and want to gain superiority. For this reason, new markets are developing. Consumers are now more knowledgeable and conscious than before. Their needs change day by day. Businesses need to adapt to the conditions of the day in order to maintain their existence. This is realised through a regular human resources management.

### ***Historical Process of Human Resources Management***

In order to master human resources management, we need to have detailed knowledge about this subject. The first thing to do in this direction is to examine the historical process related to human resources management.

We can say that the people who gathered together to turn the goals they need to realise in their lives into practice as soon as possible were actually the first times when the concept of human resources management was introduced. Even if they are in a very simple structure, it is obvious that they undertake certain tasks, communicate, impose sanctions, make decisions within themselves and realise them in line with the objectives. It is said that the concept of human resources management historically started in 1768 (invention of the steam engine) and continued until the industrial revolution. The Industrial Revolution was the time when it was realised that necessary studies should be carried out on personnel and that this issue should be emphasised (Inkaya, 2000).

The first studies on the understanding of human resources management are seen in the early 20th century. At that time, the concept of personnel management was mostly used. Over time, it has been combined with various currents. Thus, personnel management, which is seen as a dysfunctional understanding, has turned into an understanding that provides psychological and sociological benefits, is a resource for employees in achieving the objectives of the business, and analyses work and performance, and has revealed human resources management. Personnel management was first introduced in the United States of America. Noteworthy issues related to personnel management have been experienced in the USA. In the early 19th century, decisions about the business process began to be made by employers. The first book on

personnel management was written by Hugo Munsterberg in 1913. The USA was shown as a reference in the birth of human resources management. We can say that the understanding of human resources management has a different historical development in each country. Among the biggest reasons for this development; studies, trainings, information from the past, interviews, organisations have been very effective (Eroglu, 2016). Human resources management has become a sensitive point of businesses and has become an important understanding in all undergraduate programmes after 2015.

### ***Concept and Purpose of Human Resources Management***

We can say that there are different definitions of human resources management. It is possible to list some definitions in the literature as follows; Human resources management, regardless of the purpose and department, includes all the studies that carry out effective and efficient management of each institution in accordance with the rules in a way that will benefit people and society, determining the need for personnel, planning and business analyses in accordance with the objectives. Human resources management does not see people within the organisation as a cost factor, but rather as an element that benefits the organisation and has a significant impact on achieving its goals (Unlu, 2011).

It is an approach that ensures effective management of individuals in the institution or organisation, high and high quality performance, high motivation, transferring the objectives of the organisation to the working individuals and improving the competitiveness (Ozturk, 2010). Human resources management is the harmonious work of all personnel (Tureyen, 2005).

In the competitive environment that occurs in the production process, the most important element that we can use to obtain more quality, information, efficiency and gain superiority is human. During this period, providing the necessary human resources for the organisation, managing them in line with the objectives of the organisation, developing policies in accordance with the culture of the organisation constitute human resources management (Ergen, 2005). Human resources management symbolises a time for the company from beginning to end. This time includes the boss and employees. Human resources management is a strict order that aims to realise the objectives of the enterprise, effective and efficient human planning, career planning of employees, job and performance analysis, increasing the performance of employees through training and development, the relationship between the boss and the staff, providing orientation with the culture of the enterprise, motivating, and as a result of these, motivating and remunerating fairly.

Human resources management has two important objectives;

1. To use human resources in line with the objectives of the organisation.
2. To ensure the development of employees and to meet their needs

(Kaplanci, 1999).

### ***The Importance of Human Resources Management***

Human resources management is one of the disciplines most affected by the results of globalisation in our country. In the ever-changing organisational structures, human resources management is prepared to plan for the future compared to the past. In our world of success and competition competitions, the human element has begun to be seen as a valuable asset for the enterprise. It has been observed that the tasks to be fulfilled by the human resources department have increased. Today, it is seen by businesses that competition is increasing. Markets are developing. Consumers are more informed and conscious than before. Their requirements continue unabated. Businesses need to adapt to the conditions of the day in order to maintain their existence. This is realised through a successful human resources management (Unlu, 2011).

### ***Benefits of Human Resources Management***

- Reduced costs, simulation and absenteeism,
- The error rate is reduced,
- work accidents and problems that may occur are reduced,
- Solidarity and motivation increases within the enterprise,
- Competitiveness increases, service and product quality increases, high quality and speed are ensured, communication is strengthened (Ramazanoglu & Ocalan, 2016).

### ***Functions of Human Resource Management***

Human resource management has to fulfil some functions within the organisation and has seven basic functions.

### ***Personnel Selection and Placement***

It is necessary to make the necessary human selections in order to achieve the determined objectives within the enterprise. Which candidate will be selected during the application is determined in this process. In this process, reliability, validity, benefit and law are important determinants. The failure of businesses that recruit personnel only to fill the gap in the organisation is inevitable (Pelit & Ak, 2018). The most striking work to be done in services

related to personnel organisation in businesses is to create a strong staff and determine policy. Within the policy; employee information, analysis, evaluation, work entry and exit hours, leaves, job training, resignations must be included (Senyucel, 2003).

### ***Wage management***

We can say that the question of "how much salary should the organisation pay to its staff in order to perform a fair wage management?" has led to the emergence of wage management. Regardless of the sector, wage management is an important element in the organisation (Ozturk, 2010).

The wage given is an important factor for employees. Because salary is a sensitive point that plays a role in meeting their needs, as well as a point that affects our lives. Another important situation is that the personnel want to be paid for their labour (Senyucel, 2003).

We can say that wage management has three main functions:

- To retain the existing labour force for the life cycle of the enterprise.
- Attracting qualified and good labour force to the enterprise.
- Providing motivation (Ozturk, 2010).

### ***Reward Management***

Reward is an important point in terms of employee motivation. It covers everything given in return for labour (Senyucel, 2003).

It is a fact that every individual in an organisation wants to receive a reward as a result of his/her efforts. Every reward given positively affects the individual's willingness to work and focus.

### ***Performance Appraisal***

We all know that the most important element of an organisation is people. The success of the organisation is directly proportional to the performance of people and is one of the important stages. Performance appraisal determines whether the people in the organisation have achieved the success they should exhibit in line with the objectives. In short, it is a process that evaluates the employee, not the job (Özkan, 2012). Performance appraisal within the organisation is the process of measuring the success of the personnel by analysing their work and performance based on the limits previously determined by the employer. It is an application between the boss and the employee (Senyucel, 2003).

### ***Career Planning***

Career planning is the process that determines the duties of employees and adjusts the positions they should occupy, taking into account the objectives within the organisation. An indispensable part of this process is to ensure the development of employees. In case of instant crises (resignation, illness, resignation etc.), the necessary completions can be made thanks to career planning (Eren, 1996). Career planning aims to make the personnel in the organisation more productive and to keep them in the organisation for a long time. This situation is realised in line with the equipment possessed by the superiors (Senyuçel, 2003).

### ***Training and Development***

One of the most important objectives of training is to increase the knowledge of the staff within the organisation and to make them more knowledgeable. Another of the most valuable goals of development is to prepare the employee for the future. The benefits of the training and services provided in sports enterprises are quite high. In our world of rapid development and change, the knowledge and qualifications of the personnel will increase their importance. The personnel who cannot keep up with the change will remain in the background and cause failure in the business (Senyuçel, 2003). The importance of training and development; training is one of the elements that can carry the competitiveness of organisations to the highest level. Increasing the performance of employees, ensuring their development and increasing their motivation can only be realised through training and development (Yavuz, 2014).

### ***Industrial Relations***

The aim of trade unions is to increase the number of employees and to gain authorisation. Trade unions, which were initially established only for employees, were later established for employers. Trade unions improve labour conditions, protect the rights of employees and employers and ensure solidarity (Senyuçel, 2003). The aims of industrial relations are determined as follows:

- To create the most ideal and appropriate working environment for the employee and the employer. To establish lasting relationships.
- To establish the necessary communication and solidarity environment for solving problems. To eliminate conflicts between people.
- To provide social protection.

Although human resources management and industrial relations seem to have different objectives, it is seen that they are concepts that are needed for the enterprise and progress in parallel. (Kagnıcioglu, 2001).

### ***Concept of Sports Business***

Business; It is the general name of the units that produce goods or services in our environment and then market them. All businesses produce as much as they need. Sports business is the unit that creates sports products and sports applications to meet the sports needs of people. It is the most natural right of individuals to want to do sports in their environment and to use sports facilities. Sports management has to produce to meet these needs of the public. It can build facilities in nature, on the beach, at the sea without financial difficulties. Providing more concrete, tangible services attracts the attention of customers and makes them prefer the business again. The purpose of each customer coming to the business may be different. Some for physical activity, some for the environment, some to create a new job opportunity. At this point, the fact that there is no limit to the services provided will be a plus for sports businesses (Ozgunes, 2018).

Sports businesses have become a service sector that develops day by day and continues without slowing down. At this point, it is easy to predict that there will be competition between businesses. In this competition, quality, low cost and speed will be the factors that will bring businesses to the forefront. The fact that the main product of sports businesses is service is a theme that should be emphasised in terms of the development of businesses (Cutuk, 2011).

### ***Human Resources Management in Sport Enterprises***

Sports enterprises are public or private institutions that meet the sports needs of individuals in the region where they are located, ensure the good operation of open or closed facilities, have coaches, athletes, managers, auxiliary service personnel and various personnel. One of the most important reasons for the emergence of these institutions is to direct people to a healthy life. We are all aware that sport is a service sector. For this reason, as in every service sector, a well-planned human resources management is needed in sports. In this direction, sports managers have a lot of work. Because our world is constantly changing. It is very difficult to pursue innovations, to adapt to technology and to manage sports businesses in this direction in our world that brings change and development with itself. If the business wants to manage successfully, it should concentrate on human resources management (Senyucel, 2003). Sports businesses appeal to everyone and accordingly give products to people and

work. Sports businesses with various classifications address and serve people in different departments. As a result, it ensures satisfaction by receiving positive feedbacks. Satisfaction is achieved with people, that is, with personnel (Vural, 2022). It is very important for the service provided for the business to receive positive evaluations. Because customers who are satisfied with the service they receive will visit the business again and increase the quality and workforce of the institution. The purpose of each person's use of sports businesses is different from each other. Some of them participate in these programmes to evaluate their free time, to get away from the stress and intensity of the day, and some of them participate in these programmes for purely physical body development. Sports clubs, sports equipment, sports consumers, sports educators and sports practices and activities constitute the sports environment. The lack of even one of them plays a sensitive role for the success of the country. The task of Human Resources is all the work that enables everyone in the organisation to work more effectively and in harmony with each other and to achieve their goals. In a narrow sense, the success of the business is realised with an effective human staff (Gundogdu & Devecioglu, 2009).

It is an inevitable fact that management has more than one meaning. The main purpose is to determine, plan, design and realise the objectives. In short, management means dominating the organisation. In this direction, sports managers come into play. Because the control will be under their hands. Sports management is the most prominent in the field of human resources. Because it is a field with many elements such as athletes, sponsors, suppliers, teammates, etc. (Retar et al., 2016).

Today's business challenges and pressures have had a significant impact on the human resource management of more than one organisation. However, in some organisations human resource management has not received much attention. For example, in Australia, most sport organisations do not have a human resource department, despite the push to be more strategic. Many strategies in sport management are based on human resource management. Functions such as employee performance and training, which are included in sport management, constitute a large part of human resource management. Competitive advantage depends on employee satisfaction. The unit that will provide this is human resources (Krema, 2019; Yurtseven et al., 2012). The most striking work to be done in personnel organisation practices in sports businesses is to create a strong staff and determine policy. Within the policy; employee information, analysis, evaluation, work entry and exit hours, leaves, job training, resignations must be included (Vural, 2022; Cavusoglu et al, 2003). It should meet the human element required for the past and the future.



For example, the success of the business will be realised when the personnel who can meet the personal needs of the members who come to a gym with various goals such as gaining strength, seeing a decrease in weight, reaching a solid anatomy are recruited by the gym and the selection is made according to the character, structure, education, knowledge and skills of the candidates (Gundogdu & Devecioglu, 2009).

Sport is becoming more materialised over time. Organised sports events are economically important in countries. Therefore, in order for sports businesses to achieve their goals, they need to devote most of their time to human resources management. In particular, investment should be made in people so that the future of the business is solid and strong (Weerakoon, 2016). The remarkable and different point of sports businesses is that they are consumed as soon as they are produced. Therefore, having a well-organised human resources management will lead the business to success and its goals (Balta, 2007).

### ***Studies in The Literature on Human Resources Management in Sport Organisations***

When we look at the studies in detail, we can see that there are many studies on human resources management. However, the scarcity of research on both private and public sports enterprises draws attention. At this point, if we look at the relevant studies, it may be possible to summarise them as follows; Chris Wolsey, Sue Minten and Jeffrey Abrams (2011) published a book on human resource management in sport and leisure. The book provides information on all basic issues and concepts in human resource management. It covers topics such as recruitment and selection, learning, training, performance review. The book encourages the reader to develop a strategic approach to human resource management.

In the study conducted by Krsmanovic et al. in 2014, it is recognised that sport is an important social phenomenon and that sport needs to value human resources in order to survive. Ekenci and İmamoglu (2002), in their work in which all the functions of sports business management are expressed, details about the establishment, management, production, marketing, personnel, public relations and sponsorship of sports businesses are explained. Two important characteristics of businesses are mentioned in the book. Being in practice with the aim of producing goods and services and having the necessary production elements to realise this goal. The study on human resources management in sports enterprises was conducted in Istanbul province and consisted of enterprises employing 100 or more personnel. It is aimed to make suggestions for the development of appropriate models for our country by investigating how



managers and employees in sports enterprises perceive and implement human resources practices. It was concluded that the human resources management department does not implement its functions and the personnel are not equipped about this subject (Senyuçel, 2003; Cavusoglu, 2011). In another study titled "The understanding of working order and management in sports centres", the understanding of personnel management in the realisation of the management objectives of the human factor was evaluated with an analytical examination by focusing on management activities. As a result, it was concluded that sports halls have an important effect in the formation of the sports environment, and the efficient use of facilities is a major factor in both training athletes and increasing the efficiency in the production of human resources (Ramazanoglu & Ocalan, 2005). In another study, in which 21 private and 14 public enterprises in Kayseri were included in the study group, it was determined that the private sector showed more value to human resources (Bulut, 2008). In a study examining the human resources management of sports organisations in Turkey and Canada, it was concluded that quality service is equivalent to the importance given to human resources and that it is necessary to support the staff in all matters. The scope of the study consists of Vancouver city of Canada for abroad and Istanbul city for Turkey. Face-to-face interview technique and questionnaire method were used to obtain data. SPSS 13 programme was used to analyse the findings (Bozkır, 2011). In another study conducted by Cisem Unlu, it was concluded that the human resources management of sports organisations and private hospitals are similar. Face-to-face interviews were conducted with the managers of 45 private hospitals and 36 sports organisations in Istanbul. Only 34 private hospitals and 31 sports organisations were included in the evaluation. Questionnaire method was used in data collection. Mann Whitney U test was used to analyse the data obtained (Unlu, 2011). In a study examining the challenges faced by sports businesses during the Covid-19 period, problems related to human resources were also addressed (Rizvandi, Afroozeh, & Jalilvand, 2020).

## **CONCLUSION AND RECOMMENDATIONS**

Today, the rapid development and spread of sports increases competition in sports businesses. It is necessary to use human resources in enterprises in order to realise the determined targets and to provide better quality service than other enterprises. In this study, it is seen that human resources management practices have been used in private sports enterprises especially in the last three years. Especially Turkey has developed in this direction. Investment in human resources benefits the business. Taking employee ideas and increasing

motivation sources directly affect the way the tasks assigned in the enterprises are performed. Thanks to intermittent performance evaluations and job analyses, sports enterprises can make situation analyses and make plans for the future. It has been revealed in the study that the internet, which is one of the biggest markets of our age, is unfortunately not used and followed much in private sports enterprises in Turkey. If it is necessary to make suggestions on behalf of human resources management in sports enterprises; human resources management of private sports enterprises and public organisations can be compared. A comparison can be made between male and female human resources specialists working in sports enterprises. Personnel motivation resources can be developed and diversified. Various sites and applications related to human resources can be created. It is possible to benefit from the recommendations of the personnel working in sports enterprises and the people who are members.

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## Chapter 2

# Sports Entrepreneurship and Sustainability

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**ABSTRACT**

Sport can be a way to offer environmentally friendly management to the world and instil values for sustainable development of society. A large part of sport relies on the natural environment for its performance. Through its practice, values favourable to sustainability are instilled that can be reflected in everyday life. It is also worth noting that sport entrepreneurship is an option with many possibilities given its global impact. Sustainability in sports entrepreneurship is vital due to the role that sport plays in society. Sports entrepreneurship is characterised by the ability to connect different socio-economic areas and combine them in a product or service. Likewise, these processes have a direct social impact, which in many cases characterises one's routine. Therefore, the content related to the creation and management of sustainable enterprises needs to be addressed in sport management issues. In particular, content on, for example, how to organise sustainable sport events, how to build sustainable sport facilities and how to take into account the Sustainable Development Goals when making decisions in sport management is of vital importance. In addition, a positive attitude towards sustainability, the ability to innovate and social and civic values should be encouraged throughout the degree in different subjects. In this study, a literature review was conducted on entrepreneurship and sustainability in the field of sport. It was tried to contribute to the literature by bringing various suggestions to the deficiencies in this field.

