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**INVESTIGATION OF THE PLAYING DIGITAL GAMES  
ON SHOULDER FLEXILITY, STABILIZATION AND  
REACTION SPEED IN VOLLEYBALL PLAYERS**

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**PHYSICAL ACTIVITY, HEALTH AND SPORT SCIENCES DEPARTMENT  
MASTERS THESIS**

**SUPERVISOR  
Prof. Dr. F. Neşe ŞAHİN**

**ANKARA  
2023**

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**ANKARA**

**2023**

## **Ethical Declaration**

To Ankara University  
Health Sciences Institute Directorate,

The thesis titled " Investigation Of The Effect Of Playing Digital Games On Shoulder Flexibility, Stabilization, Strength And, Reaction Time In Volleyball Players", which I prepared and presented as a master's thesis; Written by me in accordance with scientific ethics and values. The idea/hypothesis of my thesis is entirely my own and my thesis advisor. The experimental work/research in the thesis was made by me, and all sentences and comments are my own. I declare that the above-mentioned facts are correct.

Name Surname:

Date:

Signature:

## ACCEPTANCE AND APPROVAL

Ankara University Graduate School of Health Sciences Department of Sports Sciences  
Physical Activity, Health and Sport Programme The thesis titled " Investigation Of The Effect  
Of Playing Digital Games On Shoulder Flexibility, Stabilization, Strength And, Reaction  
Time In Volleyball Players" prepared by Şeyma GÜNEY was unanimously  
Accepted/Rejected as a MASTER THESIS by the following juries.

Thesis Defense Date: 04.07.2023  
Prof. Dr. Cengiz AKALAN  
ANKARA University  
Chairman of the Jury

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Gazi University  
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Prof. Dr. Feriye SAHİN  
Ankara University  
Jury

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

Signature  
Title /Name and Surname  
.....  
Graduate School of Health Sciences

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## **PREFACE**

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## ABBREVIATIONS AND SYMBOLS

ESPN	Entertainment and Sports Programming Network
FIFA	Fédération Internationale de Football Association
IESF	International e-Sports Federation
Kg	Kilogram
MS	Muscle Strength
N	Newton
TDK	Türk Dil Kurumu
TESFED	Türkiye E-Spor Federasyonu

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## INTRODUCTION

Volleyball is a sport that requires high and low intensity activities, technical and tactical skills, and versatile performance such as high endurance, strength, speed, flexibility and balance (Kugler et al., 1996). While the actions performed by the players may differ in terms of the technical and tactical requirements of their individual roles, common movements include acceleration and deceleration, jumping, kicking and multi-directional movement (Forthomme et al., 2005; Ozawa et al., 2019). To perform well, players must have advanced physical and physiological capacities and important motor control and cognitive functions (Borsa et al., 2008; Eckenrode et al., 2012). In volleyball, especially during the attack, coordinative abilities such as quick strength and continuity in strength are important.

Technology has affected sports and provided the emergence of new sports branches. One of these sports branches is e-sports (Xiao et al., 2017). E-sports is any activity that is participated in offline or online, as a team or individually, via electronic device (TESFED, 2022). E-sports, like volleyball, requires quick movements to control the game. One of the determinants of speed is muscle strength and muscle strength can increase in direct proportion to the performance of the video game (Bayraktar and Kurtoğlu, 2009). Playing games on the console for a long time will increase shoulder-muscle activity; It has been scientifically proven that sitting in the anterior position of the head for five minutes causes a significant reduction in shoulder external rotator muscle strength (Thigpen et al., 2010; Tiric-Campara et al., 2014). Improvements in strength in the shoulder area improve the function of the shoulder stabilizers, thereby increasing joint stability (Emara et al., 2020). Considering that the competitions last for hours, the importance of anaerobic endurance in e-sports players emerges. One of the important factors in e-sports is the ability to react quickly (Ciucurel, 2012). Neurocognitive research has shown that video game gamers display some superior cognitive characteristics (Erickson et al., 2019). Video games require speed and concentration and these skills significantly reduce correct reaction times (Emara et al., 2020). Developing cognitive abilities in this way is vital to the success

of the volleyball player; good performance is directly related to their capacity to anticipate and respond to changes in the environment (Formenti et al., 2022).

The existence of an application that affects reaction time, joint stabilization, strength and endurance performance in volleyball athletes has a great importance in the quality of sports skills (Emara et al., 2020). E-sports; It can contribute to the development of reaction time, joint stabilization, strength and endurance in volleyball athletes.

This study aims to examine the effects of digital game playing status of volleyball players on shoulder stabilization, muscle strength and endurance, and reaction time.

### **1.1. Aim of the Study**

The purpose of the study is to investigate effects of digital game playing on shoulder stabilization, muscle strength and endurance, and reaction time on volleyball players.

### **1.2. Statement of the Problem**

Does digital game playing of volleyball players make a significant difference on shoulder region stabilization, strength, flexibility and reaction time?

### **1.3. Sub Problems**

- 1- Does digital game increase shoulder flexibility in volleyball players?
- 2- Does digital game increase shoulder stability in volleyball players?
- 3- Does digital game increase shoulder muscle strength in volleyball players?
- 4- Does digital game reduce reaction time in volleyball players?

### **1.4. Hypotheses**

- 1- Digital game increases shoulder flexibility in volleyball players.
- 2- Digital game increases shoulder stability in volleyball players.
- 3- Digital game increases shoulder muscle strength in volleyball players.
- 4- Digital game reduce reaction time in volleyball players.

### **1.5. Significance of the Study**

Previous studies have mostly focused on negative effects on health-related component of physical fitness. The common sense about e-sports is, due to fact that players perform limited physical activities, it is a sedentary behaviour. These actions may cause negative changes on the physical fitness parameters of e-sports players.

This study is important in terms of investigating the effect of esports on selective performance-related component of physical fitness. On the contrary to previous studies, and limited national and international literature, present investigation may find out positive effects of e-sport on athlete selective performance. Parameters like shoulder stabilization, strength, flexibility and reaction time.