**Keywords:** *Entrepreneurship, Sport Management, Sport Business, Sustainability.*



## **INTRODUCTION**

Sustainable entrepreneurship, and sports entrepreneurship in particular, is one way to contribute to the realisation of the United Nations (UN) 2030 Agenda (Rosa, 2017), an international plan aimed at sustainable development in general. This plan was created in 2015, when all member states of the UN developed an action plan covering 17 Sustainable Development Goals (SDGs) with the aim of helping people and the planet. Entrepreneurship and sustainability are two closely linked concepts (Santini, 2021). Many authors agree that the path to sustainability is based on the discovery of new opportunities, new products and new services through innovation, deriving economic, social and environmental benefits from this whole process (Del Vecchio et al, 2021; Fatoki, 2019; Muñoz et al, 2020; Ruiz-Ruano and Puga, 2016). Education is one of the main areas of the Sustainable Development Goals; therefore, a sustainable entrepreneurial mindset can be promoted through university education. Furthermore, Strachan (2018) reiterates the importance and value of an education rich in sustainable values to achieve a sustainable future.

The concept of sustainable entrepreneurship is often understood as environmental entrepreneurship and eco-entrepreneurship in the literature (Belz & Binder, 2017). However, according to Tilley and Young (2009), sustainable entrepreneurship is oriented towards economic prosperity, social equity and environmental protection. Based on these three concepts, sustainable entrepreneurship is defined as a taxonomically ordered medium/long-term economic process with taxonomically ordered objectives to generate profit through a business that utilises market opportunities from a social and environmental perspective (Tarnanidis & Papathanasiou, 2015). The sustainable entrepreneur offers and delivers products and services in traditional markets that meet the demands of consumers who choose a sustainable lifestyle (Feldman, 2017). In addition to meeting the demands of those who already favour sustainability, the sustainable entrepreneur also has an important role in transferring attitudes towards sustainability through their work and influence (Gasbarro et al., 2017).

Sport, in particular, is a sector that mobilises the masses and is of great importance worldwide. Sport can be a way to offer environmentally friendly management to the world (Reier-Forraddellas et al., 2021) and instil values for sustainable development of society. A large part of sport relies on the natural environment for its performance. Through its practice, values favourable to sustainability are instilled that can be reflected in everyday life (King & Church, 2017). It is also worth noting that sport entrepreneurship is an option with many

possibilities given its global impact (Reier-Forraddellas et al., 2021). Data from Eurostat (2021) shows that the sector is a growing one and is characterised by the employment of young people with higher education. Currently, Iceland (1.58%), Switzerland (1.31%), Portugal (1.3%) and Spain (1.24%) are the European countries with the highest employment rate in this sector (in total) and with higher education in this field (Eurostat, 2021). Sport entrepreneurship is an area of special scientific interest due to its impact in many aspects worldwide (Ferreira and Ratten, 2016) and can contribute to the realisation of the UN 2030 Agenda Sustainable Development Goals. Sport has social and inclusive potential and enables people at risk of social exclusion to feel capable, engaged and healthy (Pérez-Campos et al., 2018). Sports entrepreneurship is characterised by the ability to connect different socio-economic areas and combine them in a product or service. Likewise, these processes have a direct social impact, which in many cases characterises one's routine (Cardella et al., 2021). However, although the number of articles published on sustainable sport entrepreneurship has increased in recent years, there is still much to know and more research is needed to consolidate this field of study (González-Serrano et al., 2020). However, future graduates from the sport sector need to be competent in these processes (sustainable entrepreneurship) because they are the main candidates to transform the economy and society through their initiatives and future projects (Reier-Forraddellas et al., 2021).

### ***The Concept of Entrepreneurship***

There are various definitions of the concept of entrepreneurship in the literature. However, it is seen that the first definition of the concept of entrepreneurship in history was made by a French-born Irish economist named Richard Cantillon in the early 18th century. According to Cantillon, an entrepreneur is defined as a person who organises the business under unpredictable conditions and assumes the risk of the business in order to make profit (Wennekers and Thurik, 1999). Entrepreneurship has a dynamic structure and is a process that is always developing, changing, constantly active and providing economic gain. The concept of entrepreneurship is also explained as the process of creating a product or service in return for personal and economic gain, taking into account financial, social and psychological risks, using the necessary time and labour (Doğan et al., 2017).

When we examine the definitions related to the concept of entrepreneurship, it can be stated that the concept is organised in a way to include the principles of innovation and creativity. It is seen that business managers acting according to the modern business management approach explain the concept of

entrepreneurship with concepts such as innovation, flexibility, dynamism, risk taking, creativity and development orientation (Korkmaz, 2000).

Entrepreneurship is basically the ability to see, choose, analyse and then innovate in an uncertain environment (Bozkurt & Erdurur, 2013; Yurtseven et al., 2015). When the definition of the concept of entrepreneurship and the concepts related to entrepreneurship are discussed, it can be stated that the common point that emerges from the definitions is that entrepreneurship has a different connotation according to each occupational group, that entrepreneurship generally focuses on factors such as growth, innovation, uniqueness created by entrepreneurship, and that other groups focus on the value outputs obtained through entrepreneurship, especially on the purpose of profit. The main purpose of the entrepreneur is to make a profit, but he/she also has the risk of making a loss. He/she should know what to do against the slightest fluctuations that may arise in the economy, even against possible crisis possibilities, and should act accordingly. He must be a good staff member, a good manager and a good boss. He should act like a real leader in the face of problems, be able to produce practical solutions and even take on the problem where necessary. When establishing his business, he must have a certain knowledge and experience. Because this accumulation will make self-confidence unshakable (Ermis, 2007). Although it is not enough for entrepreneurs to believe in the business they have established/will establish, it is of great importance that they can convince the people around them that they can realise this initiative. While considering the advantages of starting their own business, they should also take into account the disadvantages and be able to bear the responsibility of facing all kinds of situations (Ozer, 2017).

### ***The Relationship Between Entrepreneurship and Sport***

It is very difficult to define the concept of sport, which is an integral part of human life and causes many discussions day by day, in a single mould.

The change in the concept of sport emerges as a result of people's ideas, transformations and diversifications (Yerlikaya, 2012). Apart from the origin of the concept of sport, when it is considered in terms of content, it has become a concept that can be done alone or in multiples, contains its own rules, and creates a field of activity that can be a profession for some and a leisure time for others (Sahin Oren, 2018). Sports activity is a phenomenon that alleviates the sense of aggression inherent in human beings and contributes to the spiritual and physical development of individuals.

In the main layer of sport lies the motive of raising the individual and revealing his/her talents. At the same time, the fact that it is an educational tool

that provides national and social unity is an important point that should not be overlooked (Atasoy & Kuter, 2005).

Another point that should be emphasised is that the social effects of sports activities should not be ignored even when they are performed individually. Although there are individual sports, each sport has its own norms and legal frameworks. When we consider the finding that each individual performs the same sports activity, there are common norms and legal frameworks to be followed. For this reason, sport does not operate in a disorganised and unregulated manner (Erdemli, 2008; Yurtseven et al., 2010). Sport can be defined as a process that focuses more on the social aspect by starting to apply consciously and directly when the whole of the activities that man has been applying unknowingly and unsystematically since his existence is replaced by settled life.

For those who follow the sports activity, it can be a means of entertainment that fills free time, while for those who carry out this activity, it can also be perceived as a means of acquiring a profession. In addition, sport is a set of activities that can be carried out with or without vehicles and individually and socially, and which includes both education and health, passion and the drive to succeed. In the 21st century, when we consider the concept of sport, it has gained new meanings with its aspect that is gradually lost in the depth of economic and political events (Sumer, 1990). Sport is not only an activity that individuals or individuals do or watch with pleasure, that is used as a national or international tool in the hands of political mechanisms, where rents are obtained for economic purposes. When the concept of sport is considered only from this aspect, it is not possible to think of sport and life as integrated, and missing aspects are constantly emerging. Sports activity should be considered as the most fundamental rights of individuals in line with their education and health, and for this reason, it should be accepted as a social policy tool. In the 21st century, when the free market economy is dominant according to the market conditions of the 21st century, the fact that the sport activity is an educational tool and contributes to the healthy life of individuals has left the situation in the background and the definitions of the concept of sport have not found a response in this period (Bektas, 2010).

### ***The Concept of Sport Entrepreneurship***

As of the 21st century, many different business lines have emerged in the developing technology and created employment. Especially in this period when there should be an increase in entrepreneurship, attitudes towards entrepreneurship are always negative in terms of inadequate education of

universities, inability to see the front of talents, and entrepreneurship is only explained in the literature.

Entrepreneurship is the key to innovation. For this reason, especially in the education sector, when entrepreneurship education is emphasised, the existence of positive approaches to entrepreneurship has increased. When sufficient importance is given to entrepreneurship, which also contributes to the economic growth of the country, it is certain that innovations will give birth to innovation.

In addition to providing adequate education and opportunities, the lack of restrictions on innovations in the sectors paves the way for entrepreneurship. Sports entrepreneurship, which has contributed significantly to the economy especially in recent years, should also be evaluated in this context. It is determined by academic sources that if the students who are educated in the field of sports are not adequately prepared for entrepreneurship life, it is more difficult to be employed in other sectors.

Apart from professional athletes in the sports sector, there are many employment areas where entrepreneurial ideas can be realised, such as employees who organise competitions and organisations, workers who sell tickets, box offices, TV broadcasters, sponsors, professional managers, lawyers, technical directors (Demir et al., 2015).

According to the definition of The Sports Journal; a sports-based entrepreneur is someone who organises, manages and accepts risk for this business venture (Ratten, 2011). In order to achieve success in sports entrepreneurship, it is certain that individuals with a high level of education and a drive for success are needed. This is the only way to achieve success in economic life. It has been determined by scientific sources that there is a direct relationship between the educational status of the person and entrepreneurial performance (Demir et al., 2015). In sports entrepreneurship, it is not enough for individuals to satisfy themselves in terms of education, they should measure how to make entrepreneurship sustainable, how to make maximum use of technology, how to contribute to the economy and society outside the academic field, and spend their time, capital and energy in the right way.

Economic systems and economic policies implemented in the world are getting closer and closer to each other. In short, with the globalised economy coming to the agenda more intensively, free market conditions are gaining more importance. A liberal economic order in the economic field and a system based on democracy in the political field are accepted all over the world (Biricik, 2020). An economic policy approach in which the interventionist state approach and free market criteria (competition, productivity, free market, efficiency) are valid has started to be implemented all over the world. This change in the

understanding of production makes itself felt in the social and cultural sphere. This new system, which leads to the transformation of capitalism and the transformation of the world into a single market, is described as "globalisation".

Within this accepted new and global world order, sport as a social organisation and phenomenon has a growing structure within economic and cultural organisations and this social phenomenon should be re-evaluated by taking into consideration the changing and globalising economic and social conditions of the world. The changes experienced in sports today should not be isolated from the economic and cultural changes in the world. Because nothing is independent from other things existing in nature or social life. It is an active and passive part of the whole of being by living in relation with those outside itself. In this process of globalisation, where free market economy and international competition conditions are dominant and the world has been turned into a single market, sports and sports entrepreneurship also take their share (Bozkurt, 2011).

### ***Sustainability Concept and Its Dimensions***

The concept of sustainability, which had a great resonance at the world summit, experienced great developments in a session held in Rio de Janeiro in 1992. Each United Nations member country has defined and accepted the concept of sustainability as a three-dimensional model. This model has become a sustainable development model that provides a common denominator in the social, economic and environmental interest relations of countries (Esen, 2018).

Sustainability, as stated in the report titled "Our Common Future" published by the World Commission on Environment and Development (WCED) in 1987, is the ability to meet today's needs without compromising the needs of future generations. Within this process, the resources obtained should be utilised to the fullest and resources should be protected in the maximum way (Kocak, 2013).

In recent years, the concept of sustainability has emerged in many fields. Certain definitions are put forward for the concept of sustainability, which has gained a place especially in the field of tourism. Varol (2017) defines the concept of sustainability as "the ability to maintain a certain ecosystem or any system with continuity without interruption, without deterioration, without overuse, without overloading the main resources".

According to another definition of sustainability, it is described as "a colour confusion between the efforts of people and their social, cultural and environmental conditions" (Demir and Cevirgen, 2006; Cavusoglu, 2011). Based on this definition, it is said that sustainability is not only considered economically, but also in the social, cultural and environmental context. In the

developing global world, the non-stop increase in population forces sustainability in both human and physical terms depending on the needs and demands of the population. In this context, the value of investment in physical and human capital should be equal to the value of natural resources.

Aksoy (2012) explains sustainability as follows: "Sustainability is not only a need that constitutes the components of the economy, but also a philosophy that touches all points of life". When considered in this way, it is thought that sustainability is not a one-dimensional concept. If we summarise sustainability in general terms, it is that sustainability cannot be considered alone, that it has an impact on the whole order in the universe and that ensuring continuity in economic, cultural, political and even environmental terms will benefit the world and society. Sustainability dimensions are generally based on three main topics. These are; meeting human needs, determining and respecting environmental limits, and ensuring social equality (Gedik, 2020).

When we divide the contents of the three main topics mentioned above according to their dimensions, it is concluded that sustainability dimensions are analysed as economic, social and environmental dimensions. Sustainability covers the types of economic and social development that protect the natural and social environment and contribute to its development. This long-term definition proves that the dimensions of sustainability are clearly economic, social and environmental. In addition, it should not be ignored that the environmental and social aspects are prioritised.

In his definition of sustainability dimensions, Gedik (2020) has broken the taboo of "weak sustainability" such as substituting one for the other, without considering the concepts of environment, economy and social equality separately from each other. It clearly states that any economic and social activity is sustainable as long as it protects the environment and social equality and contributes to their development (Paul, 2008). It is not possible to find a stereotypical definition for social sustainability. The meaning of the word social may be different for each individual, either because sociality is prescriptive and analytical or because people give more importance to one than the other. Therefore, social sustainability can have many connotations (Littig and Grießler, 2005).

### ***Social Sustainability***

The most common definition of social sustainability is a favourable condition within societies and communities and a systematic process to ensure these conditions. This definition includes the following principles (Littig and Grießler, 2005)



- Intergenerational equality
- A relationship system that does not judge different cultures
- Motivation to be a community
- Equal and easy access to key services
- A holistic system for creating and advancing social sustainability awareness
- The system by which a society can fulfil its own needs within the framework of feasibility
- Political defence mechanism in response to needs that cannot be met by community activities
- Citizens' participation in political activities, especially at local level

### ***Environmental Sustainability***

Environmental sustainability is an integral part of sustainability dimensions and sustainable development.

The environment is an important stakeholder for organisations along with customers, suppliers, shareholders and society because of their dependence on other environments. The activities of governments, organisations and consumers have a significant impact on the environment. In particular, there are three important motivations for businesses responding to environmental problems (Vallance et al., 2011):

- Recognition of the business
- Competitiveness
- Environmental (ecological) responsibility

Environmental sustainability is defined as creating and maintaining a system in which humans and nature can operate in harmony and which allows future generations to meet their social, economic and environmental needs (Morelli, 2011; Cavuoglu, 2014). It is also expressed as "Environmental sustainability is meeting human needs without compromising the health of ecosystems" (Morelli, 2011).

### ***Economic Sustainability***

There are many different definitions of economic sustainability in the literature. The difference between the definitions given in the literature is that this sustainability dimension is superficially included in the subject through many models before the economic sustainability model. As a common definition, economic sustainability is explained as follows (Gedik, 2020):



"Economic sustainability is economic development that does not have a negative impact on environmental or social sustainability." Therefore, any increase in economic capital should not lead to a reduction in natural resources and social capital (Yavuz, 2010).

### ***The Importance of Sustainability***

Sustainability is defined as transferring productivity and diversity to future generations without harming them and preserving its permanent ability, as can be inferred from its general definitions. Based on this general definition, it can be said that being sustainable is of great importance in our lives both personally, socially and economically.

Being sustainable in ecological, social and economic terms leads all living things on earth to prosperity. A cleaner environment, a better society and a better economy can be created by utilising renewable energy resources instead of using the power of non-renewable energy resources in every activity from eating to drinking, from clothing to clothing. This brings with it an increase in the level of welfare (Kim & Kim, 2018).

## **CONCLUSION AND RECOMMENDATIONS**

In recent years, in order to protect and improve environmental values in the agenda of the world and Turkey, steps have been taken to use natural resources more balanced and carefully. Sustainability is a concept that has social, economic and environmental dimensions and whose importance is rapidly increasing in the world and in Turkey. The rapid increase in the population and the increasing consumption-oriented understanding of life accordingly lead to a rapid decrease in natural resources. Many projects have been implemented in the world and in Turkey in the light of sustainable development goals determined by focusing on this problem. When the examples in the world and in Turkey are compared, it is seen that the social aspect of the examples in Turkey is more predominant, the technology and innovation aspect is lighter compared to the examples in the world and the awareness on sustainable development is less developed compared to the world. It is revealed that developed countries attach great importance to sports. Thanks to the importance given to sports, another important issue that emerges is that it positively affects both mental and physical health of individuals. Sport affects many areas of life, and it is also seen that individuals who do sports are more successful in business life. In this context, while the development of sports activities is accelerating at the maximum level, it is seen that Turkey is still trying to develop in terms of sustainability and recycling when compared to the world. In this case, it can be

said that developed countries in the world are significantly ahead of Turkey. It can be stated that the investments of developed countries in this field are well-established and involve serious costs. Since the studies in this field have only recently started in Turkey, the level of awareness is just emerging. In schools, courses in the field of entrepreneurship have recently started to be given in the curricula. Raising individuals consciously at a young age will not be an extra burden for trying to change habits in the future, and will not cause more conscious consumers and increasing costs. In this regard, both in the world and in Turkey, all public and private sector organisations have a great role to play. Since this field is a new field in Turkey, it can be stated that state support for sports sustainability is not yet at the desired level.