## **1.6. Assumptions**

- 1- It was assumed that the participants reported correct statements about their personal information.
- 2- It was assumed that none of the participant have shoulder injury in their medical history.

## **1.7. Limitations**

- 1- The research was limited to the fifty volleyball players
- 2- Esports playing time was determined according to the participant's self-report.

## **1.8. Definitions**

Play: Play has been examined in depth by many researchers and comes up with many different and complementary definitions. For example, Fromberg (1992) suggests that play is characterized by thinking and activity that is active, meaningful, symbolic, pleasurable, rule-governed, voluntary and episodic (Fleer, 2009). Bundy (2001) defined play as a transaction between the environment and the individual that is internally controlled, and intrinsically motivated free of many of the constraints of reality (Stagnitti, 2004).

Game: A game is an activity involving some aspects of competition, in which one or more players participate, with goals, constraints, rules, payoffs and consequences (Dempsey et al., 2022).

Sports: According to the definition made by the Turk Dil Kurumu (TDK, 2022), "The movements performed in accordance with the predetermined rules,

performed individually or in groups in order to improve the body or mind, are called sports.”

**Digital games:** These are the games in which the software is made with different technologies, the visual data in a logical relationship is transferred to the user via a screen output, and the connection with the PC software is established with the help of monitor, keyboard, mouse or other hardware in the integrity of the systems with certain rules (Günay, 2011; Özhan, 2011).

**E-sports:** International e-Sports Federation (IeSF) (2022) defines esports as competitive sport in which gamers compete using their mental and physical abilities in a virtual, electronic environment. Türkiye E-Spor Federasyonu (TESFED) (2022) on the other hand, defines e-sports as “It covers all kinds of activities, whether individually or as a team, in an online or offline environment via an electronic device”

**Flexibility:** Flexibility is regarded as an important component of fitness (Jain et al., 2009). It is defined as the maximum possible normal joint motion in a joint or several joints, in other words, the range of motion (Holt et al., 1995). Flexibility is associated with sports performance as it is closely related to increased range of motion, reduced muscle soreness, and injury prevention for athlete profiles. (McHugh et al., 1999). Flexibility measurements are made to assess the lengthening ability of skeletal muscle and tendon (Gleim & McHugh, 1997).

**Stabilization:** Stability is the persistence against change despite the factors that will change the condition or situation (Thomas, 1993). If we consider this definition for the shoulder, stability is that the humeral head does not go out of the glenoid fossa or returns to its correct position rapidly thanks to the balanced forces (Myers et al., 2006).

**Strength:** Strength is the ability to produce force (Stone, 1993). Strength is a relative phenomenon, as it varies with joint direction, joint angle and movement speed,

type of movement and muscle group (Siff, 2000). They might influence sport performance significantly (Stone et al., 2002).

**Reaction Time:** The reaction time is the amount of time period between a signal and the response to it, it simply represents the speed and is mainly dependent on the nervous system (Radák, 2018). Individual's reaction times plays a key role to achieve high performance in all forms of sports (Poliszczuk et al., 2013). Athletes' simple reaction time depends on several variables: arousal or state of attention, type of stimulus, including muscular tension, gender, age, personality type, fatigue, effect of distraction, exercise, anxiety and stress (Ciucurel, 2012).

## **1.9. Play, Game and Digital Game**

### **1.9.1. Play and Game**

Plays and games are among the cultural dynamics. Johan Huizinga (2014), points to a variety of play elements in culture and convincingly shows that such elements can be found in sports, games, role-play, theatre, stories, poetry, music, dance, rituals, language, knowledge, politics, law, competition, war, art and philosophy. Culture always presupposes human society, but play, as seen in most mammals; It is also seen in some reptilians and birds (Huizinga, 2014; Nijhof et al., 2018).

Generally play a game is activity bringing about a specific state of affairs, using only means permitted by certain rules (Suits, 1967). Although the terms play and game are often used interchangeably, they are actually two separate issues.

This difference in the meanings of the terms is also defined by de Carvalho and Coelho (2022) as follows:

““Play” comes from the Latin word “Paidia”, meaning (childish) amusement, and relates to creativity, freedom to improvise, and in general occurs in open systems. “Game” comes from the Latin word “Ludus”, meaning both learning and entertainment” (p. 1).

Play is fun, unpredictable, spontaneous activities and involves volunteering. It is controlled by the player (Stagnitti et al., 2004). It is considered to be free because it transcends reality as well as reflects the real (Cohen, 1996). Plays and playful activities allow individuals to experiment, explore and develop a flexible and rich behavioral, emotional and social repertoire (Nijhof et al., 2018). We have a biological drive to move and play, and that drive is especially strong in children (The National Institute for Play, 2018). Froebel (1902), emphasizes the importance of play in his article in which he talks about the importance of early childhood education in general, and states that game is not an insignificant period of time, it has a very serious and deep importance, and the game in childhood sheds the seeds of later life (Tuğrul et al., 2014). According to Erikson (1977), play enables individuals to have various experiences and prepares them for events that may occur in the future. Play improves fitness and develops physical skills, promotes strength and increases endurance through strengthened cardiovascular capacity and improved muscle development (Graham & Burghardt, 2010).

Game, in contrast to play, are bound by rules, both players know the rules, and there is usually a winner and a loser (Cohen, 1996). It helps the individual to develop as a whole in the physical, cognitive and social-emotional stages that develop as the individual matures (Dilekmen, & Bozan, 2018). Considering the effects of game on human development, it is seen that individuals benefit from various aspects of physical activities such as running, climbing, squatting and jumping, as well as providing the development of features such as speed, strength, attention, flexibility, which are necessary for individuals to be successful during the game, and also benefit the muscle development of individuals (Dilekmen & Bozan, 2018).