It is seen that waste management has an important place in sustainable development. Within the scope of waste management, waste should not be seen as rubbish, it should be seen as a resource and waste should be prevented, reduced, recycled, disposed and the process should be monitored in the best way. Each waste saved from the natural environment will both reduce the use of a new resource and prevent further pollution. Sustainable development should be adapted to all areas of life. Especially in sports initiatives, sustainability and recycling practices should be prioritised in order for individuals to lead a healthier life and leave resources to future generations to meet their needs. It is recommended that companies with high recognition in sustainability and recycling practices in sports initiatives, which are recognised by the society, should take initiatives that will set an example for the society. It is predicted that these studies will encourage individuals in sustainability and recycling. It is seen that studies on sustainability and recycling practices in sports initiatives are limited in the national literature. It is recommended that academicians and researchers conduct more studies in this field.

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## Chapter 3

# Carbohydrate Ingestion in Racket Sports

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### **Abstract**

The most popular racket sports are tennis, badminton, squash and table tennis, which are usually played between two or four players. Racket sports are characterized by short rest periods and very intense exercise cycles. The metabolic demands of these intense loads are met by both anaerobic and aerobic energy systems. That's why nutrition is so important for athletic performance. Nutrition plays an important role in energy production and rapid recovery. It is important to understand the specific nutritional requirements of each sport, as these nutritional requirements are affected by the duration and frequency of training and competition, the length of the season, and the gender and age of the athlete. Training and nutrition should be coordinated to achieve high levels of athletic success. Recent studies have shown that both macro- and micronutrients have a potential role in regulating the exercise-stimulated cell signaling pathway, which is thought to regulate skeletal muscle adaptation to exercise. Carbohydrates (CHOs), one of the macronutrients, are used as the primary fuel source in both anaerobic and aerobic energy systems due to the stop-start and sudden changes of direction in racket sports. CHOs are also the best source of energy to fuel muscles, brain and organs. During the high-intensity parts of a racket sport match, CHO oxidation makes a significant contribution to ATP production. Therefore, in racket sports, the daily CHO intake of players should be periodised to match the fuel needs of training and competition, especially on days of high intensity training or when it is important for the athletes to train hard. The importance of CHO consumption should be well understood by all stakeholders involved in sport. Therefore, the aim of this review was to investigate the effects of carbohydrate intake in racket sports.

***Keywords:*** *Racket sports, Carbohydrates, Nutrition*

## **INTRODUCTION**

In racket sports, the aim is to score points by throwing the ball to a point where the opponent player cannot be met or that will force the opponent into an error. Among the racket sports, the most popular are tennis, badminton, squash, and table tennis, usually played between two or four players (Lees, 2003). Racket sports involve short rest intervals and very intense load cycles. The metabolic demands resulting from these intense loads are met by both anaerobic and aerobic energy systems (Majumdar & Yadav, 2009). Therefore, nutrition is very important for sportive performance.

Nutrition plays an important role in body weight control, especially in energy production, preservation of sports-specific body composition, rapid recovery, bone health, strengthening of immune functions, and protection against oxidative damage (Beck, Thomson, Swift, & Von Hurst, 2015). Training and nutrition should be coordinated for high-level success in sports (Beck et al., 2015). The relationship between nutrition and physical performance has been of interest to people for a long time. Since the energy and nutritional requirements of each exercise or sports branch are different, food consumption should be regulated accordingly (Campbell & Wisniewski, 2017). Because these nutritional requirements are shaped according to the rule of each sport, the field size, the duration and frequency of the matches, the length of the season, the duration of the training, the climatic conditions, the level of the game, the gender and the age of the athlete (Holway & Spriet, 2011). Individuals participating in a fitness program that lasts three days a week and for 30-40 minutes in each session 45-55% of their daily diet is carbohydrate (3-5 g/kg/day), 10-15% of their daily diet (0.8-1.0 g/kg/day) and 25-35% from fat (0.5-1.5 g/kg/day) to meet the required nutritional needs (Kreider et al., 2010). However, due to the increased exercise intensity, athletes need above-average energy and consequently, nutritional intake to continue training, accelerate recovery, and keep their performance high (Thomas, Erdman, & Burke, 2016).

Recent studies have shown that both macro and micronutrients have a potential role in regulating the cell-signaling pathway stimulated by exercise, which is thought to regulate the adaptation of skeletal muscles to training (Close, Hamilton, Philp, Burke, & Morton, 2016). As it is known, macronutrients consisting of carbohydrates (CHO), proteins, and fats meet almost all of the daily energy needs compared to micronutrients due to their high caloric values (Fink & Mikesky, 2017). CHOs, one of the macronutrients, are used as the primary fuel source in both anaerobic and aerobic energy systems due to the stop-start and sudden changes of direction of racket sports (Kovacs & Baker, 2014).

### **How Important Is Carbohydrate in Racket Sports?**

CHOs composed of carbon, hydrogen, and oxygen molecules are converted into glucose in the body and play a major role as the main fuel source in all physical activities (Campbell & Wisniewski, 2017; Fink & Mikesky, 2017). CHOs; In addition to being the best energy source that provides fuel for muscles, brain, and organs (International Tennis Federation, 2020), it minimizes the pressure on the immune system by reducing the stress hormone response produced against exercise (Parker-Simmons, 2010). High CHO diets are recommended to support immune function and prevent overtraining during periods of intense training (Ranchordas et al., 2013). Today, both athletes and physically active individuals do not have a clear understanding of the effects of CHOs on performance (Fink & Mikesky, 2017). Therefore, the importance of CHO consumption should be well understood by all stakeholders related to sports.

In their nutritional strategies, athletes must give due importance to the consumption of a sufficient amount of CHO for a rapid recovery and replenishment of glycogen stores before, during, and after long-term training and matches (Campbell & Wisniewski, 2017; Simulescu, Iliu, Macarie, Merghes, & Sports, 2019). Because, to increase exercise performance, the basis of contemporary sports nutrition practices is the principle of providing sufficient CHO (Close et al., 2016).

CHO's can be in the form of glucose, sucrose, maltodextrin, or some high glycemic index starch. Since the consumption of such CHOs may cause gastrointestinal disorders, their consumption should be limited (Teodor, 2010).

Although preferring high glycemic index foods before and after the match means faster energy and recovery, athletes are recommended to include low glycemic index foods in their overall dietary strategies for training for a more balanced blood glucose level and energy level (International Tennis Federation, 2020).

It is recommended to consume complex CHO's, especially due to their high fiber and vitamin content, low glycemic index, and continuous energy supply for a long time. Complex CHO's take longer to digest than simple CHO's due to their fibrous structure. It is recommended to consume complex CHOs, especially those with low glycemic index. However, liquid CHO sources and simple CHO-containing foods can be used in cases where glucose levels need to be raised rapidly during training or matches (International Tennis Federation, 2020).

Which source or pathway energy is supplied during exercise is related to the intensity and duration of the work done (Ranchordas et al., 2013). Measuring

blood lactate concentrations is an accurate approach to detect energy pathways used in matches or training (Vicente-Salar, Santos-Sánchez, & Roche, 2020). Therefore, knowing these values is very important in determining how energy is produced and how much the body needs.

### **Physiology of Racket Sports**

The more we know about the cardiovascular, metabolic and respiratory demands in racket sports, the better we can evaluate the performance and training programs of the players. Physiologic parameters such as blood lactate level, heart rate and oxygen consumption values are almost similar in racket sports.

When we investigate the racket sports, it is observed that the mean match playing times may last from 3.7 minutes to more than 2 hours. This can be as both physically and physiologically demanding, and players may also need to play multiple matches in a day (i.e., for singles and doubles or for team events) with competitions typically lasting for one week. Such competition structures further emphasize the need for timely and appropriate refueling for optimal physical performance on multi-match days.

Considering the nature of racket sports, match-play is characterized by high intensity, intermittent actions separated by short rest periods. Therefore, it is suggested that having greater anaerobic capacity may be advantageous in allowing more explosive strokes and returns during the play. Similarly, energy requirements in racket sports are mainly met by aerobic and alactacid metabolic pathways. Therefore, a well-developed endurance capacity as well as good speed abilities over short distances is the most important performance prerequisites for players in racket sports.

When the energy requirements are considered, energy used in racket sports is provided by approximately 97% ( $\pm 2\%$ ) of the aerobic, 1% ( $\pm 0.7\%$ ) by anaerobic and 3% ( $\pm 1\%$ ) by phosphocreatine breakdown (Zagatto, Mello, Leite, Papoti & Beneke, 2016). Although the contribution of the anaerobic pathway is small during the game, greater anaerobic capacity enabled rallies to be played at a higher intensity (Milioni et al., 2018). Considering the nature of racket sports, this suggests that having greater anaerobic capacity may be advantageous in allowing more explosive strokes and returns. Therefore, CHO consumption should be the main source of fuel for racket players, while ensuring sufficient creatine intake to saturate the muscle storage of phosphocreatine.

### **Work - Rest Periods**

Average rally and rest times in racket sports vary by 1:2 (Fernandez, Mendez-Villanueva & Pluim, 2006). These times are as follows in other racket

sports. Rally time 3.6-7s in badminton, rest time 9.8-15s (Cabello, Tobar, Puga, & Delgado, 1997; Phomsoupha & Laffaye, 2015), rally time in table tennis 3.5s, rest time 8-20s (Moura, Kondric, Knechtle, Nikolaidis, & Sperlich, 2018) while the rally time in squash ranges from 4 to 17.5s on average (Vučković & James, 2010), rest periods are on average 9s (Vučković, Dezman, Pers, & Kovačić, 2005). The mean duration of the games increased as the competition progressed from the preliminary rounds to the finals. For example, while the game play times in table tennis ranged from 3.8 min to 5.5 min for men, from 3.7 min to 7.5 min (Katsikadelis, Pilianidis & Misichroni, 2004; Katsikadelis, Pilianidis & Vasilogambrou, 2007) for women. The average men's match duration in the Beijing Olympic Games was 27.5 min and the women's duration was 32.3 min. However, when the ball size increased from 38 mm to 40 mm, the average rally time per point increased by up to 10 s (Djokic, 2007). Therefore, such competition structures further emphasize the need for timely and appropriate refueling for optimal physical performance on match days.

### **Oxygen Consumption**

Maximal oxygen uptake ( $VO_2\max$ ) is probably the most widely accepted single parameter for the estimation of endurance capacity in both healthy subjects and athletes. When oxygen consumption amounts are examined, the average  $VO_2\max$  values in tennis matches are 45 ml/kg/min in female players and 55 ml/kg/min in male players (König et al., 2001), in badminton matches 47.2 ml/kg/min in women and 56.1 ml/kg/min in men (Phomsoupha & Laffaye, 2015). It has been found that athletes competing in badminton singles competitions (50.6 ml/kg/min) have higher  $VO_2\max$  values than those competing in doubles (45.5 ml/kg/min) (Alcock & Cable, 2009). Mean  $VO_2\max$  values in table tennis matches were  $44 \pm 4.5$  ml/kg/min (Zagatto, Vieira, Papoti, & Beneke, 2016), and 54.4-64 ml/kg/min in squash matches (Girard, Chevalier, Habrard, & Sciberras, 2007; Girard et al., 2005).

### **Blood Lactate**

Average blood lactate values recorded in tennis matches were  $2.07 \pm 0.88$  mmol/l, while the highest blood lactate level was reported to be 8 mmol/l (Fernandez, Fernandez-Garcia, Mendez-Villanueva, & Terrados, 2005). The average lactate concentration in badminton was around 4.4 mmol/l in both genders, while the maximal lactate value recorded in male players was 7.0 mmol/l and in women 7.1 mmol/l (Phomsoupha & Laffaye, 2015). While the average blood lactate concentration recorded in table tennis matches was 1.8

mmol/l, the maximal lactate concentration was 2.2 mmol/l (Zagatto, Morel, & Gobatto, 2010), and this value was  $8.3 \pm 3.4$  mmol/l in squash (Girard et al., 2007).

### **Heart Rate**

It is known that the average heart rate (HR) during the tennis match is between 140-160 beats/min (Smekal et al., 2001), while in badminton it is between 169-173.5 beats/min (Faude et al., 2007; Hughes, Reilly, Hughes, & Lees, 1995; Manrique & Gonzalez-Badillo, 2003; Phomsoupha & Laffaye, 2015). In a table tennis study, the average HR values in six official matches were between 162-172 beats/min (Djokić, 2009), in another study 163.8 beats/min (Zagatto et al., 2010), while during squash matches the HR it is observed that 177 beats/min is determined (Girard et al., 2007). These values can go up to  $189 \pm 3$  beats/min depending on the intensity of the matches (Christmass, Richmond, Cable, Arthur, & Hartmann, 1998). It was reported that the average HR of the athletes who won and lost in squash matches were 167 and 175 beats/min, respectively (Alvero, Barrera, Mesa, & Cabello, 2006).

### **Energy Rates**

Playing times in racket sports vary between 10 minutes and 5 hours (Kovacs, 2006; Lees, 2003). Despite the stop-and-go structure inherent in racket sports, these sports have a high aerobic component. However, while the urgent energy needed by the muscles during explosive movements is provided by high-energy phosphate bonds, it is met from aerobic oxidation during the rest and recovery periods (Essén, 1978; Smekal et al., 2001). A combination of carbohydrate-weighted nutrition is used as the primary fuel source in both anaerobic and aerobic energy systems in tennis (Kovacs & Baker, 2014). It has been suggested that aerobic (60-70%) and anaerobic (30%) systems are predominant in energy production in badminton (Edel, Song, Wiewelhoe, Ferrauti, & Research, 2019; Phomsoupha & Laffaye, 2015). It has been reported that more lipid oxidation occurs in table tennis than in other racket sports due to low cardiorespiratory responses (96% aerobic, 4% anaerobic) (Sperlich et al., 2011; Zagatto, de Mello Leite, Papoti & Beneke, 2016). In Squash, it is stated that the alactic energy system is higher than other racket sports (Girard et al., 2007).

In the high-intensity parts of a match in racket sports, CHO oxidation has a significant contribution to ATP production (Ranchordas et al., 2013).

While the absolute oxidation rates of all energy substrates increase after training, CHO-based fuels for training muscles become the dominant energy

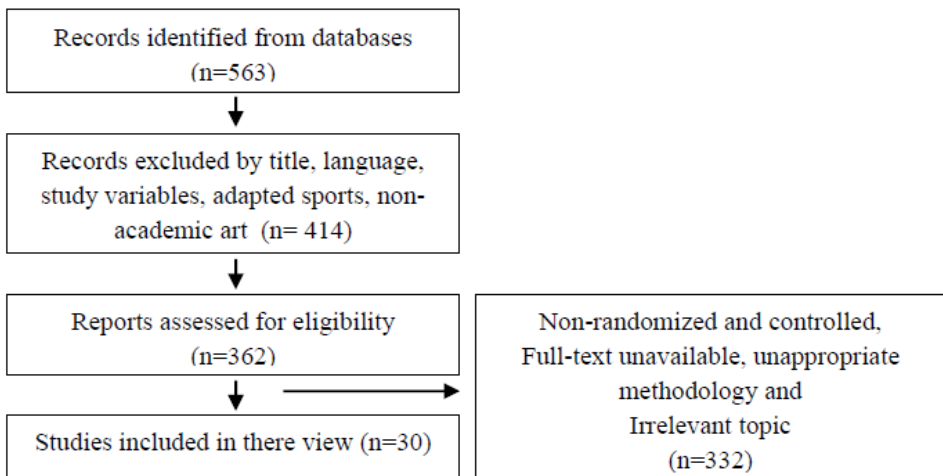
source when the exercise intensity is more than 60% of the VO<sub>2</sub>max (Hawley & Leckey, 2015).

When the energy consumption in racket sports is examined, it has been reported that it is in the range of 31-45 kJ/min in tennis, 46-68 kJ/min in badminton, 29-46 kJ/min in table tennis, and 42-82 kJ/min in squash (Faude et al., 2007; Girard et al., 2007; Ranchordas et al., 2013; Sharp et al., 1998).

## METHOD

Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Guidelines used to search for articles that met the inclusion criteria in Web of Science, Pubmed, Scopus and Science Direct database (Moher, Liberati, Tetzlaff, & Altman, 2010). The search was performed between January 2023, and May 2023 with the keywords “Rackets sports” or “tennis” or “badminton” or “table tennis” or “squash” and “carbohydrate”. Finally, a total 30 records were included for analysis in this study as seen in Figure 1.

Studies that assessed the heart rate, blood lactate level and oxygen consumptions and full-text academic journals published in English were considered as inclusion criteria. Moreover, studies in which adult male and female players were analyzed in real competition or in simulated situations were included. However, systematic reviews, narrative reviews meta-analysis, scoping reviews, articles that analyzed the adapted sport, articles that analyzed subjects with different pathologies, abstracts, conferences and/or communications to congress were considered as the exclusion criteria.



**Figure 1.**Flow chart of the search process the selection of article (Moher et al., 2010).



### **Inclusion Criteria**

Data were extracted from the fully reported studies in peer-reviewed literature identified by our search, with additional studies being located by cross-referencing from this literature. Abstracts, single case studies, and unpublished data were not included among the final information sources. The last day of the search was 31 May 2023.

### **RESULTS**

As a result of this review, the following results were obtained about the use of CHO in racket sports.