### **1.9.2. Digital Game**

Digital games, in short, are software that enable individuals playing digital games to interact with each other or against artificial intelligence (Sayın, 2016). According to Frasca (2001), digital game is a leisure time activity software in which one or more people can use digital software, either alone or a mutual physically over a network (Frasca, 2001; Sağlam & Topsümer, 2019).

Digital games appeal to the sense organs of individuals and encourage communication and cooperation of players (Fuchs, 2008). According to Sucu (2012), he argues that although digital games, which have become a social activity for individuals, reduce tactile communication between individuals, the social distance between people decreases. Djaouti et al., (2008) states in their research that digital games are entertainment software that allows players to interact with each other (Sağlam & Topsümer, 2019).

### **1.9.3. Effects of Digital Games on Players**

Digital games are virtual environments where players can benefit from the service as they wish and feel free. Effects of preferred games; The content of the games is related to when and how much they are played (Akçay and Özcebe, 2013).

Possible effects from playing digital games can be classified as positive and negative effects. In parallel with the spread of digital games, the positive and negative effects of this situation on individuals have begun to be questioned (Anderson et al., 2010). There are a lot of warnings today that predict the addiction that can occur with these games and its bad consequences, especially on children and adolescents (Granic et al., 2014). Most studies examining the effects of playing game have prioritized the negative effects of playing game (Bergstrom et al., 2016). Balanced research focusing on the positive effects as well as the negative effects is needed to accurately assess the effects of video games. Granic et al. (2014) stated that games can have undesirable

negative aspects, but they can contribute to the development of the individual mentally and emotionally with the right guidance.

### **1.9.3.1. Negative Effects of Digital Games**

Studies have shown that digital games negatively affect cognitive development and can cause eye discomfort, sleep disturbance, neuropathic diseases such as carpal tunnel syndrome, and problems such as posture disorder and restlessness (Çınar, 2020). It has also been suggested that it may cause increases in stress hormones (norepinephrine and epinephrine), blood pressure and heart rate (Rosser et al., 2007).

The use of digital games can affect physical health by replacing physical activities, leading to a sedentary lifestyle. The incline of the computer monitor, the height of the chair, the position and size of the mouse, the time it takes to look at the screen, sitting posture and discomfort are all important components (Breen et al., 2007; Sen and Richardson, 2007). These environmental determinants contribute to an individual's poor posture and musculoskeletal discomfort/pain. Some studies have highlighted the importance of sitting position, showing that discomfort from playing video games is likely due to inadequate workstation setups that do not meet students' posture needs (Jacobs, Hudak & McGiffert, 2009).

Video games have been associated with neck and upper extremity musculoskeletal disorders by causing repetitive strain injuries, which is thought to have an etiological role in posture (Straker, 2007). "A individual may have weak musculature in the back extensors, abdominals, and scapular stabilizers, such as the serratus anterior and the lower trapezius resulting from poor posture. These also contribute to pulling the individual's upper extremity downward thus causing rounded shoulders. This position may result in shoulder impingement symptoms" (Jacobs, Hudak & McGiffert, 2009). Sillanpää et al. (2003) examined the relationship between use of computer in 56 office workplaces and musculoskeletal symptoms of the upper

extremities and neck and found that these symptoms were associated with postural and ergonomic considerations.

The content and amount of games played can affect school success. In a study conducted by Lieberman et al. (1988), it was observed that children who spend more time to using computers for playing computer games tend to have poorer academic performance, whereas those who allocate more time to using computers for school-related activities tend to perform better academically. It has been suggested that playing time may affect learning and social behavior more negatively than kind of play, by replacing activities such as social play with peers, family interaction and reading (Gentile et al., 2004).

Digital games, especially violent games, can negatively affect individuals when they play games uncontrollably. Anderson and Bushman (2001) in a meta-analysis investigating the relationship between violence and aggression in video games, revealed that playing violent games produces negative consistent results in individuals. "Playing violent games increases aggressive behaviors, increases aggressive cognitions, increases aggressive emotions, increases physiological arousal, and decreases prosocial behaviors" (Gentile et al., 2004).

Obesity is one of today's health problems, and our sedentary life with today's technology triggers weight gain (Shields and Tremblay, 2008). Digital games, which are one of the digital products for entertainment purposes, have increased the time spent sitting and have caused inactivity. This causes eating disorders and obesity as a result of inconsistency in eating times and unbalanced nutrition. (Strauss & Knight, 1999).

Since 1981, there have been documented cases of seizures associated with video games: Rushton (1981) reported a case of so-called "Space Invader epilepsy": a 17-year-old boy had a history of seizures during a amusement arcade game. Kasteleijn-Nolst Trenite et al. (1999), in his study in Europe, recorded a 387 referrals with a history of television, computer or video game seizures.

One of the negative results of the studies on video games is video game addiction. In a study examining the relationship between game addiction and general health, people who reported being addicted to video games had poor health condition; liver disease, diabetes, hay fever and itchy skin have been observed. In addition, it was observed in the study that hyperlipemia, allergies, and mental illness were associated with video games (Shiue, 2015).

### **1.9.3.2. Positive Effects of Digital Games**

It is known that digital game has many benefits such as increase in cognitive abilities such as quick decision making, hand-eye coordination, analysis-synthesis, management, concentration and problem solving, maintaining team spirit, accelerating the learning process, reducing stress levels, supporting foreign language learning, providing a psychologically sound stance, increasing socialization (Aghlara and Tamjid, 2011; Akçay and Özcebe, 2013 and Bourgonjon et al., 2016).

A functional magnetic resonance imaging investigation shown that attention-related regions become less active in gamers during challenging tasks than in non-gamers, suggesting that gamers use their attention-related functions more successfully (Gordon et al. 2003).

Gordon et al. (2003) in a study with mice revealed that certain brain mechanisms, playing games significantly increase chemical output in certain regions of the brain (amygdala and dorsolateral frontal cortex). Considering that some studies have proven that human and non-human animals show morphological similarity in free play experiences, the same results can be expected in the play experiences of children in developmental age in general (Palagi et al., 2020).

Playing all type of video games increases an individual's creative capacity. For example, Jackson et al. (2012) stated in their study that playing video games was positively related to creativity in a sample of 491 12-year-old students. They also think

that video games are an excellent tool to develop their complex skills based on problem solving, in-game puzzles, memorization, calculation and analytical skills. Moreover, playing strategy games predicts greater self-reported aptitude for problem-solving, which in turn predicts better academic grades (Granic et al., 2014).

Digital games often do not require physical exertion, but the player's hands and eyes are constantly in motion. For example, Li et al. (2016) reported the curative effects of participation in 5 to 10 hours of action video games on player's hand-eye coordination. In the study of Rosser et al. (2007), it was seen that doctors who play games on digital devices for more than 3 hours a week make 37% fewer mistakes, make 27% faster and 42% more accurate decisions compared to doctors who do not play games.

“Beyond social cognition, developmentalists have emphasized that play constitutes an emotionally significant context through which themes of power and dominance, aggression, nurturance, anxiety, pain, loss, growth, and joy can be enacted productively” (Granic et al., 2014). According to Erikson (1977), children rehearse against similar and alternative situations in the future by making social experiences with play. These situations used in the game are concretely and clearly linked to achieving the goal.

The average gamer is not an unsocial. More than 70% of players play their games by communicating with their friends in teams or competitively (Granic et al., 2014). “For example, World of Warcraft—a multiplayer fantasy game set in a massive virtual world—boasts 12 million regular players, and Farmville—one of the most popular social networking games on Facebook—hosted over 5 million daily users in 2012” (Granic et al., 2014).

One of the genres included in the concept of digital games is digital health games. Digital health games can be expressed as digital games that aim to provide information about health and to encourage and maintain a positive attitude about health (Knoll and Moar, 2012). Kato et al. (2008) conducted one of the studies showing that

play has a healing effect on attitudes and behaviors. In this study, a video game that addresses relevant treatment and care for patients undergoing cancer treatment was observed to significantly improve cancer-related self-efficacy and treatment adherence, and knowledge indicators in adolescent and young adult patients.

#### **1.9.4. What is Digital Game Addiction? How is it Determined?**

Game addiction, which is evaluated with similar criteria to gambling addiction for some, is seen as just obsessive use and preoccupation for others (Kuss, 2013). The American Psychiatric Association defined gaming addiction as a gaming disorder in the Diagnostic and Statistical Manual of Mental Disorders (Petry & O'Brien, 2013). Whether digital games are a pathological disorder continues to be investigated today. Similarities can be observed between the symptoms of individuals with digital game addictions and those suffering from other substance or behavioral addictions (Savcı & Aysan, 2017). The study, which systematically examined studies using neuroimaging techniques to evaluate internet and digital gaming addiction, showed that gaming addiction leads to neuroadaptation and structural changes as a result of increased activity in addiction-related brain regions (Kuss and Griffiths, 2012). Similarly, some studies using functional magnetic resonance imaging to investigate brain structure in individuals with gaming addiction have observed that certain regions are abnormally active (Irmak & Erdogan, 2016).

Some features and emotions of digital games are considered as factors that lead to the development of game addiction by causing the game to be played for a long time. For example, since the games are low cost and free and easy to access, they are available to be played at any time (Irmak & Erdogan, 2016). Studies on game addiction emphasize that there are individual factors such as low self-perception, feeling of loneliness, shyness, and game playing motives, as well as ease of access (Kneer et al., 2014).

Various measurement tools were used in the evaluation of game addiction. In the DSM-5, one of these tools, preoccupation with playing game, tolerance -increased need for amount of gaming time, experience of withdrawal symptoms (irritability, sadness and anxiety), inability to quit or reduce playing game, relocation -preferring enjoyed other activities to gaming, continuing to play the game despite the problems that occur, deceiving others about of gaming time, using games to escape or relieve negative emotions, and losing or jeopardizing an important job or relationship due to gaming is diagnosed with nine-item diagnostic criteria. Presence of five or more criteria for 1 year indicates internet gaming disorder (Kneer et al., 2014; Petry & O'Brien, 2013 and Savcı & Aysan, 2017).

### **1.10. What is Sports?**

Sport, which has been a part of human life for centuries, has recently gained a very important place in human life. Planned sports based on scientific resources make a great contribution to individuals being healthy, fit, successful, peaceful and happy. Ensures that the motivation, socialability and well-being of the individual are at the highest level (Wankel et al., 1990). Sport in the European Sports Regulation adopted by the Council of Europe in 1992 and revised in 2001; It is defined as any physical activity focuses on improving or expressing physical fitness and mental well-being through organised or casual participation, establishing social relationships or achieving competitive results at all levels (Council of Europe, 2001). Although the reasons for doing sports vary, such as getting rid of excess weight, being more flexible, being stronger by increasing muscle ratio or having a fit appearance, and living a healthy life, nowadays, mostly, it is to minimize the risk of nutrition, psychological, physical and cardiovascular disorders. (Eime et al., 2013; Downward and Rasciute, 2011; Şahin Özdemir and Ersöza, 2013).

In the earliest times of history, humans ran, climbed, jumped to hunt, feed, protect and protect themselves from dangers, and they have always been directly or indirectly involved in sports. In the following times, the concept of leisure has

emerged, and this, has led to the formation of the concept of game, one of the developmental stages of physical education and sports science (İnalkaç & Yaman, 2021). In the prehistoric and post-historical periods, besides being a means of physical education and war training, sportive games that aimed at competition and reward, especially in Greek civilization, they were important element of their cultural originality (Mandell et al., 1999, p. 15; İnalkaç & Yaman, 2021).

Sport is a significant institution, in terms of social impacts on the society (Godfrey, 2009). Sport is institutionalized competitive activity that contests of human specialized facilities and physical skills (Parry, 2019). "Sport can be thought of as a specialized or higher order of play and as a kind of game with certain characteristics that set it apart" (Woods and Butler, 2020, p. 7).