#### **Pre-Match Use of CHO**

CHO is an important determinant of performance in many sports. Depletion of CHO stores in the body is the most important cause of fatigue and performance impairment, especially during prolonged (>90 minutes) submaximal loads or high-intensity interval exercise (HIIT) (Campbell & Wisniewski, 2017). Therefore, to provide sufficient CHO support on the day of the competition, athletes are recommended to consume at least 6-12g/kg CHO 24-36 hours before the competition (Burke, Hawley, Wong,& Jeukendrup, 2011). It is known that consuming a carbohydrate-rich (approximately 200-300g CHO) food 2-4 hours before exercise can replenish CHO reserves and is associated with an increase in performance (Hargreaves, Hawley,& Jeukendrup, 2004).

When sufficient CHO support (> 8g/kg/day) was provided, it was observed that there was no significant decrease in the blood glucose levels of the players even in a 180-minute tennis match (Gomes et al., 2013).

CHO reinforcement in racket sports is very important not only for tournaments in which more than one game is played on the same day but also in terms of providing full recovery for more than one training performed on the same day during training periods (Kovacs, 2006).

It demonstrates the ergogenic effect of consuming CHO (0.7g/kg/hr) on stroke quality in the late phase of the long-term simulated tennis match game. CHO reinforcement not only enabled players to produce stronger and more precise shots, but the error rate was reduced in at least two test cases (Vergauwen, Brouns,&Hespel, 1998).

In studies conducted, liquid consumption containing 6.4% CHO increased the rates of successful serving and serving in tennis matches (McRae & Galloway, 2012). While the same amount of CHO consumption kept the short

serve accuracy rate constant at the initial level in badminton (Clarke & Duncan, 2016), it was observed that 6.4% CHO consumed after fatigue increased the short serve accuracy (Bottoms, Sinclair, Taylor, Polman, & Fewtrell, 2012). In another study, it was reported that 6.4% CHO consumption continued to maintain and protect the technical skills of squash players (Bottoms, Hunter, & Galloway, 2006). Although table tennis matches last shorter compared to other racket sports, carbohydrate intake has been reported to prevent hypoglycemia (Gomes, Moreira, Coutts, Capitani, & Aoki, 2014; Moura et al., 2018).

However, fluid intake containing 6% CHO is less effective on tennis performance (Hornery, Farrow, Mujika, & Young, 2007), reducing the effect of salivary cortisol after a three-hour match (Gomes et al., 2014), and even other. In another study, it was reported that it did not increase performance (Gomes et al., 2013). In another study, it was reported that fluid intake containing 7.6% CHO increased tennis performance, specific running speed, but had no definite positive effect on tennis performance during long-term training/match (Ferrauti & Struder, 1997).

Fluid intake containing 7% CHO, which was consumed twice as 250 ml 60 and 30 minutes before the measurements, was determined by the sprint speed, maximum power, and cognitive performance parameters (information processing speed, attention, perception) during a high-intensity interval exercise (HIIT) in squash and fencing athletes. It has been reported to improve and reduce muscular fatigue (Pomportes, Brisswalter, Hays, & Davranche, 2016).

### **Use of CHO during the Match**

It has been shown that CHO intake during exercise can increase exercise performance during HIIT training (Jeukendrup, 2014). It is known that CHO consumed during matches has a very positive effect on focusing and decision-making since it provides sufficient glucose to the brain (Winnick et al., 2005). The traditional approach to CHO support during exercise is to consume 6–8% CHO drink. However, relying on this approach alone is considered to be insignificant, as it does not meet the actual fluid requirements in individual variations in body mass and ambient conditions (Lee et al., 2014). For this reason, it has been reported that setting the CHO consumption strategy to be 600–1200 ml/hour and having the CHO rate in liquid consumption between 4 and 8% (4–8g/100ml) will provide sufficient CHO supply (Kovacs, 2006a; Kovacs, 2006b). At the same time, CHO intake can be obtained by consuming beverages, gels, or by consuming low-fat, low-protein, and low-fiber solid foods (bars). Of course, the choice should be made according to personal preferences (Jeukendrup, 2014). During exercises that last more than an hour

and cause fatigue, athletes are generally recommended to consume 30-60 g of CHO per hour as it increases performance (Coyle, 2004). The more is better philosophy is not a good approach to CHO consumption. Because consuming high amounts of CHO (> 8%) may cause gastrointestinal disturbances rather than an increase in oxidation rate (Parker-Simmons, 2010; Wagenmakers, Brouns, Saris, & Halliday, 1993). Because regardless of the structure of CHO consumed during exercise, it is known that only 1g per minute can be oxidized (Jeukendrup & Jentjens, 2000). Similarly, it has been reported that consuming a liquid solution containing 7.5% CHO at 200ml every 15 minutes during a tennis match does not have a significant effect on tennis performance (Mitchell, Cole, Grandjean & Sobczak, 1992).

One study in cycling and triathlon athletes reported that consuming 39g or 64g of single-source CHO per hour was equally effective in improving endurance performance. Therefore, consumption of 39g CHO per hour was said to be sufficient to change substrate use and improve performance during a two-hour submaximal exercise (Newell, Wallis, Hunter, Tipton & Galloway, 2018).

### **Post-Match Use of CHO**

Recommendations for CHO recruitment during recovery depend on the severity and duration of the training and matches. To support recovery and regeneration, daily CHO consumption should be 5-7g/kg in moderate training, 6-10g/kg in submaximal training, and 8-12g/kg in high-intensity training (Burke et al., 2011). However, when there is a recovery time of fewer than 8 hours between training or matches, it is suggested that CHO intake should be 1-1.2g/kg immediately after training and match (Kovacs & Baker, 2014; Mujika & Burke, 2010). The timing of CHO intake is especially important if the athlete has two training or matches in one day. However, timing is less important if there are one or more days between intense training sessions, provided that enough CHO is consumed during the 24 hours after training or match (Burke et al., 1996). It is recommended that the type of recovery food consumed in short recovery periods should be easily digestible CHO sources (Holway & Spriet, 2011).

1-2 hours after the game: eat a balanced meal containing a variety of carbohydrate sources, a portion of protein and liquids; -High-carb sports drinks, sports bars, and other high-carbohydrate foods with a high glycemic index will facilitate the rapid restoration of muscle glycogen (International Tennis Federation, 2020).

The type of CHO consumed is important. High glycemic index CHOs consumed after exercise increased the muscle glycogen synthesis rate measured

after 24 hours by 48% compared to low glycemic index CHOs (Burke, Collier,& Hargreaves, 1993; Kovacs, 2006a).

## **CONCLUSION**

The main role of CHO is to provide fuel for the muscles, especially during high-intensity short-time exercises. Therefore, in racket sports, daily CHO intake of the players should be periodized to match the fuel needs of training and competition, especially on days with high intensity training or when it is important for athletes to train hard (Burke, Hawley, Wong & Jeukendrup, 2011). Guidelines on the daily intake of CHO should be based on body mass and exercise load. Given the dominantly aerobic but moderate intensity at training and competition in racket sports, CHO usage recommendations in-season for the players in racket sports range from 5g to 7 g/kg of body weight per day, depending on the gender, duration and intensity of exercise as well as environmental conditions. Intakes of CHO should also vary according to macro- and micro-cycles as the followings;

- Main aim is to match CHO intake to training demands.
- Off-season/light intensity, single training session days: 4-5g/kg CHO body weight/day
- In-season/moderate intensity, double training session days: 5-7g/kg CHO body weight/day
- Limit CHO intake to 25g per episode during the match day.

The players in racket sports should also consider the types of CHO ingested. As racket sports that rely heavily on cognitive function, mental alertness and speed of reactions, players should aim to maintain blood glucose levels between desired limits before and during competitions by having appropriately timed meals and snacks. Players may benefit from consuming low to moderate glycemic index (GI) foods and meals before competition for sustained fuel release. The following practical strategies can be suggested to achieve the recommended intake of CHO;

- Aim for low–moderate GI CHO foods where possible. Most whole fruits such as apples, bananas, berries, etc., have low to moderate GI.
- Ensure that CHO foods (e.g., rice, noodles, pasta, bread, etc.) are consumed at all meals and snacks.
- During in-season/moderate training periods, consume carbohydrate–electrolyte -drinks during training to maintain blood glucose level during training.

- Consume foods containing both carbohydrate and protein (e.g., milk) to optimize post-exercise recovery (Atkinson, Brand-Miller, Foster-Powell, Buyken & Goletzke, 2021).

In the days leading up to competition, players should consume CHO-rich meals to ensure that their glycogen stores are replete. Players should aim to consume a meal comprising 1g to 2g/kg of body weight of CHO, 3 to 4 hours before the match and top up glycogen and energy levels with low–moderate GI snacks 1 to 2 hours prior to a match. Food choices should be familiar, and low in fat and spice to minimize interference with digestion (e.g., banana, oat-based cereal bars). Players should follow up with the appropriate recovery methods suggested below.

During competition, players may have to play multiple matches in a day and compete over several consecutive days. Players competing in multiple matches in a single day should ingest CHO drinks or gels during game play to maintain motor skill proficiency and mitigate the cognitive function decline resulting from fatigue (Welsh, Davis, Burke & Williams, 2002). The aim is to maintain sufficient glycogen stores for ongoing and subsequent matches. While the ingestion of CHO generally improved mental performance, there appears to be an inverted-U dose–response relationship between CHO intake and performance, with an optimal dose of 25g (Gibson, 2007). This suggests that players in racket sports should not consume more than 350 ml of a standard CHO–electrolyte drink (7% CHO) during a match interval or time outs and should instead sip on the drinks. For back-to-back matches, players should continue to sip on CHO drinks and gels to maintain body glycogen stores.

Players who undergo training twice a day and wish to recover from the first training session should aim to consume a meal or snack immediately post exercise. Players should aim to consume CHO at 1.0g to 1.2g/kg of body weight at frequent intervals for up to 4h post exercise (Thomas, Erdmann & Burke, 2016). For refueling between matches on multi-match day, players should consume CHO snacks or drinks that are moderate to high in GI for speedy glycogen replenishment, especially for matches that are less than 4h apart.

Based on the current understanding of the demands of racket sports, nutrition has potential in optimizing performance. Sport nutrition professionals should work closely with athletes and coaches to ensure that athletes consume the right amounts and types of nutrients for training and competition.

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## Chapter 4

# The Key To Sports Psychology: Mental Toughness

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## **ABSTRACT**

Sports psychology is a discipline aimed at enhancing, preserving, and achieving superior performance among athletes, and significant developments have been observed in this field in recent years. Sport is not only a combination of physical abilities but also of mental and emotional competencies. Therefore, the mental preparedness, motivation, and mental resilience of athletes are critically important for successful performance. Mental resilience is a crucial factor for success at every level of sports. Mental resilience in sports psychology consists of critical skills that extend beyond athletes' physical abilities. These skills help athletes enhance their performance, overcome challenges, and achieve long-term success. In this context, mental resilience is a skill set that goes beyond athletes' physical abilities and plays a significant role in the field of sports psychology. These skills assist athletes in delivering better performances, overcoming challenges, and attaining long-term success. Therefore, athletes should not only focus on physical training but also emphasize the development of mental resilience and include it in their training regimen. In this study, it was aimed to emphasize the importance of mental endurance in sports.

**Keywords:** Mental toughness in sports, sports psychology, psychology

## **ÖZET**

Spor psikolojisi sporcuların üstün performans elde etmeyi, sürdürmeyi ve artırmayı amaçlayan bir disiplindir ve bu alanda son yıllarda önemli gelişmeler yaşanmıştır. Spor, yalnızca fiziksel yeteneklerin bir kombinasyonu değil, aynı zamanda zihinsel ve duygusal yeteneklerin bir bileşimidir. Bu nedenle sporcuların zihinsel hazırlığı, motivasyonu ve zihinsel dayanıklılığı, başarılı performans için son derece önemlidir. Zihinsel dayanıklılık sporun her seviyesinde başarı için kritik bir faktördür. Spor psikolojisinde zihinsel dayanıklılık sporcuların fiziksel yeteneklerinin ötesine uzanan önemli becerilerden oluşmaktadır. Bu beceriler sporcuların performanslarını artırmalarına, karşılaştıkları zorlukları aşmalarına ve uzun vadeli başarı elde etmelerine yardımcı olmaktadır. Bu bağlamda, zihinsel dayanıklılık, sporcuların fiziksel yeteneklerinin ötesine uzanan bir beceri setidir ve spor psikolojisi alanında önemli bir rol oynamaktadır. Bu beceriler, sporcuların daha iyi performans sergilemelerine, zorlukları aşmalarına ve uzun vadeli başarı elde etmelerine yardımcı olmaktadır. Bu nedenle sporcular yalnızca fiziksel antrenmana odaklanmamalı, aynı zamanda zihinsel dayanıklılığın gelişimine de vurgu yapmalı ve bu konuyu antrenman programlarına dahil etmelidirler. Bu çalışmada da sporda zihinsel dayanıklılığın önemini vurgulamak amaçlanmıştır.

**Anahtar Kelimeler:** Sporda zihinsel dayanıklılık, spor psikolojisi, psikoloji

## **INTRODUCTION**

Sport is the entirety of activities that individuals engage in to feel physically, mentally, and emotionally well, allowing them to lead more comfortable lives (Bayarslan & Çevik, 2023). It is widely acknowledged worldwide and in Turkey that the formation of sporting success is influenced not only by physical abilities but also by psychological factors. In today's sports landscape, researchers and practitioners emphasize the increasing role of psychological skills among the factors contributing to success. This holds true for various stakeholders in sports, including athletes, managers, coaches, and sports psychological performance consultants (Parker et al., 2004; Lane et al., 2009; Meyer & Zizzi, 2007).

In recent years, it has been observed that in the field of sports, mental studies have gained increased significance alongside physical performance. This development places significant responsibilities on sports psychologists, as they play a crucial role. Athletes lacking mental resilience may struggle to cope with adverse conditions, fail to turn challenges into opportunities, and may experience a negative impact on their performance during stressful situations. Therefore, working with sports psychologists is of utmost importance to assist athletes in achieving success and overcoming such issues. Sports psychologists teach the necessary skills to enhance athletes' mental health and performance. These skills include stress management, focus enhancement, motivation boosting, self-confidence building, and goal setting, among other crucial aspects. Sports psychologists help athletes confront negative thoughts and empower them mentally, making them stronger mentally (Yılmaz, 2021).

The relationship between the mind and body has been a subject of human fascination throughout history. This interest has persisted since ancient times. The renowned Greek philosopher Plato articulated the foundation of sports psychology with the statement "a healthy mind in a healthy body" (Karageorghis & Terry, 2011).

The early years of sports psychology represent a period when conceptual understanding was sought about the relationship between psychology as a science and sports. During this period, contemplation revolved around the nature and significance of the connection between psychology and sports, forming a conceptual framework. Subsequently, the development of laboratory research and psychological assessments has led to significant advancements in the field of sports psychology. These advancements have enabled a more scientific and systematic approach to the mental preparation of athletes, performance enhancement, and coping with challenges. Sports psychology has become an indispensable discipline today, contributing positively to athletes' achievements (Ersöz, 2022).

Psychology is defined as a branch of science that studies the human mind. However, the definition of psychology has evolved over time. Particularly, under the influence of John B. Watson, psychology was directed towards a more observational approach. Hence, a perspective emerged that defined psychology as the scientific study of observable behaviors. This definition emphasizes that psychologists focus on observing, measuring, and analyzing human behaviors under laboratory conditions. This approach, while asserting that science is more measurable and observable, tends to overlook the more abstract and complex aspects of the human mind. However, this narrow definition of psychology was criticized by psychologists in later years, and it was accepted that psychology is not only a science based on observation but also examines human thoughts, emotions, and internal processes. Therefore, the definition of psychology is generally made in a more inclusive manner, encompassing both observable behaviors and internal mental processes. In this context, the definition of psychology can change over time and be interpreted from different perspectives. Both definitions emphasize different aspects of psychology, but today psychology is approached from a broader perspective and is considered a science that examines both observable behaviors and internal mental processes (Cüceloğlu, 2013).

The origins of sports psychology date back to ancient Greece, and the thoughts in this field extend to philosophers such as Socrates, Plato, and Aristotle. These philosophers pondered the spiritual aspect of sports, games, and exercise as part of human life. In later years, philosophers and educators laid the foundations of sports psychology. For example, Hippocrates, Galen, Avicenna, and Taoist priests emphasized the effects of exercise and overexertion on health. During the Renaissance and beyond, interest in physical activities increased. In the 16th and 18th centuries, the results of scientific studies emphasized the importance of sports and especially fitness. Notably, scientists like Dr. Speck in 1883 and A.V. Hill in 1922 conducted significant research on exercise physiology. Additionally, a laboratory for sports-related studies was established in Germany in 1891. These developments laid the foundations of sports psychology and emphasized that sports is not merely a physical activity but also an area with mental and spiritual dimensions. Therefore, sports psychology has developed as a multidisciplinary field aimed at enhancing both the physical and mental potential of individuals (Başer, 1998; Özbaydar, 1983; Tiryaki, 2000).



## **MENTAL TOUGHNESS**

Mental toughness can be defined as the ability to cope with challenging situations such as negative events, failure, conflict, and increased responsibilities, and the capacity to recover and return to one's previous state when faced with such situations. This represents a positive psychological capacity, signifying an individual's ability to maintain and enhance their mental resilience when confronted with difficulties in life. Enhancing mental toughness involves becoming more resilient to negative events, recovering quickly, and maintaining a more positive outlook (Luthans, 2002). Researchers in the relevant literature have defined mental toughness as the effective ability to cope with pressure and challenges (Clough et al., 2002; Jones et al., 2002; Loehr, 1995; Middleton et al., 2004; Williams, 1988). Mental toughness can also be described as the ability to be resilient in adverse situations and cope flexibly with them. This concept implies maintaining emotional balance when faced with adverse conditions, stressful events, or difficulties (Bull et al., 2005; Clough et al., 2002; Goldberg, 1998; Gould et al., 2002). Additionally, having a strong belief in controlling one's own future is an essential component of mental resilience (Clough et al., 2002; Jones et al., 2002; Middleton et al., 2004).

In recent years, research has emphasized the significant role of mental resilience as one of the psychological factors that affect athletes' performance. The competitive nature of sports, filled with pressure, stress, and challenges, leads athletes to encounter numerous situations that require mental toughness. Consequently, enhancing mental toughness and improving athletes' ability to cope with adverse conditions have become a focal point of research in the field of sports psychology in recent years (Erdoğan, 2016; Yarayan et al., 2018).

One of the key figures in the development of the concept of mental toughness in sports is sports psychologist James Loehr (Peke, 2020). He has presented various approaches and definitions to describe mental resilience in sports. For instance, Loehr (1982) defined mental toughness as the ability to sustain performance under pressure.

Several important theories have been developed concerning mental toughness including the "Personality-Construct Theory" and the "Hardiness Model" (Kobasa, 1979). According to Kobasa's "Hardiness Model," a resilient personality consists of three fundamental components: control, challenge, and commitment. These components form the foundation of mental toughness. Control represents an individual's belief and ability to influence events in their life. Challenge reflects the ability to cope with adverse situations, while commitment signifies how much individuals trust their social support systems and benefit from them.

Additionally, Clough et al. (2002) have added the construct of confidence to this model. Confidence represents an individual's trust in their abilities and environment. This expands our understanding of mental resilience and underscores how an individual's self-confidence can impact their performance.

These theories assist in comprehending the fundamentals and constituent elements of mental resilience. Athletes and individuals can use these theories to enhance their mental resilience and cope more effectively with adverse conditions. Therefore, these theories hold great significance for anyone striving to improve their mental toughness (Yılmaz, 2021).

These theories assist us in understanding the foundations and constituents of mental resilience. Athletes and individuals can use these theories to enhance their mental resilience and cope more effectively with adverse conditions. Therefore, the significance of these theories is substantial for anyone striving to improve their mental resilience (Yılmaz, 2021).

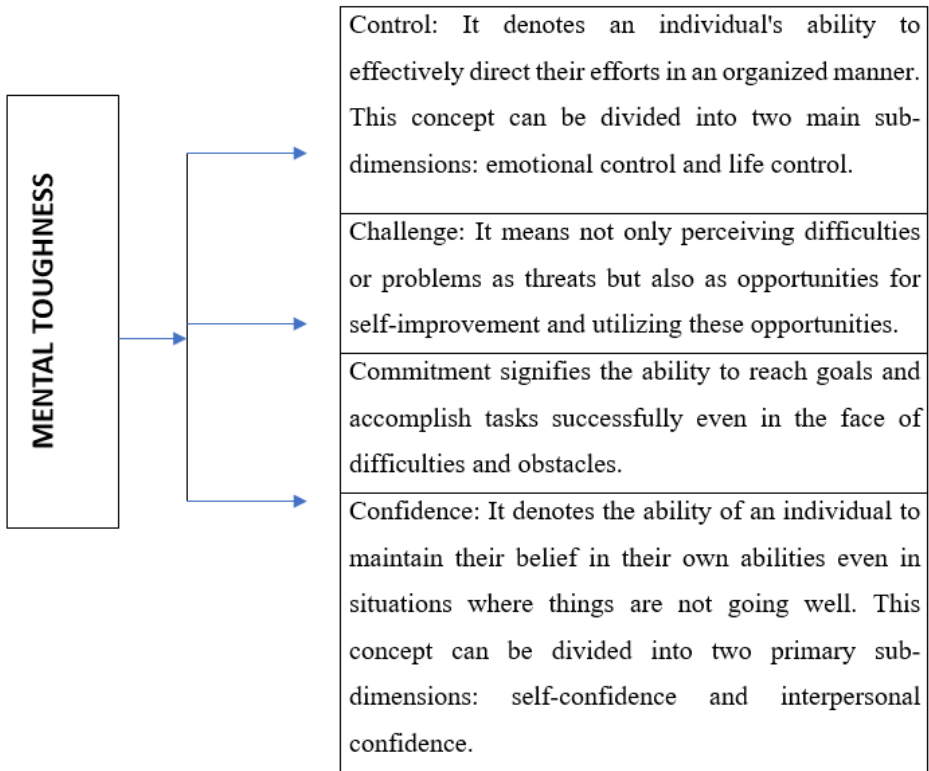
The "Personality-Construct Theory," which played a significant role in developing the concept of mental toughness, was proposed by Kelly (1955). This theory suggests that individuals make efforts to understand themselves, the world, and events and, as a result, construct different schemas in their minds. Kelly's theory presents the fundamental proposition that individuals' processes, such as emotional reactions, thoughts, behaviors, and experiences, are shaped by their psychological expectations about events and includes 11 sub-propositions that support this proposition. In other words, the "Personality-Construct Theory" explains how individuals cope with situations based on their schemas, which they create in line with their worldviews and expectations. Individuals interpret events according to their own worldviews and expectations, which in turn affect their mental resilience and their ability to cope with stress. Kelly's theory emphasizes the consideration of an individual's perception and thought processes to understand and improve their mental resilience.

The 16 Personality Factor Questionnaire, developed by Cattell (1957), is one of the theories that consider mental resilience as an essential part of personality structure. According to this approach, mental resilience is regarded as one of an individual's personality traits. Cattell describes individuals with high mental resilience scores as generally realistic, independent, responsible, resilient, and capable of coping with difficulties

While the 16 Personality Factor Questionnaire has been frequently used in the field of psychology, it has not been employed for measuring mental resilience in the field of sports. Cattell's view of mental resilience as a significant component of personality has prompted researchers to delve deeper into the concept of mental resilience and to consider personality traits when aiming to enhance

athletes' performance. This theory emphasizes that mental resilience can be related not only to physical abilities but also to personality traits. Therefore, athletes may need to understand their personalities and focus on developing these traits to improve their mental resilience and achieve superior performance. This represents an important area of research and practice for individuals who aspire to make further progress and succeed in the field of sports (Werner and Gottheil, 1966; Kroll, 1967).

Having high mental resilience has been observed to positively affect athletes not only in terms of enhancing their sports performance but also from a psychological perspective. These positive effects can be associated with psychological attributes such as coping with uncertainty, managing anxiety, handling stress, self-confidence, self-efficacy, courage, resilience, and positive self-talk. For example, a study examining the impact of mental resilience on coping with uncertainty revealed that athletes with lower mental resilience had more difficulty coping with uncertain situations. In other words, athletes with high mental resilience can respond to uncertainty more calmly and effectively. These findings demonstrate that mental resilience can enhance athletes' psychological resilience and make them more resilient against challenging factors like stress, anxiety, and uncertainty. Therefore, enhancing athletes' mental resilience can be an important strategy not only for improving their performance but also for supporting their psychological well-being and personal development (Gümüšoğlu and Aşçı, 2020).



**Figure 1.** Mental Resilience 4C Model (Clough et al., 2002).

Observations indicate that athletes who possess the attribute of confidence or challenge, considered as a subcomponent of mental resilience, have a strong belief structure. This belief structure enables athletes to reassess the changes they experience.

Confidence or challenge expresses self-confidence, resilience, and determination in athletes. Athletes with these attributes tend to persevere when faced with adverse conditions or difficulties instead of giving up. This strong belief structure allows them to approach the changes they encounter in a positive manner. This represents a significant aspect of mental resilience in athletes. A robust belief structure encourages athletes to be less inclined to give up when they encounter obstacles on their path to achieving their goals and helps them work with greater motivation. Additionally, it assists them in being more effective in coping with challenges (Kurt, 2011; Maddi, 2004).

Continuity or dedication expresses an individual's tendency to integrate any situation they face, any experience, into their own life. It signifies a person's desire to interact, learn, and grow through their experiences. This attribute

indicates that an individual, when confronted with life's challenges, prefers to view these experiences as opportunities for personal development rather than giving up. It includes the belief that even adverse situations can offer opportunities for learning and growth. Individuals with this trait seek to integrate these situations into their life story and draw lessons from them. In this context, continuity or dedication represents the desire to explore all aspects of life, learn from experiences, and use these experiences as stepping stones for personal growth. This attribute can assist individuals in adopting a more positive and constructive approach to all aspects of their lives (Şahin, 2008; Maddi, 2003).

## **CONCLUSION**

The increasing development and application of practices in the field of sports psychology have led to the emergence of a new set of terms (Erdoğan et al., 2014; Weinberg and Gould, 2003). One of these terms is mental resilience. Mental resilience is considered by athletes and coaches to be one of the most critical psychological attributes for achieving optimal performance (Bull et al., 2005; Cox, 2012; Gould et al., 1987; Jones, 2002; Jones et al., 2007). Researchers in the field of exercise and sports psychology have explored how sport performance is related to psychological factors such as mental resilience (Gümüşoğlu and Aşçı, 2020). It is evident that mental resilience is one of the fundamental components of high performance (Şahin and Güçlü, 2018).

In this context, the impact of mental resilience on success in sports is not limited to physical performance alone. It also contributes to athletes' abilities to cope with psychological factors such as stress and anxiety, leading to more consistent and superior performance. Therefore, enhancing mental resilience in athletes can help them become not only physically stronger but also psychologically more robust and resilient individuals (Jones, 2002; Ekmekçi and Miçooğulları, 2018; Jackson et al., 2001).

In all of this context, improving athletes' mental resilience can make a significant contribution to building more successful and sustainable careers. Athletes who develop their mental resilience generally have the potential to establish longer-term and successful careers. This can greatly enhance both their on-field and off-field performances, leading to a more stable and sustainable sports career.

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## Chapter 5

# E-Sports Industry: Growth and Opportunities

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## **ABSTRACT**

The impact of technology on e-sports is of great importance not only for players and spectators, but also for the sport itself. E-Sports is a reflection of a major transformation that technology has brought to the world of sport. This new sport has become a growing industry for technology companies and media, while offering a new career and entertainment option for young people. In this way, e-sports has transcended the traditional boundaries of sport and opened the doors to a new era. The E-Sports industry has experienced remarkable growth and offers a plethora of opportunities that have captured the attention of enthusiasts, investors, and analysts alike. Today, what was once considered a niche hobby has evolved into a global phenomenon, drawing a lot of participants and spectators from around the world. The potential for further innovation and growth in this area shows the importance of e-Sports. As the E-Sports industry continues to evolve and redefine entertainment, it is crucial to understand its dynamics and potential for those looking to be part of this exciting journey. This study aims to emphasize the importance of e-sports in the sports industry.

**Keywords:** e-Sports, Technology and Sports, e-Sports Industry

## **ÖZET**

Teknolojinin e-spora etkisi sadece oyuncular ve izleyiciler için değil, aynı zamanda sporun kendisi için de büyük önem taşımaktadır. E-Spor, teknolojinin spor dünyasına getirdiği büyük bir dönüşümün bir yansımasıdır. Bu yeni spor dalı gençler için yeni bir kariyer ve eğlence seçeneği sunarken, teknoloji şirketleri ve medya için büyüyen bir endüstri haline gelmiştir. Bu sayede e-Spor, sporun geleneksel sınırlarını aşarak yeni bir çağın kapılarını aralamıştır. E-Spor endüstrisi kayda değer bir büyüme yaşamıştır ve hem meraklıların hem yatırımcıların hem de analistlerin dikkatini çeken çok sayıda fırsat sunmaktadır. Bir zamanlar niş bir hobi olarak kabul edilen bu sektör, bugün dünyanın dört bir yanından çok sayıda katılımcı ve izleyiciyi kendine çeken küresel bir fenomene dönüşmüştür. Bu alanda daha fazla inovasyon ve büyüme potansiyeli taşıması e-Sporun önemini göstermektedir. Spor endüstrisi gelişmeye ve eğlenceyi yeniden tanımlamaya devam ederken, bu heyecan verici yolculuğun bir parçası olmak isteyenler için dinamiklerini ve potansiyelini anlamak önem taşımaktadır. Bu çalışmada da e sporun spor endüstrisindeki önemini vurgulamak amaçlanmıştır.

**Anahtar Kelimeler:** e-Spor, Teknoloji ve Spor, E-spor Endüstrisi

## **INTRODUCTION**

In the last century, technological advances shaped in parallel with the human needs of the world have led to incredible changes. These technological developments have caused significant changes in every field, and the field of sport has not been unaffected. New programs specific to different branches of sports have been developed thanks to technology and thus sports have been introduced to a wider audience. At the same time, technology has been used to develop and improve many positive aspects of sports (Kocadağ, 2017). Rapid developments in the field of technology have profoundly affected the world of sports, leading to the emergence of the concept of electronic sports or e-Sports. Sport is not only a spectacle, but also a pastime that provides entertainment (Bayarslan, 2023). As technological devices have become more accessible and inexpensive, gaming experiences have become available not only in arcades but also in the comfort of homes and on television screens. The development of game consoles and computers brought about a major transformation in the world of gaming and encouraged a shift from single player games to multiplayer games (Argan, et al., 2006).

E-Sports has grown rapidly all over the world, reaching large budgets and a wide audience. Rapid advances in technology have also affected the world of sports and led to new developments. Both playing and watching competitive video and computer games has led to the emergence of the concept of electronic sports or e-Sports. e-Sports draws attention as a sports branch that combines physical and mental skills. However, it stands out with the fact that it takes place in a virtual environment, requires lower costs than traditional sports, can be performed anywhere in the world, allows individual and team games and unique equipment requirements. Worldwide, at least 400 million people are among the spectators watching e-Sports competitions, while more than 100 million people are active as e-Sports players (Mustafaoğlu, 2018).

### **E-Sports**

The term sport, which is of Latin origin, is derived from the word "deportere" and includes meanings such as distributing and separating from each other. The term sport has taken its current form with the addition of the word "sport" since the 17th century (Atasoy & Kuter, 2005). Mirzeoğlu (2003) defined sport as the development and competition of individuals' cognitive, affective and physical abilities through planned and appropriate methods under certain rules.

One of the most important debates in the E-Sports literature is the recognition of E-Sports as a sport and one of the most prominent arguments is

that this type of sport should not be accepted as a sport due to the lack of physical activity (Gedik, 2023).

Happonen and Minashkina (2019) stated that E-Sports is no longer just a limited niche area and has an important enough place to take part in the 2024 Paris Olympics.

This statement reflects the fact that E-Sports is increasingly being accepted by a wider audience and is gaining enough prestige to be included in major international events. If E-Sports is indeed included as a discipline in the 2024 Paris Olympics, it could be an indication of the rise of E-Sports in the world of sport.

Technological advances and the internet have reshaped the meaning of sport. E-sport refers to a field of sporting activities in which people train and develop their mental or physical abilities using new communication technologies (Wagner, 2006).

E-sports is a sport based on online games. Professional acting in this field refers to participation in competitive games, and this type of acting is one of the most prominent aspects of e-sports. E-sports can also be defined as a sport where people from all over the world can meet and play games via the internet or compete in large local or international sports organizations organized at certain times (Argan et al., 2007). According to the definition explained by Wagner (2006), E-Sports is a concept in which computer games with professional rules are played competitively on a digital platform.

### **E-Sports and Traditional Sports**

Although electronic sport is often referred to by terms such as electronic games, cyber games, computer games, online games, it actually represents a broader concept. Electronic sport is a sport that involves people around the world, connected via the internet, competing through large organizations or tournaments. It involves more than many traditional sports that rely on both physical and mental skills. Electronic sport may require fast reaction times like in archery, involve reflex movements like in baseball, and present a similar mental challenge to the thinking strategy of chess. However, it also has a complex structure that requires players to manage characters or teams within the game, develop tactics, and cooperate to defeat opponents (Argan et al., 2006). E-sports can be defined as a competitive sport between professional or amateur players using computers, game consoles and mobile devices (Bayram, 2018). E-sports is recognized not only as an entertainment activity but also as a type of sports tourism, and its economic contributions and growing audience in this field are very important (Yayla & Güven, 2020; Aktuna & Ünlüönen, 2017).

E-sports is often used to describe types of sports where key features of traditional sport are combined with electronic systems. The participation of players and teams in e-sports platforms takes place through human-computer interaction. E-sports is used to refer to competitive video games, usually coordinated by different leagues and tournaments, where players participate in teams or are supported by sponsors (Hamari and Sjöblom, 2017: 211). E-Sports are usually organized in the form of league tournaments and participants focus on specific goals, such as winning championship titles and prize money (Mangelolja, 2019).

As with all sports, e-Sports is a competitive concept and combines entertainment and sports that take place on a digital platform within certain rules. The concept of sport is a science with a long history, but e-Sports is gaining importance as a field that has been examined with increasing research and different perspectives, especially in recent years. The interest in scientific research in this field is increasing (Büyükbaykal, 2020).

The main feature that distinguishes e-Sports from traditional sports is that it operates in a completely digital environment. Games included in the e-Sports category and traditional sports disciplines host similar types of tournaments, leagues and organizations, and tactics, strategies and intelligence are of great importance to achieve success in both fields (Kocadağ, 2017).