#### **1.10.1. Digitalization of Sports**

Digitalization is known as one of the most important trends that change business and society in the near and long term (Parviainen et al., 2017). The Oxford English Dictionary defines digitization as "the adoption or increased use of digital or computer technology by an organisation, industry, country, etc" (Brennen & Kreiss, 2016). Many important elements in every aspect of our lives continue to be digitized (Rigamonti et al., 2020).

Technology was created to make human work easier (Priyambada et al., 2022). Digitization is the process of changing from analog (telephone calls, snail mai) to digital form (email, social media, chat) (Bloomberg, 2018). A few examples of digitization would be e-healthcare, smart mobility, smart homes (for security, entertainment, childcare, heating and electricity) and smart cities (Gray & Rumpe, 2015). Digital products and services, which emerged with the widespread effect of digitalization, have become an integral part of daily life, from personal relationships to organizations (Gimpel et al., 2018).

Recent changes in digital technologies have led to major developments in the sports industry (Xiao et al., 2017). More than 8,000 indigenous sports have emerged today since the first Olympic Games, which included boxing, running, long jump, javelin, pankration and equestrian events alone, were held in Olympia, Greece in 776 BC (Baca, 2014). The extensive legacy of sports has shown that starting from a game activity by being coded, it has turned into an organizational activity by becoming strategized, professionalized, commercialized and especially today in digital environments as media and marketing (Baca, 2014; Dugalić, 2018).

One of the important developments shaping the sports industry is the spread of digitalization (Xiao et al., 2017). Digital Technologies, for example electronic platforms, artificial intelligence, and cloud computing, have transformed various aspects of how the sports industry competes and operates (Gruettner, 2019). Digitalization provides helpful information about healthy eating and physical activity. Rigamonti (2020) stated that "The training programs that digitalization offers to individuals serve diagnosis, treatment and preventive behaviors for injuries as well as lifestyle adaptations. Sports such as yoga, climbing or parkour owe their popularity to the mass media in social networks".

It is seen that digitalization, which affects our lives in many ways, has a great influence on the concepts of games and sports. The advent of digitalization has given rise to the emergence of novel sports such as e-Sports and digital games, leading to significant ramifications for the fundamental essence of the sporting domain (Xiao et al., 2017). To sum up, the increasing digitization in sports, has a great impact on fields and members of the sport industry (Ráthonyi et al., 2018).

### **1.10.2. What is E-sport?**

Electronic sports is a considerable sport where people can play even with the farthest person via the internet or compete together for large organizations, which includes the physical and mental functions of most traditional sports (Argan et al.,

2006). E-sports is mostly for competitive video games played by connecting to computer or game consoles, where amateur or professional players join teams and other sports organizations (Radman Peša et al., 2017).

“eSport has many of the components of traditional sport, including players, teams, managers, leagues, competitions, marquee events, endorsement deals, player transfer fees, college scholarships, and a dark side with match fixing, doping, and gender-related disputes” (Pizzo et al., 2018).

Esports is also divided into genres like traditional sports. “Popular genres of eSport include fighting games (e.g., Street Fighter IV), first-person shooters (FPS; e.g., Counter-Strike: Global Offensive or CS:GO), real-time strategy games (RTS; e.g., StarCraft II), multiplayer online battle arenas (MOBAs; e.g., League of Legends or LoL), and sport-based video games (SBVGs; e.g., FIFA (Fédération Internationale de Football Association) 17). eSport includes both individual (e.g., StarCraft II) and team-based (e.g., CS:GO) games, with the most popular games (LoL and CS:GO) featuring teams of five competitors battling against each other in head-to-head match-ups” (Funk et al., 2018).

Professional esports players have social status as professional athletes and get prize money and good rewards (Brock, 2017). In addition, individuals gain the opportunity to play games, join competitions as spectators, have fun, socialize via chat, thanks to virtual environments (Wulf et al., 2020). Today, it is noticed that the interest of students and young people in traditional sports is gradually decreasing and their interest in esports is increasing (Göktaş, 2019).

Although all eSports are considered video games, it should be acknowledged that not every type of video gaming can be designated as an eSport (Jenny et al., 2017). “Video games must have structure (e.g., standard rules), organization (e.g., rule adherence), and competition (e.g., clear winners and losers) to be considered e-sport. Furthermore, the criterion of institutionalization, refers to an activity having regulation

and official governing bodies, must also be met to elevate a game to a sport” (Funk et al., 2018).

### **1.10.3. Sports and Esports**

Despite the growing popularity of eSports and its resemblance to traditional sporting events and competitions, discussions has been increasing in recent years about the relationship between esports and sports (Martončík, 2015). Some opinions from the sports community and academics emphasize that eSports is different from traditional sports. For example, ESPN (Entertainment and Sports Programming Network) President John Skipper stated in an article that eSport should not be regarded a real sport, eSport is a competition (Tassi, 2014). Those who argue that e-sports is a sport, on the other hand, argue that there is a framework for the definition of sport and that esports is included in this definition. NBA's Dallas Mavericks owner and media mogul Mark Cuban stated in an interview that eSport is a sport and people will understand it out very quickly (Gu, 2015).

The main reason why eSport is not seen as a real of sport is the perceived lack of physical activity or finesse (Hamari and Sjoblom, 2017). Although esports requires less contact and physical activity than most sports, esports players need to use their reflexes, brain functions and hand-eye coordination well to perform successfully (Aktuna and Ünlüönen, 2017). The sporting community and scientists disapprove of eSports entering the field of sport, as people equate sport with general physical activity, health benefits, and institutionalized activity. (Jonasson, & Thiborg, 2010). Although the perception of eSports athletes sitting in their chairs as if they are riveted is dominant, the player's body and physical activities are very important for deciding the eSports competition outcome (Funk, Pizzo and Baker,2018). ESport requires physical skills especially based motor skills (Meng-Lewis et al., 2022). Measured in actions per minute (APM), these movements require fine motor skills and significantly affect performance in eSports. Professional eSport athletes can perform up to 400 to

500 APM, while amateur eSport athletes can execute in the mid-200s, novice players starting well below 100 APM (Lewis, Trinh, & Kirsh, 2011).

#### **1.10.4. Success Factors for E-sports**

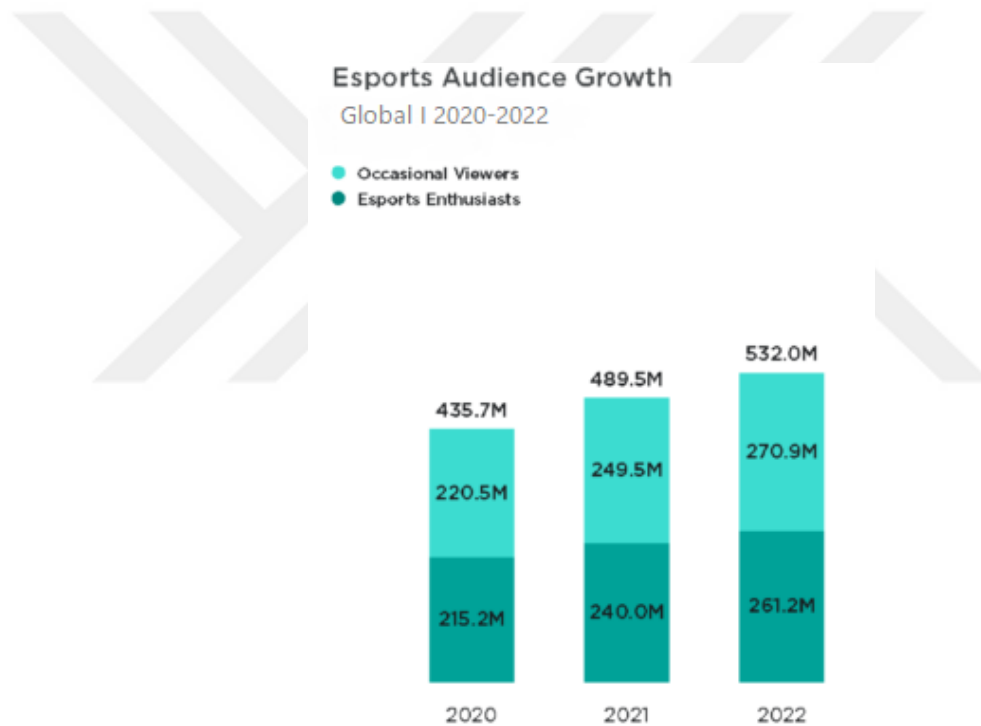
As in all sports, e-sports athletes also have factors that affect the results of the competition. Some of these factors are; sensory-motor coordination abilities such as visual, auditory, haptic, proprioceptive; general coordinative abilities such as balance, reaction, spatial orientation, rhythm, dexterity, agility, eye-hand and eye-foot coordination, condition, strength, endurance, flexibility, speed, cognitive abilities (Bayraktar and Kurtoğlu, 2009). A successful e-sports player must have a high level of eye-hand coordination and quick reflexes (Bornemark, 2013). Speed of thinking, intuition and intelligence are the main factors that enable the development of the sleight of hand factor, which greatly affects the performance of the game on what will be the next move (Argan, Ozer and Akın, 2006). In a study evaluating success factors in esports, intelligence, daily training routine, motivation, disciplinary, being in team games, leadership, governance matters, concentration and vision were evaluated as important success factors (Meng-Lewis et al., 2022). According to Suits (2007), in addition to the listed features, talent, strategy, and stability are the main features that affect success. In addition, all kinds of equipment such as keyboard, mouse, mouse pad, internet speed, headphones, gloves are an important factor in the success of e-sports athletes (Mustafaoğlu, Zirek and Yasacı, 2018).

#### **1.10.5. E-sports Statistics and Current Situation in the World**

Although the world of digital gaming and e-sports is accepted as a new concept, it is recorded as an explosive sector worldwide in terms of economic resources, audience, number of users, organizations (Jonasson, & Thiborg, 2010). Digital games play an important role for societies as an important entertainment tool that can be easily accessed in homes (Radman Peša et al., 2017). According to the data announced by

Newzoo, it has been determined that the interest shown in e-sports and digital games for the purpose of getting away from stress and having fun during the time spent at home with the coronavirus pandemic seen in the first half of 2020 is more than ever (Newzoo, 2020a).

The game and gaming audience has continued to grow even after the unprecedented addition of new players in 2020. The major breakthrough sports industry in 2020 has 435.7 million viewers. In 2021, it reached 489.5 million viewers. At the end of 2022, it is estimated that it will achieve 8.7% growth and reach 532 million (Newzoo, 2022b).



**Figure 1. 1.** Esports Audience Growth. Global Esports & Live Streaming Market Report 2022

<https://newzoo.com/resources/trend-reports/newzoo-global-esports-live-streaming-market-report-2022-free-version> Retrieved 15.11.2022