**Table 1.** E-Sports and Traditional Sports

<b>E-Sports</b>	<b>Traditional Sports</b>
Requires a virtual environment created in a computer environment.	Requires a real environment.
Requires mental effort.	Requires both mental and physical effort.
Does not require a significant financial resource.	Requires financial resources specific to the relevant sport branch.
Involves the use of its own tools and equipment (computer, mouse, etc.).	Involves the use of tools and equipment specific to the relevant sport branch.

**Reference:** (Güler, 2022).

When the main differences between e-sports and traditional sports are examined, the biggest distinction is that e-sports can be played in a virtual environment. E-Sports can be played with their own special tools and equipment without requiring a large financial resource, while traditional sports have branch-specific requirements such as physical infrastructure, equipment and facilities. Moreover, while E-Sports emphasize intellectual intelligence, traditional sports require both intellectual and physical effort. Both types of sports can be practiced as individual and team games, which is one of their common aspects (Güler, 2022).

### **Various Perspectives on the Importance of E-Sports in the Sports Industry**

In the related literature; Hasselberg (2020) revealed that competition, socialization, exploration, challenge and fun affect the interest in E-Sports. Moreover, participants want to get into the game quickly on an E-Sports platform, play the game in a competitive environment, examine their performance with advanced statistics, and socialize with other players. Chalmet (2015) argues that trust, which is one of the key factors for establishing long-term sponsorship relationships in E-Sports, directly affects engagement and satisfaction levels.

E-Sports has made great economic and participation advances since its integration into the digital gaming ecosystem. This development has made it a sector like traditional sports, providing an effective investment opportunity. In this process, the demand for individuals with skills in different fields has increased and E-Sports players are of great importance in this context (EGDF, 2016). It is a fact that the inclusion of E-Sports in the digital gaming ecosystem has made significant progress in terms of economics and participation. This development shows that E-Sports is becoming an increasingly large and influential investment opportunity. Similar to traditional sports, E-Sports has become a major industry, attracting millions of dollars in prize pools, sponsorship deals and large audiences.

The e-sports industry is based on computer technologies and the digital gaming industry. This ecosystem includes elements such as software, hardware, publishing platforms, game developers, publishers, interactive media tools and communication technologies (Burk, 2013). From a different perspective, the e-sports ecosystem consists of 5 main components and 2 ancillary components. The main components are game companies, organizations, broadcast platforms, teams and players. The ancillary components are brands and fans (Catalyst, 2017). This ecosystem of various components allows E-Sports to grow more and more and become an important industry. Each component plays its own important role in

this dynamic world and this will enable E-Sports to grow and develop further in the future.

The most popular games of e-sports worldwide include Dota 2, Counter-Strike: Global Offensive (CS:GO), League of Legends and Hearthstone. E-sports require a player's ability to react quickly, such as a goalkeeper in soccer, the ability to strategize in chess, and accurate timing in ice hockey. In short, it involves a variety of mental and physical efforts required in other sports. For example, Toby Dawson, a Dota 2 host, has described Dota as a combination of chess and soccer. E-sports can be considered as a sport branch where individuals can develop both their mental and physical abilities while using information and communication technologies (Kocadağ, 2017).

The E-Sports market is a relatively new phenomenon, but it is growing rapidly. In 2019, worldwide revenues from the E-Sports market amounted to \$957.5 million and are expected to reach over \$1.6 billion by 2024. The majority of these revenues come from sponsorship and advertising, with betting, prize pools and tournaments also playing an important role. China is the leader of the E-Sports market, while the US is the second largest regional market (Gedik, 2023). The rapid growth of the E-Sports market shows how dynamic and interesting this field is. The fact that revenues of \$957.5 million were generated in 2019 and this figure is expected to exceed \$1.6 billion by 2024 shows the economic potential of E-Sports. This growth can rely heavily on revenue sources such as sponsorships and advertising. In addition, betting, prize pools and tournaments can also contribute to the growth of the E-Sports industry. The fact that E-Sports has such a variety of revenue sources shows that the industry is on a sustainable growth trend.

When the researches with psychosocial dimensions are examined in the relevant literature, various studies have been conducted by sports psychologists examining the physical and mental development of game players. These researchers found that male and female students who play interactive video games have improved spatial and orientation skills, increased ability to mentally rotate objects, players' attention is successful in following multiple events, improved performance in tasks requiring dual attention, and improved motor skills (Murphy, 2009). In addition, it was observed that doctors who played games for at least 3 hours a week made 37% fewer mistakes, 27% faster decisions and 42% more accurate decisions (Rosser et al., 2007). This kind of research shows that games are not only a means of entertainment, but also have the potential to improve mental and cognitive abilities. This emphasizes that games are not only fun but can also be a valuable resource for learning and development.

Oblinger (2004) argues that games are powerful learning tools. Games encourage active participation and provide multifaceted sensory inputs, experiences and problem-solving opportunities.

Moreover, E-Sports tournaments can extend the length of stay of athletes in the destination, sometimes up to 10 days. From a touristic point of view, athletes participating in these major tournaments can be considered as tourists in the destination. In addition, the spectators who come to watch the tournament take part in a certain touristic experience as part of the organization. Therefore, both athletes and spectators can be seen as tourist resources for destinations (Bulut et al., 2021).

As stated by Keçeci and Çelik (2021), E-Sports has emerged as a new type of sport and has become an important sport branch with its rapidly increasing popularity in recent years. Bayram (2018) states that E-Sports makes significant contributions to the tourism of the country and the region. E-Sports makes great economic contributions to the economies of developed countries in terms of tourism, strengthens the image of countries and is recognized as an effective promotional tool. The view that E-Sports can offer economic contributions, image enhancement and promotional opportunities for countries in terms of tourism emphasizes the potential and importance of E-Sports. This reflects an approach towards recognizing E-Sports not only as a game, but also as an industry and a national asset.

## **CONCLUSION**

Technological advances have changed and transformed not only technology, but also many habits, professions, lifestyles and more. These rapid and innovative developments have radically changed long-standing habits, professions, lifestyles and much more. In particular, the widespread use of the internet has brought many needs such as entertainment, work, health and education to online platforms. In this period, new professions were born and existing professions started to adapt to the internet environment. Sports has undergone a similar transformation and moved to a new context where time and space have become independent from each other under the name of e-sports (Sine Nazlı & Yağmur, 2021).

The view that E-Sports can offer economic contributions, image enhancement and promotional opportunities for touristic developed countries highlights the potential and importance of E-Sports. This reflects an approach towards recognizing E-Sports not only as a game, but also as an industry and a national asset. As a result, the economic and social importance of E-Sports is growing. The existence of growth and investment opportunities in this area will support the further growth of E-Sports in the future. Moreover, the usability of games as a



tool for learning and development reveals the importance of research and practice in this field. E-Sports is not only a game, but also an industry, a national asset and a tourist attraction. The economic and social importance of this field is growing, both in terms of contributing to the development of young talents and helping countries to establish their presence on the global stage. Therefore, the growth of E-Sports and increased investment opportunities will support its further growth in the future.

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## Chapter 6

# The Role of Personality Traits in Predicting Mindfulness and Mental Toughness in Athletes

**Esin KAPLAN<sup>1</sup>**

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## **ABSTRACT**

This study aims to examine the role of personality traits in the prediction of mindfulness and mental toughness in athletes. The study group consists of 307 participants, 101 females and 206 males, aged  $21.44 \pm 4.97$ , who were determined by convenience sampling method among licensed athletes. The Personal Information form, the short form of the Eysenck Personality Questionnaire (EPQ-S), the Mindfulness Inventory for Sport (MIS), and the Sport Mental Toughness Questionnaire (SMTQ) were used as data collection tools in the study. The data were analyzed by applying path analysis, one of the tests of structural equation modeling, to determine the effect of different scales on each other. While Neuroticism, Extraversion, and Psychoticism parameters have a significant effect on confidence, which is the sub-dimension of mental toughness ( $p < 0.01^*$ ), the Lie parameter has no significant effect ( $p > 0.01$ ). The Extraversion, Neuroticism, and Lie parameters had a significant effect on the Constancy sub-dimension ( $p < 0.01^*$ ), while the Psychoticism dimension did not ( $p > 0.01$ ). Additionally, regarding the Control sub-dimension, the Neuroticism and Psychoticism parameters had a significant effect ( $p < 0.01^*$ ), while Lie and Extraversion parameters did not create significant differences ( $p > 0.01$ ). The Lie parameter has a significant effect on the Awareness sub-dimension. Regarding the Refocusing sub-dimension, the Lie parameter was found to have a significant positive effect ( $p < 0.01^*$ ). While the Neuroticism, Extraversion, and Psychoticism parameters did not have a significant effect on Mindfulness ( $p > 0.01$ ), the Lie parameter had a positive significant effect ( $p < 0,01$ ). In conclusion, an interpretation can be made by mentioning personality traits play a role in mindfulness and mental toughness.

**Keywords:** Athlete, Personality, Mental Toughness, Mindfulness

## **INTRODUCTION**

The human being is a bio-psycho-psycho-social being and is a whole with cognitive, emotional, physical, and social aspects (Erdoğan and Kocaekşi, 2015). When we consider this holistic structure of human beings with different characteristics regarding sportive performance, examining psychological parameters jointly can contribute to the ability of athletes to perform at an optimal level.

Personality is a concept that is frequently used in daily life and has many different definitions. Although there are various definitions, they are not opposed to one another or vary from each other (Doğan, 2005). Personality can be defined as a set of organized mental, physical, and functional characteristics that distinguish a person from others (Yıldız et al. 2009). Since personality is a multidimensional concept, the number of personality traits is very high. In addition, factors such as hereditary, structural, spiritual, environmental, and cultural affect the development of personality traits. Considering that many different factors play a role in the development of personality and that each person's interaction with these factors is incompatible, it is a inevitable that there are many personality traits (Doğan, 2005).

Inventories frequently used in personality research in sports are developed within the scope of the trait theory. Based on the trait theory, personality consists of some traits. Of course, a trait found in one person can also be observed in other people. What matters here is the continuity of the trait in that person (Tiryaki, 2000). The trait approach is based on the premise that the basic units of personality, namely traits, are relatively stable. These traits are constant and consistent across a wide range of circumstances. Psychologists who adopt this approach accept that the causes of behavior are usually individual-related, with situational or environmental factors playing a minor role (Weinberg and Goul, 2019). The Eysenck Personality Questionnaire is an inventory developed according to this theory (Tiryaki, 2000). The Eysenck Personality Questionnaire consists of four sub-dimensions: psychoticism (disturbing types who cause trouble for others), extraversion (sociable and cheerful types), neuroticism (anxious, moody, and resentful types), and lying (types who try to give a false appearance) (Yıldız et al., 2009).

Mindfulness is a form of attention and awareness focused on the present (Baer et al. 2020). Nyanaponika Thera expressed that mindfulness is "the master key to knowing the mind, the perfect tool for shaping the mind, and therefore the starting point (Kabat-Zinn, 2015). From a Western-oriented psychological perspective, mindfulness is generally defined as the intentional focusing of one's attention in a non-judgmental or accepting way on experiences that are

occurring in the present (Baer et al. 2020). From this point of view, we can accept attention, intention, and attitude features as the basic features of mindfulness. In addition, focusing on these three features can help individuals to reveal conscious awareness. However, individuals need to go through a certain process and practice to reach the level of mindfulness (Aktepe and Tolan, 2020).

In the literature, studies on mindfulness and personality are mostly associated with personality disorders (Seraj Khorrami et al. 2021, Schmidt Gómez et al. 2021, Salgo et al. 2021, Caletti et al. 2020, Elices et al. 2016, Ottavi et al. 2016, Fossati et al. 2012, Wupperman et al. 2009). Mindfulness practices are a promising clinical tool for the treatment of personality disorders and can be adapted to the unique characteristics of different personality disorders (Sng and Janca, 2016).

Considering the sports environment, mindfulness and acceptance may offer different advantages for different sports depending on the main sub-components of performance. When considering different sports branches, it is important to examine how mindfulness and acceptance can contribute to achieving optimal performance states in various sports contexts, as optimal performance shows certain characteristics (Bernier et al., 2009).

Mental toughness is the possession of a natural or developed psychological advantage that enables athletes to cope better than their competitors with the many demands that sport places on an athlete (competition, training, lifestyle) and to be more consistent and better than their competitors at remaining determined, focused, confident and in control under pressure (Jones et al., 2002). Mental toughness (MT) is recognized as a necessary component for high-level performance (Anthony et al. 2016). It is also noted that mental toughness generally corresponds to higher standards of competitiveness, levels of achievement and performance outcomes (Cowden, 2017). Applied sport psychologists, athletes and coaches mention mental toughness as one of the most important psychological traits related to success in sport (Crust, 2007).

As a result of the increase in competition in the sports environment, athletes who have a desire to win should make enough effort to ensure their psychological and physical development both in their personalities and in the competitive environment (Çimen, 2022). It would be appropriate to examine the effect of personality on mental toughness by considering personality traits together with mental toughness in the ever-evolving sport. In the literature, there are studies in which mental toughness and personality traits of athletes are examined together (Zamanisani et al. 2022, McAuley et al. 2022, Miller and Dolendo, 2022, Çimen, 2022, Arisoy and Özkan, 2021, Bagheri



Sheykhangafshe et al. 2021, Topçu, 2017).

Although there are some studies in the literature observing mindfulness, mental toughness, and personality traits in athletes, no study has been found that considers these three parameters together. The hypothesis formed in the current study is that personality traits will positively and significantly affect mindfulness and mental toughness ( $p < 0,01$ ). In addition, suggestions were made regarding the fact that mental toughness has a direct impact on mindfulness.

## **METHOD**

### ***Research Model***

In this study in which the role of personality traits in the prediction of mindfulness and mental toughness in athletes was examined, the correlational research design was used. Correlational research can be conducted in different ways according to the research problem of the researcher. Researchers may be satisfied with correlation analysis to reveal whether there is a relationship between variables, whereas some researchers may turn to regression equations to better interpret the relationship (Oral and Çoban, 2020).

### ***Study Group***

The study group consists of 307 participants, 101 women and 206 men, aged  $21.44 \pm 4.97$ , who were determined by the convenience sampling method among licensed athletes. Of the athletes participating in the study, 137 (46%) were practicing individual sports, and 170 (55.4%) were practicing team sports.

### ***Data Collection Tools***

#### ***Personal Information Form***

The personal information form, which is one of the data collection tools used in the study, was created by the researchers to determine the age, gender and sports branches of the athletes.

#### ***Eysenck Personality Questionnaire (Short Form) (EPQ-S)***

Eysenck Personality Questionnaire-Shortened Form (EPQ-S) was developed by Francis et al. (1992) and adapted into Turkish by Karancı et al. (2007). The questionnaire consists of 24 items evaluating personality in three dimensions (extraversion, neuroticism, psychoticism). In addition, the lying subscale aims to prevent bias during the administration of the questionnaire and to control its validity. In the questionnaire, the respondent is asked to answer 24 questions in the form of Yes (1)-No (0). The score for each personality trait varies between 0 and 6. The internal consistency coefficients of the questionnaire were ( $\alpha = .65$ ) for neuroticism, ( $\alpha = .78$ ) for extraversion, ( $\alpha = .64$ ) for lying, and ( $\alpha = .42$ ) for

psychoticism. Regarding the current study, the internal consistency coefficients were found to be ( $\alpha=.66$ ) for neuroticism, ( $\alpha=.69$ ) for extraversion, ( $\alpha=.61$ ) for lying, and ( $\alpha=.25$ ) for psychoticism.

#### *Mindfulness Inventory for Sport (MIS)*

The Mindfulness Inventory for Sport was developed by Thienot et al. (2014) and adapted into Turkish by Tingaz (2020). The scale consists of 15 questions that determine the mindfulness levels of athletes. The scale has three sub-dimensions: awareness, nonjudgmental, and refocusing. The Cronbach's alpha internal consistency coefficient of the scale was found to be ( $\alpha=.82$ ), and the Cronbach's alpha values of the sub-dimensions were found to be ( $\alpha=.81$ ) for the awareness dimension, ( $\alpha=.70$ ) for the nonjudgmental dimension, and ( $\alpha=.77$ ) for the refocusing dimension. Regarding the current study, Cronbach's alpha internal consistency coefficient was found to be ( $\alpha=.72$ ), and Cronbach's alpha values of the sub-dimensions were found as ( $\alpha=.80$ ) for the awareness dimension, ( $\alpha=.69$ ) for the nonjudgmental dimension, and ( $\alpha=.81$ ) for the refocusing dimension.

#### *Sport Mental Toughness Questionnaire (SMTQ)*

The Sports Mental Toughness Questionnaire was developed by Sheard et al. (2009), and its Turkish adaptation study was carried out by Altıntaş and Koruç (2016). The Questionnaire was developed to determine the level of mental toughness in the sports environment. The scale consists of 14 questions and has three sub-dimensions: confidence, control, and constancy. The Cronbach's Alpha values of the questionnaire were found to be ( $\alpha=.84$ ) for the confidence dimension, ( $\alpha=.51$ ) for the constancy dimension, and ( $\alpha=.79$ ) for the control dimension. Regarding the current study, Cronbach's Alpha values of the sub-dimensions were found as ( $\alpha=.77$ ) for the confidence dimension, ( $\alpha=.55$ ) for the control dimension, and ( $\alpha=.72$ ) for the constancy dimension.