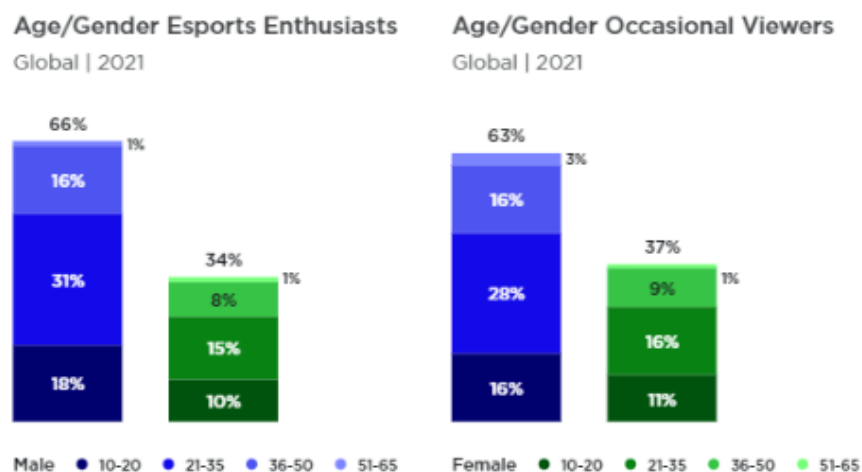
Esports enthusiasts are mostly young and male. The number of women is increasing day by day. Women made up 34% of esports enthusiasts in 2021. Within the female esports enthusiast community, 24% are aged between 21 and 65, with the remaining 10% are aged between 10 and 20 within the 10-20 age group. For consumer

brands, esports enthusiasts represent an enticing consumer segment, given that 74% of them are employed full-time (compared to 56% of the general online population), and roughly 44% fall into the high-income category (compared to 33% of the general online population) (Newzoo, 2022c).



**Figure 1.2.** Esports Market Demographics. 2022 Global Esports & Live Streaming Market Report

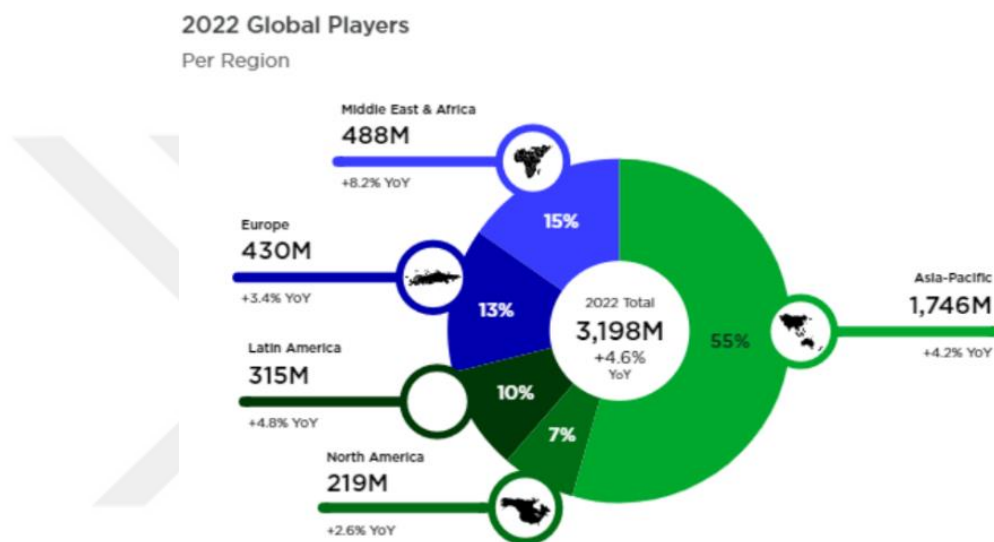
<https://newzoo.com/products/reports/global-esports-live-streaming-market-report> Retrieved 15.11.2022



**Figure 1.3.** Esports Market Demographics. 2022 Global Esports & Live Streaming Market Report -2

<https://newzoo.com/products/reports/global-esports-live-streaming-market-report> Retrieved 15.11.2022

People who started to spend more time at home with the pandemic found the chance to play games. It is estimated that the number of people playing games in 2022 will reach 3.2 billion with a growth of 4.6%, as people meet the game and their addiction to the game increases. Latin America, the Middle East and Africa take the lead in this growth. Player growth factors in these regions include affordable internet access, better internet infrastructure and a growing number of smartphone owners (Newzoo, 2022c).

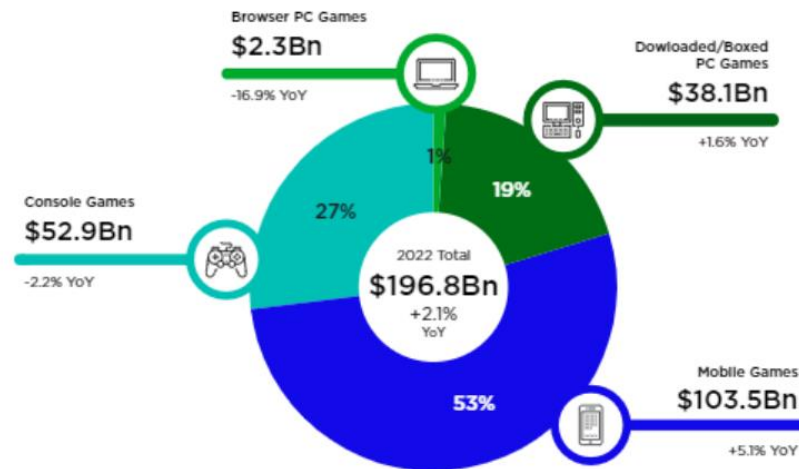


**Figure 1.4.** Global Players. 2022 Global Games Market Report

<https://newzoo.com/products/reports/global-games-market-report> Retrieved 15.11.2022

The pandemic had an enhancing effect on gaming-related interaction in its early years. However, this effect affected the usage rates of game tools in different ways. In 2022, the biggest increase in the global market is mobile, which will generate revenue of 103.5 billion dollars (53% of the market) with a growth of +5.1%. As a result of the decrease in game production due to supply shortages and interrupted supply lines for the console during the pandemic process, the console is expected to decline by -2.2% year-on-year to \$52.9 billion, or 27% of the global market (Newzoo, 2022c).

## 2022 Global Games Market Per Segment



**Figure 1. 5.** Global Games Market. 2022 Global Games Market Report

<https://newzoo.com/products/reports/global-games-market-report> Retrieved 15.11.2022

### 1.11. The Shoulder Complex

“The shoulder complex consists of the clavicle, scapula, and humerus; the glenohumeral and acromioclavicular (AC) joints that unite them; and the sternoclavicular (SC) joint, the only connection of the complex to the axial skeleton. In addition, a scapulothoracic and a subacromial joint are often included in anatomical descriptions of the shoulder complex” (Culham & Peat, 1993).