### ***Research Publishing Ethics***

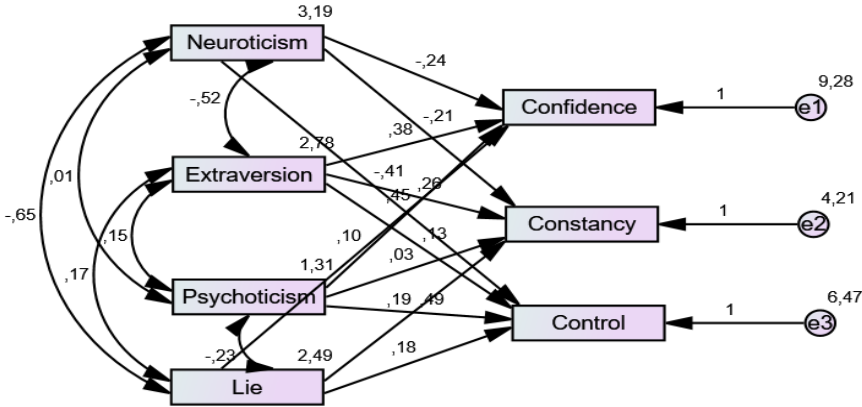
Ethics Committee Approval of the study was taken from the Ethics Committee of Burdur Mehmet Akif Ersoy University before starting the research (Decision No: GO 2022/921).

### ***Statistical Analysis***

Preliminary to the data analysis, a normality analysis was applied to the data. The normal distribution of the data was based on the skewness and kurtosis values ranging between -2 and +2 (George and Mallery, 2010). After the normal distribution of the data, path analysis, one of the structural equation modeling tests, was applied to determine the effect of different scales on each other. The

significance values of the data were evaluated at  $p < 0.05$  and  $p < 0.01$  significance levels.

**RESULTS**



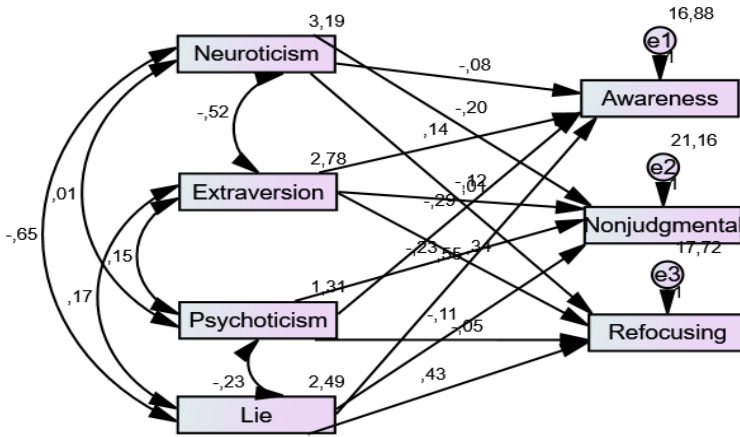
**Figure 1.** The effect of personality types on mental toughness parameters

**Table 1.** Results of the analysis of measurement model 1

Measurement Model 1	$\beta 1$	$\beta 2$	S.E	CR	P
Confidence <--- Neuroticism	-.239	-.133	.102	-2.357	<b>.018*</b>
Confidence <--- Extraversion	.383	.199	.106	3.598	<b>0.00*</b>
Confidence <--- Psychoticism	.448	.160	.154	2.912	<b>.004*</b>
Confidence <--- Lie	.098	.048	.114	.856	.392
Constancy <--- Neuroticism	-.213	-.175	.068	-3.114	<b>.002*</b>
Constancy <--- Extraversion	.258	.198	.072	3.605	<b>0.00*</b>
Constancy <--- Psychoticism	.028	.015	.104	.269	.788
Constancy <--- Lie	.187	.135	.077	2.422	<b>.015*</b>
Control <--- Neuroticism	-.408	-.265	.085	-4.815	<b>0.00*</b>
Control <--- Extraversion	.129	.078	.089	1.451	.147
Control <--- Psychoticism	.488	.203	.128	3.801	<b>0.00*</b>
Control <--- Lie	.182	.104	.096	1.907	.057

According to Table 1, as a result of the evaluation of the effect of personality traits on mental toughness parameters, Neuroticism, Extraversion, and Psychoticism dimensions have a significant effect on confidence, which is the sub-dimension of mental toughness, while the Lie dimension has no significant effect ( $p < 0.01$ \*). ( $p > 0.01$ ) While Extraversion, Neuroticism, and Lie dimensions had a substantial impact on the Constancy sub-dimension ( $p < 0.01$ \*), the Psychoticism dimension did not have a significant effect

( $p > 0.01$ ). While Neuroticism and Psychoticism dimensions had a significant effect on the Control sub-dimension ( $p < 0.01^*$ ), Lie and Extraversion dimensions did not create significant differences ( $p > 0.01$ ).



**Figure 2.** The effect of personality types on the sub-dimensions of mindfulness

**Table 2.** Results of the analysis of measurement model 2

Measurement Model 2	$\beta 1$	$\beta 2$	S.E	CR	P
Awareness <--- Neuroticism	-0.080	-0.034	.137	-0.587	.557
Awareness <--- Extraversion	.145	.057	.144	1.008	.313
Awareness <--- Psychoticism	-0.290	-0.078	.207	-1.398	.162
Awareness <--- Lie	.554	.206	.154	3.588	<b>0.00*</b>
Nonjudgmental <--- Neuroticism	.014	.005	.161	.087	.931
Nonjudgmental <--- Extraversion	-0.200	-0.077	.153	-1.306	.192
Nonjudgmental <--- Psychoticism	-0.233	-0.058	.232	-1.004	.315
Nonjudgmental <--- Lie	-0.107	-0.037	.173	-0.619	.536
Refocusing <--- Neuroticism	-0.116	-0.048	.140	-0.830	.407
Refocusing <--- Extraversion	.340	.131	.147	2.314	<b>.021*</b>
Refocusing <--- Psychoticism	-0.054	-0.014	.213	-0.254	.799
Refocusing <--- Lie	.429	.156	.158	2.710	<b>.007*</b>

According to Table 2, the Lie dimension has a significant effect on the Awareness sub-dimension. Regarding the Refocusing sub-dimension, the lie dimension has a significant positive effect ( $p < 0.01^*$ ).

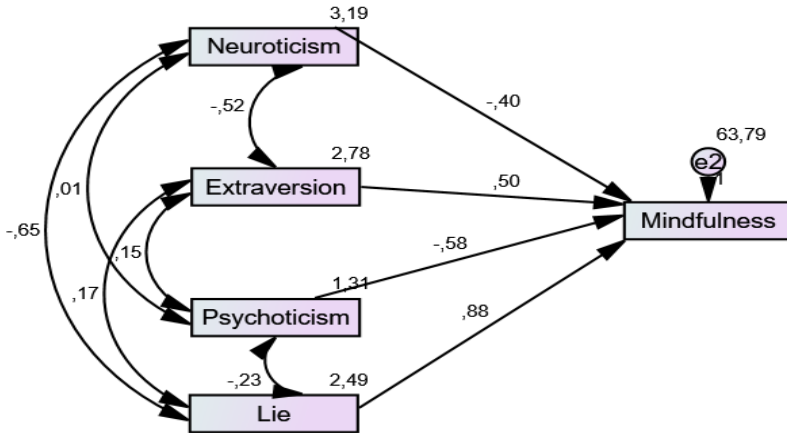


Figure 3. The effect of personality types on the total score of mindfulness

Table 3. Results of the analysis of measurement model 3

Measurement Model 3	$\beta 1$	$\beta 2$	S.E	CR	P
Mindfulness <--- Neuroticism	.499	.101	.279	1.788	.074
Mindfulness <--- Extraversion	-.397	-.086	.266	-1.491	.136
Mindfulness <--- Psychoticism	-.577	-.080	.403	-1.431	.152
Mindfulness <--- Lie	.875	.167	.300	2.918	.004*

Based on the results of Table 3, the Neuroticism, Extraversion, and Psychoticism dimensions did not have a significant effect on Mindfulness ( $p > 0.01$ ); however the Lie dimension had a positive significant effect ( $p < 0.01$ ).

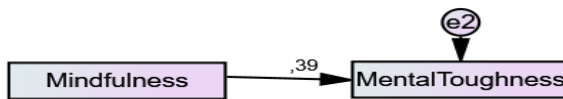


Figure 4. The effect of mental toughness on mindfulness

Table 4. Results of the analysis of measurement model 4

Measurement Model 3	$\beta 1$	$\beta 2$	S.E	CR	P
Mindfulness <--- MentalToughness	.539	.385	.074	7.306	0.00*

According to Table 4, Mental Toughness had a positive and significant effect on Mindfulness based on model 3 ( $p < 0.01^*$ ).

## **DISCUSSION AND CONCLUSION**

Mental toughness (MT) is an important psychological trait that supports athletes' success (Cowden, 2017). Again, individuals who score high on mental toughness are confident in successfully completing tasks and assertive in social situations (Lin et al. 2017). In the current study, based on the evaluation of the effect of personality traits on mental toughness parameters, Neuroticism, Extraversion, and Psychoticism dimensions affect confidence significantly, which is the sub-dimension of mental toughness. In addition, the Extraversion, Neuroticism, and Lie dimensions have a significant effect on the Constancy sub-dimension, while Neuroticism and Psychoticism dimensions have a significant effect on the Control sub-dimension (See Table 1). When the literature is examined, it is possible to come across studies that have concluded that personality traits and mental toughness are related. For instance, the study results of Arısoy and Özkan (2021) show that mental toughness and personality traits overlap significantly. The study results of Delaney et al. (2015) show that mental toughness is associated with many other personality traits. Some studies have explained the relationship between personality and mental toughness by focusing on genetic and/or environmental characteristics. Horsburg et al. (2009) used the twin study methodology to determine the genetic and/or environmental basis of any relationship between mental toughness and personality. As per the study results, univariate behavioral genetic analyses showed that individual differences in mental toughness (and personality) are largely attributable to genetic and non-shared environmental factors. The bivariate behavioral genetic analyses, on the other hand, revealed that phenotypic correlations between mental toughness and personality are largely attributable to shared genetic and non-shared environmental factors. However, traits are known to be constant and consistent across a wide range of circumstances. Psychologists who adopt this approach accept that the causes of behavior are usually related to the individual, with situational or environmental factors playing a minor role (Weinberg and Goul, 2019). The Eysenck Personality Questionnaire was developed according to this theory (Tiryaki, 2000). When the studies on personality in the literature are examined, it is seen that the effects of genetic factors and environment explain personality. However, the absence of genetic controls, the effect of environmental factors will be insufficient to explain individual differences in personality. (Bouchard, 1993). In addition, according to Matthews and Gilliland (1999), only a biological approach may not be sufficient to explain the behavioral correlates of traits.

In the literature, there are studies that use personality theories in the development of the concept of mental toughness (Jones et al., 2002) and studies that consider the MT construct as a construct within personality traits (Cattell 1957)

(Altıntaş and Koruç 2006). Therefore, personality traits and MT are generally in a relationship. The use of the Eysenck Personality Questionnaire in the current study shows that different personality traits are also related to MT and thus contribute to the literature.

The concept of mindfulness, as defined by Kabat-Zinn, refers to a mechanism in which experiences occur moment by moment within the focus of attention (Aktepe and Tolan, 2020). Individuals with high levels of mindfulness lead a life focused on the place and moment and accept life as it is (Nam and Akbay, 2020). Considering the sports environment, it is known that mindfulness is an important variable affecting the performance of athletes. Based on the current study, a significant effect regarding the lie dimension on the mindfulness, refocusing sub-dimensions and mindfulness overall score was found (see Tables 2 and 3). Based on the examination of the literature, different instruments measuring personality traits are also used and the studies revealing their relationship with mindfulness are limited. According to the results of Giluk's (2009) meta-analysis, although all personality traits show significant relationships with mindfulness, the foremost relationships are found in neuroticism, negative affect, and conscientiousness. The research results of Gül and Gül (2022) show that there is a strong relationship between personality traits and mindfulness of tourism students. According to Aumeboonsuke and Caplanova (2021), mindfulness has an important mediating role in the relationship between personality traits and risk aversion.

Mental toughness is the ability to deal with pressure and distress. It is also the state of the ability to continue without refusing to quit (Pandian et al., 2022). According to Lin et al. (2017), mental toughness is connected with various psychological traits, more effective coping strategies, and positive outcomes in mental health, and also approximately 50% of the variation in mental toughness may be due to genetic factors. Also, the associations between IQ and psychological traits can be mainly explained by either genetic or environmental factors.

Based on model 3 created in the current study, the concepts of Mental Toughness and Mindfulness positively and significantly affect each other (see Table 4). Studies in the literature show that mindfulness and mental toughness are positively related. According to Walker (2017), mindfulness is positively correlated with all aspects of mental toughness and individuals with higher levels of mindfulness show higher control, constancy, and general mental toughness than those with lower levels of mindfulness. Jones and Parker's (2018) study results show that mental toughness is positively correlated with mindfulness. According to Abdul Rafeeqe and Sultana (2016), mindfulness has an important role in the relationship between mental toughness and athletic performance in athletes.

It has been suggested that mindfulness can contribute to the treatment of psychopathologies resulting in the development of various intervention methods (Aktepe and Tolan, 2020). Therefore, these methods have been adapted to the field of sports psychology and started to be used as supportive practices in the regulation of different cognitive processes. In the literature review conducted in light of this information, studies examining the effect of mindfulness practices on increasing the mental endurance of athletes were also found. The findings of Ajilcihi et al. (2019) and Ajilcihi et al. (2022) show that mindfulness training can be effective in increasing the mental toughness of athletes. Wang et al. (2021) concluded in their study that mindfulness training improved the level of mindfulness and mental endurance of female university students in endurance sports while reducing the feeling of fatigue. Mir et al. (2022) state that the effect of a mindfulness-based yoga intervention on athletes' mental toughness is positive. They also suggest that given the importance of mental toughness in achieving a high level of competition, coaches should use a mindfulness-based yoga intervention with athletes of different skill levels to promote this psychological factor. Airapooran and Godarzi (2021) suggest using Mindfulness-Based Stress Reduction (MBSR) to increase mental toughness. The study results of Pandian et al. (2020) show the importance of mental toughness on sports performance and the role of various interventional strategies focusing on mindfulness and psychological interventions in improving mental toughness. According to Tsebe and Van Niekerk (2021), the Mindfulness-Acceptance-Commitment (MAC) program seems to be a valuable intervention to secure mental toughness in volleyball players.

Mindfulness is an excellent tool for shaping the mind. Therefore, when we think about the characteristics of mindfulness, developing a non-judgmental and in-the-moment acceptance regulates the mental toughness traits (confidence, control and, constancy), which are among the psychological traits.

As a result, athletes with neurotic personality traits do not trust their abilities to reach their goals in difficult situations that require struggle, cannot be controlled under pressure, and do not struggle as per their goals by concentrating. In addition to this, athletes with extraverted and psychotic traits have the characteristics of being able to control under pressure, take responsibility, and struggle in line with determined goals. To conclude, athletes with lying personality traits show awareness, refocusing, and mindfulness. Concurrently, showing an extrovert personality trait positively affects refocusing. In addition to that, mindfulness affects mental toughness. Therefore, personality traits play a role in mindfulness and mental toughness.



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**Chapter 7**

**The Relationship Between  
Score Components and Apparatuses in  
Rhythmic Gymnastics: Analysis of the  
39<sup>th</sup> Rhythmic Gymnastics World  
Championship**

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## **Abstract**

The aim of the study is to investigate the difference between score components in all apparatuses according to the new CoP rules at the 39<sup>th</sup> Rhythmic Gymnastics World Championship (RG-WCh) held in Sofia, Bulgaria in 2022. Eighty gymnasts in hoop routines (age  $18.863 \pm 2.604$  years), 80 gymnasts in ball routines (age  $18.850 \pm 2.591$  years), 79 gymnasts in clubs routines (age  $18.911 \pm 2.578$  years) and 79 gymnasts in ribbon routines (age  $18.936 \pm 2.569$  years) was competed 39<sup>th</sup> RG- WCh, 2022, Sofia, Bulgaria. Differences between score components in all routines (hoop, ball, clubs, ribbon) were analyzed. Difficulty Body Score (DBS), Difficulty Apparatus Score (DAS), Diffuculty Total Score (DTS), Artistic Score (AS), Execution Score (ES), Penalty Score (PS), and Total Score (TS) of the individual routines competed were evaluated. In this context, 2226 score were analyzed. SPSS 24.0 (SPSS Inc., Chicago, IL) program was used for statistical analysis of the study. Mean  $\pm$  Standard Deviation values were given as descriptive statistics of score components. The differences between the apparatus and their score components was determined by One-Way Anova analysis. The difference between which apparatus and which score components were determined by Post Hoc analysis. Significance level was determined as  $p < 0.05$ . Based on these analysis, it was determined that the gymnasts achieved the highest TS and components in their ball routines, except for ES, PS and DBS. In addition, ball routines had the highest score means from the artistic panel, which was revised for the 2022-2024 period and took its place as a separate evaluation panel in the CoP. Significant differences were found between DAS and DTS among all routine score components. These differences are for DAS; hoop routines were lower than ball routines, ribbon routines were higher. Ball routines were high on all routines. Clubs routines were lower than ball routines and higher than ribbon routines. Ribbon routines were lower than all routines. For DTS; Hoop, ball and clubs routines were statistically significantly higher in ribbon routines, while ribbon routines were significantly lower than all routines.

**Key words:** Rhythmic gymnastics, routines analysis, score components.

## **Özet**

Çalışmanın amacı, 2022 yılında Bulgaristan'ın Sofya kentinde düzenlenen 39. Ritmik Cimnastik Dünya Şampiyonası'nda (RG-WCh) yeni CoP kurallarına göre tüm aletlerdeki skor bileşenleri arasındaki farkı araştırmaktır. Çember aletinde 80 cimnastikçi (yaş  $18.863 \pm 2.604$  yıl), top aletinde 80 cimnastikçi ( $18.850 \pm 2.591$  yıl), labut aletinde 79 cimnastikçi ( $18.911 \pm 2.578$  yıl) ve kurdele aletinde 79 cimnastikçi ( $18.936 \pm 2.569$  yıl) yarıştı. Tüm aletlerdeki (çember, top, labut, kurdele) skor bileşenleri arasındaki farklar analiz edildi. Yarışılan bireysel

aletlerin Zorluk Vücut Puanı (DBS), Zorluk Alet Puanı (DAS), Zorluk Toplam Puanı (DTS), Artistik Puanı (AS), Uygulama Puanı (ES), Ceza Puanı (PS) ve Toplam Puanı (TS) değerlendirildi. Bu kapsamda 2226 puan analiz edilmiştir. Araştırmanın istatistiksel analizinde SPSS 24.0 (SPSS Inc., Chicago, IL) programı kullanıldı. Puan bileşenlerinin tanımlayıcı istatistikleri olarak ortalama  $\pm$  standart sapma değerleri hesaplandı. Alet ve skor bileşenleri arasındaki farklar One-Way Anova analizi ile belirlendi. Hangi alet ve hangi skor bileşeni arasındaki fark Post Hoc analizi ile tespit edildi. Anlamlılık düzeyi  $p < 0.05$  olarak belirlendi. Bu analizlere göre cimnastikçilerin top aletinde (ES, PS ve DBS dışında) en yüksek TS ve bileşenleri elde ettikleri saptandı. Ayrıca 2022-2024 dönemi için revize edilen ve kural kitapçığında (CoP) ayrı bir değerlendirme paneli olarak yerini alan artistik panelde en yüksek puan ortalaması top aletinde bulundu. Tüm alet skor bileşenleri arasında DAS ve DTS arasında anlamlı farklılıklar bulundu. Bu farklılıklar DAS için; çember aleti skorları top aleti skorlarından daha düşük, kurdele aleti skorları ise daha yüksek idi. Top aleti skorları tüm alet skorlarından yüksekti. Labut aleti skorları top aleti skorlarından daha düşük ve kurdele aleti skorlarından ise daha yüksekti. Kurdele aleti skorları tüm alet skorlarından daha düşük bulundu. DTS'ye yönelik olarak; Çember, top ve labut aletleri skorları kurdele aletleri skorlarından istatistiksel olarak anlamlı derecede yüksek bulunurken kurdele aleti skorları ise tüm alet skorlarına göre anlamlı derecede düşüktü.

**Anahtar kelimeler:** Ritmik cimnastik, puan analizi, skor bileşenleri.

## INTRODUCTION

The sport of gymnastics, which has been included in all Olympic Games since the Modern Olympic Games, which started to be organized for the first time in 1896, continues to development. Currently, the International Gymnastics Federation (FIG) has eight gymnastics disciplines named according to the way gymnastics is practiced (artistic women, artistic men, rhythmic, trampoline, acrobatic, aerobics, gymnastics for all and parkour). Among these, artistic, rhythmic and trampoline are Olympic gymnastics disciplines (FIG, 2023a). Rhythmic gymnastics (RG), which is an Olympic discipline after artistic gymnastics, is applied in a choreographic way with the use of various apparatuses (rope, hoop, ball, club and ribbon) of body movements. RG is a branch that combines art and sports, with a performance measurement system [The Code of Point (CoP)] determined by FIG (Flessas, K., et al. 2015). CoP, which is the booklet containing the competition rules, is determined by the FIG RG Technical Committee. It is updated with necessary changes in each Olympic cycle.

According to current rules an RG routine must be judged by a group of 3 judges. These groups of judges are D - Panel (Difficulty), A - Panel (Artistic) and E - Panel (Execution). There are 4 judges in the D panel divided into 2 subgroups, 2 judges in each group [Difficulty Body 1 (DB<sub>1</sub>), Difficulty Body 2 (DB<sub>2</sub>), Difficulty Apparatus 1 (DA<sub>1</sub>) and Difficulty Apparatus 2 (DA<sub>2</sub>)]. There are 4 judges in both the A panel (A<sub>1</sub>, A<sub>2</sub>, A<sub>3</sub>, A<sub>4</sub>) and the E panel (E<sub>1</sub>, E<sub>2</sub>, E<sub>3</sub>, E<sub>4</sub>). Each panel makes calculations according to specific criteria. The gymnast's total score is obtained by adding the D, A and E scores, taking into account the scores of the line and time. (FIG, 2022a).

In the 2017-2020 CoP, panel D as today included two subgroups (D<sub>1-2</sub> / D<sub>3-4</sub>) However, unlike today, panel E had two subgroups (E<sub>1-2</sub> / E<sub>3-4-5-6</sub>). E<sub>1-2</sub> judges evaluated artistic mistakes, E<sub>3-4-5-6</sub> judges evaluated technical mistakes. In other words, panel A, where artistic components are evaluated today, was a part of panel E (E<sub>1-2</sub>). In addition, while the D score, which consists of body and apparatus difficulties, was 10.00 points at the most in 2017, this upper score limit was removed with the updates made in the CoP on February 1, 2018 (FIG, 2017). The removal of the 10.00 point limit encouraged coaches to score higher in the D components. This update has caused gymnasts to increase the body and apparatus difficulty movement groups in the routines. Based on the view that this orientation negatively affects the artistic part of the rhythmic gymnastics routines, in the CoP, which was revised for the 2022-2024 cycle, Artistic Panel (A) took its place in the panel as a separate evaluation panel in order to increase the artistic emphasis. Undoubtedly, artisticity, in rhythmic gymnastics is one of the most important components that increase the viewing pleasure and emphasize the characteristic feature of the discipline. In line with these changes made in Cop, it is thought that it will be important to determine the differences between the apparatuses of the all panel score in the new scoring system.

Therefore, the aim of the study is to investigate the difference between score components in all apparatuses according to the new CoP rules at the 39<sup>th</sup> Rhythmic Gymnastics World Championship (RG-WCh) held in Sofia, Bulgaria in 2022.

## **METHODS**

### ***Participants***

Eighty gymnasts in hoop routines (age  $18.863 \pm 2.604$  years), 80 gymnasts in ball routines (age  $18.850 \pm 2.591$  years), 79 gymnasts in clubs routines (age  $18.911 \pm 2.578$  years) and 79 gymnasts in ribbon routines (age  $18.936 \pm 2.569$  years) was competed 39<sup>th</sup> RG- WCh, 2022, Sofia, Bulgaria.

**Procedure**

Individual Qualifications competition scores and ages of rhythmic gymnasts participating in the 39<sup>th</sup> RG-WCh, 2022, Sofia, Bulgaria were obtained from the result book published on the FIG official website (FIG, 2023b). Differences between score components in all routines (hoop, ball, clubs, ribbon) were analyzed. Difficulty Body Score (DBS), Difficulty Apparatus Score (DAS), Diffuculty Total Score (DTS), Artistic Score (AS), Execution Score (ES), Penalty Score (PS), and Total Score (TS) of the individual routines competed were evaluated. In this context, 2226 score were analyzed.

**Statistical Analysis**

SPSS 24.0 (SPSS Inc., Chicago, IL) program was used for statistical analysis of the study. Mean ± Standard Deviation values were given as descriptive statistics of score components. The differences between the apparatus and their scores was determined by One-Way Anova analysis. The difference between which apparatus was determined by Post-Hoc analysis. Significance level was determined as  $p < 0.05$ .

**RESULTS**

Descriptive statistics for all apparatuses routines are shown in Table 1.

**Table 1.** Descriptive statistics of the all apparatuses routines.

Score Components	Hoop (n=80)	Ball (n=80)	Clubs (n=79)	Ribbon (n=79)
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
DBS	7.785 ± 1.556	7.231 ± 1.386	7.754 ± 1.467	7.438 ± 1.528
DAS	3.947 ± 0.903	4.756 ± 0.928	3.905 ± 0.703	3.461 ± 0.778
DTS	11.773 ± 2.177	11.971 ± 2.113	11.661 ± 2.042	10.900 ± 2.184
AS	7.328 ± 0.648	7.434 ± 0.594	7.291 ± 0.646	7.384 ± 0.662
ES	7.426 ± 0.724	7.382 ± 0.761	7.182 ± 0.871	7.167 ± 0.792
PS	-0.043 ± 0.123	-0.036 ± 0.094	-0.027 ± 0.120	-0.049 ± 0.121
TS	26.480 ± 3.334	26.766 ± 3.241	26.105 ± 3.387	25.413 ± 3.466

*N*; Number of routines, *SD*; Standard Deviation, *DBS*; Difficulty Body Score, *DAS*; Difficulty Apparatus Score, *DTS*; Difficuluty Total Score, *AS*; Artistic Score, *ES*; Execution Score, *PS*; Penalty Score, *TS*; Total Score.

The One-Way Anova analysis results of the differences between score components for all apparatuses are given in Table 2.

**Table 2.** The One-Way Anova analysis of differences between score components for all apparatuses.

<b>Score Components</b>	<b>f</b>	<b>p</b>
<b>DBS</b>	2.542	0.056
<b>DAS</b>	<b>33.365*</b>	<b>0.000*</b>
<b>DTS</b>	<b>3.848*</b>	<b>0.010*</b>
<b>AS</b>	0.772	0.510
<b>ES</b>	2.298	0.078
<b>PS</b>	0.299	0.826
<b>TS</b>	2.410	0.067

*DBS; Difficulty Body Score, DAS; Difficulty Apparatus Score, DTS; Diffuculty Total Score, AS; Artistic Score, ES; Execution Score, PS; Penalty Score, TS; Total Score, p<0.05.*

Statistically significant differences were found between DAS and DTS of routines (Table 2). The results of the Post Hoc analysis performed to determine which apparatuses these differences are are shown in Table 3.

**Table 3.** The Post Hoc analysis of differences between DAS and DTS score components for all apparatuses.

		Mean Diff ± Std Error	P	95% Confidence Interval		
				Lower Bound	Upper Bound	
<b>DAS</b>	Hoop	Ball	-0.809 ± 0.132	0.000*	-1.069	-0.550
		Clubs	0.042 ± 0.132	0.751	-0.218	0.302
		Ribbon	0.486 ± 0.132	0.000*	0.226	0.746
	Ball	Hoop	0.809 ± 0.132	0.000*	0.550	1.069
		Clubs	0.851 ± 0.132	0.000*	0.591	1.111
		Ribbon	1.296 ± 0.132	0.000*	1.035	1.556
	Clubs	Hoop	-0.042 ± 0.132	0.751	-0.302	0.218
		Ball	-0.851 ± 0.132	0.000*	-1.111	-0.591
		Ribbon	0.444 ± 0.133	0.001*	0.183	0.705
	Ribbon	Hoop	-0.486 ± 0.132	0.000*	-0.746	-0.226
		Ball	-1.296 ± 0.132	0.000*	-1.556	-1.035
		Clubs	-0.444 ± 0.133	0.001*	-0.705	-0.183
<b>DTS</b>	Hoop	Ball	-0.199 ± 0.337	0.556	-0.861	0.464
		Clubs	0.113 ± 0.338	0.738	-0.552	0.778
		Ribbon	0.874 ± 0.338	0.010*	0.209	1.539
	Ball	Hoop	0.199 ± 0.337	0.556	-0.464	0.861
		Clubs	0.312 ± 0.338	0.357	-0.353	0.977
		Ribbon	1.073 ± 0.338	0.002*	0.408	1.737
	Clubs	Hoop	-0.113 ± 0.338	0.738	-0.778	0.552
		Ball	-0.312 ± 0.338	0.357	-0.977	0.353
		Ribbon	0.761 ± 0.339	0.025*	0.094	1.428
	Ribbon	Hoop	-0.874 ± 0.338	0.010*	-1.539	-0.209
		Ball	-1.073 ± 0.338	0.002*	-1.738	-0.408
		Clubs	-0.761 ± 0.339	0.025*	-1.428	-0.094

*DAS; Difficulty Apparatus Score, DTS; Difficulty Total Score, Mean Diff ± Std Error; Mean Difference ± Standard Error, p<0.05.*

## DISCUSSION

In the rhythmic gymnastics branch, there are 5 apparatuses for gymnasts, including rope, hoop, ball, clubs and ribbon (Klentrou., P. 1998). The program of individual exercises includes four apparatuses valid for an Olympic cycle based on rules predetermined by the FIG Rhythmic Gymnastic Technical Committee. In the 2022-2024 cycle, the individual competition program routines for the senior group were determined as hoop, ball, clubs and ribbon (FIG, 2022b).

In this study, which aims to investigate the difference between score components in all apparatuses according to the new CoP rules at the 39<sup>th</sup> RG-WCh held in Sofia, Bulgaria in 2022, the descriptive statistics of the score

components for the apparatuses are given in Table 1. The analysis results of the differences between the score components for all apparatuses are shown in Table 2. According to these results, statistically significant differences were found between DAS ( $f= 33.365$ ;  $p= 0.000$ ) and DTS ( $f= 3.848$ ;  $p= 0.010$ ). According to the Post Hoc Analysis performed to determine between which apparatus these differences were, the statistically significant differences for DAS were as follows; between hoop and ball ( $p= 0.000$ ) and ribbon ( $p= 0.000$ ); between ball and hoop ( $p= 0.000$ ) and ribbon ( $p= 0.000$ ); between clubs and ball ( $p= 0.000$ ) and ribbon ( $p= 0.001$ ); ribbon and ball ( $p= 0.000$ ), hoop ( $p= 0.000$ ) and clubs ( $p= 0.001$ ).

It is stated that the primary determinant of success in rhythmic gymnastics is good execution of both difficulty movements. For this reason, it was emphasized that the choreography should be prepared in a versatile way and that it should be perfect according to the competition rules, especially for elite gymnasts (Agopyan, A., & Örs., B. S. 2019). In addition, gymnasts must have extraordinary coordination for the implementation of apparatus difficulties (Sierra-Palmeiro, E., et al. 2015). In the results of this study, ball routines had the highest DAS and DTS means results. In addition, the highest AS and TS means scores ball routines were also found. Contrary to this, the lowest DBS means was also detected in ball routines (Table 1).

In the new CoP (2022-2024), fundamental and non-fundamental technical groups belonging to the ball apparatus have many uses (Large roll of the ball, figures eight of the ball with circle movement of the arm, catch of the ball with one hand, bounces, roll of the ball on the floor, flip-over, etc). Within the new rules; large roll of the ball over minimum 2 large body segments and catch of the ball with one hand from high throw were determined as 0.40 points for DA (FIG, 2022a). This is thought to be an advantage for ball DAS in gymnasts. In these study results, DAS was the highest score component for the ball, in line with the new rules. Ball is one of the starting apparatus in the branch of rhythmic gymnastics. From an early age, gymnasts begin to compete with the ball routines. In the following processes, they may be more experienced than other apparatus such as clubs and ribbons. Ball exercises have a more elegant and lyrical structure rather than brisk and very fast movements (FIG, 2022c). In this study, it is understood that gymnasts can reflect ball apparatus techniques fluently and in a desired way. In addition, although the new CoP is limited to a maximum difficulty of 20 for the apparatus, the results of this study show that the gymnasts received the highest DTS and TS from the ball apparatus (among all apparatus). DAS is thought to have the greatest effect on DTS scores for ball routines. Also, the lowest DBS belongs to the ball routines, while the highest DTS obtained in the ball routines again highlights the high impact of DAS.



According to Post Hoc Analysis, the significant differences for DTS were as follows; It was between hoop and ribbon ( $p= 0.010$ ), between ball and ribbon ( $p= 0.002$ ), between clubs and ribbon ( $p= 0.025$ ), between ribbon and hoop ( $p= 0.010$ ), ball ( $p= 0.002$ ), clubs ( $p= 0.025$ ). The highest DTS means data was found in ball routines, while the lowest means was found in ribbon routines. Besides the lowest DTS, again the lowest ES, TS and highest PS were in ribbon routines. The ball can be seen as a round and risky apparatus due to its structure. However, the ribbon is a soft structure and it is an apparatus that is difficult to control for gymnasts.

According to the results of this study, ball DAS, which was found to be significantly higher than all routines, shows that these competition gymnasts have a higher level of technical use in the ball apparatus than both ribbons and other routines. Hökelmann, A., et al. (2013) mentioned that showing both quantitative and qualitative characteristics with choreography is an important criterion for rhythmic gymnastics (Hökelmann, A., et al. 2013). In this study, the highest AS means and the lowest DBS means in ball routines. Although not statistically significant, in the results of the means value, higher scores were found in ball routines than in ribbon routines, except for DBS, in TS and all components. According to these results, it is thought that ball routines, which seem stronger in terms of artistic and apparatus technique, are weaker in terms of body difficulties compared to other apparatuses. In this direction, ensuring the balanced development of apparatus technique and body difficulties can be effective in bringing routines to higher performance.

## **CONCLUSION**

Based on these results, it was determined that the gymnasts achieved the highest TS and components in their ball routines, except for ES, PS and DBS. In addition, ball routines had the highest score means from the artistic panel, which was revised for the 2022-2024 period and took its place as a separate evaluation panel in the CoP. Significant differences were found between DAS and DTS among all routine score components. These differences are for DAS; hoop routines were lower than ball routines, ribbon routines were higher. Ball routines were high on all routines. Clubs routines were lower than ball routines and higher than ribbon routines. Ribbon routines were lower than all routines. For DTS; Hoop, ball and clubs routines were statistically significantly higher in ribbon routines, while ribbon routines were significantly lower than all routines.

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