The shape of the articulating surfaces, ligament structures and joint capsules are critical structural factors that determine the joint angle that may occur between the two joint surfaces, stability, muscle length and muscle strength, and predisposition to injury (Schenkman & Rugo de Cartaya, 1987).

### **1.11.1. Sternoclavicular Joint**

The SC joint is a synovial joint resembling a ball-and-socket articulation, where the bulbous medial end of the clavicle articulates with a shallow sternal socket and the cartilage of the first rib. (Culham & Peat, 1993; Peat, 1986). The joint stability is dependent on the fibrocartilagenous disc, ligaments and capsule (Wheeler et al., 1979). “The disc helps prevent the clavicle from dislocating medially over the sternum when forces are transmitted along the clavicle to the axial skeleton. Anterior and posterior sternoclavicular ligaments reinforce the capsule and limit anterior-posterior movement of the medial end of the clavicle. The costoclavicular ligament attaches the inferior surface of the medial end of the clavicle to the first rib. It acts as a check to clavicular elevation and helps limit clavicular protraction. The interclavicular ligament unites the nonarticular portion of one clavicle to the other above the manubrium and functions to limit excessive downward movement of the medial end of the clavicle” (Culham & Peat, 1993). The SC joint's configuration allow movements in the horizontal and frontal planes (Renfree and Wright, 2003).

### **1.11.2. Acromioclavicular Joint**

“The AC joint is a plane synovial joint between a small convex facet on the lateral end of the clavicle and a small concave facet on the acromion of the scapula and surrounded by a fibrous capsule” (Peat, 1986). The joint is upheld by the inferior and superior acromioclavicular ligaments, which strengthen the joint capsule (Culham & Peat, 1993; Engín, 1980). “In addition to these capsular ligaments the clavicle is connected to the scapula by a two part coracoclavicular ligament (conoid and trapezoid) and coracoacromial ligament. Due to the closeness of the coracoid process of the scapula to the clavicle and possible formation of cartilage between closely apposed bone surfaces, this region is sometimes called coracoclavicular joint” (Engín, 1980). “Movement can occur between the acromion and lateral end of the clavicle, about a vertical axis, around a frontal axis, and about a sagittal axis. Functionally, the two major movements at the acromioclavicular joint, however, are a gliding movement

as the shoulder joint flexes and extends and an elevation and depression movement to conform with changes in the relationship between the scapula and the humerus during abduction” (Peat, 1986).

### **1.11.3. Glenohumeral Joint**

The glenohumeral (GH) joint is a synovial joint with a ball-and-socket structure, allowing for movement in multiple axes. It connects the glenoid fossa of the scapula with the head of the humerus (Peat, 1986). “The glenoid cavity exhibits a much smaller surface area than does the humeral head; consequently, the contact area between the two articulating surfaces is rather small. The joint capsule along with the capsular glenohumeral ligaments provides a loose sleeve around the joint” (Engín, 1980). Very little of this mobility in the articular surfaces is achieved by bone harmony. Joints in the shoulder complex maintain their stability by adjacent ligaments (Halder et al., 2000). Engín (1980) explained that in addition to the ligaments, the mobility and stability of the shoulder complex is provided by three topological muscle groups:

- (1) The scapulohumeral group (those passing from the scapula to the humerus) which are the supraspinatus, infraspinatus, teres minor, subscapularis, deltoid and teres major.
- (2) The axioscapular group (those passing from the torso to the scapula) which are the trapezius, rhomboids, serratus anterior, and levator scapulae.
- (3) The axiohumeral group (those passing from the torso to the humerus) which are the pectoralis major, pectoralis minor, and latissimus dorsi.

Although these muscle groups do not play any significant role in the passive resistance of the shoulder complex during the major portion of the movements of the joints, at the extremes of the range of motion some of the muscles may be stretched beyond their active lengths and, thus, contribute to the passive resistance

#### **1.11.4. Glenoid Labrum**

The glenoid labrum is a structure that attaches to the sides of the glenoid cavity, to which the glenohumeral ligaments attach, and includes the beginning of the tendon of the long head of biceps brachii (Nishida et al., 1996). The inner layer of the labrum is lined with synovium, while the outer layer is attached to the joint capsule and seamlessly extends to the periosteum of the scapula's neck. The glenoid labrum is a fibrocartilaginous structure, its form adapts to the rotation of the humeral head, adds depth and flexibility, prevents subluxation, and increases the stability of the GH joint (Halder et al., 2000; Zanetti et al., 2001).

#### **1.11.5. Glenohumeral Joint Capsule**

The capsule of the glenohumeral joint is twice the surface area of the humeral head (Halder et al., 2000). Beyond the labrum, it surrounds the joint and attaches to the glenoid cavity (Peat, 1986). The capsule enters the anatomical neck laterally and forms the axillary recess closer to the articular cartilage (Halder et al., 2000; Peat, 1986). It is lined inside by the synovium and protect the capsule on the inside (Kaltsas, 1983). On the outside, the rotator cuff tendons strengthen the capsule, ensuring its integrity (Halder et al., 2000). The rotator cuff tendons and ligaments protects and gives stability (Moore et al., 2013, p. 706).

#### **1.11.6. Glenohumeral Ligaments**

The static stability of the shoulder results from the integrity of the GH ligaments and their lax and taut throughout the range of motion (Lugo et al., 2008). “The superior glenohumeral ligament (SGHL) extends from the anterior-superior labrum to the anatomical neck of the humerus and is responsible for restricting inferior translation when the arm is in neutral rotation and at the side. The SGHL also stabilizes the biceps tendon in the groove, acting as a pulley” (Bakhsh & Nicandri, 2018).

The middle of the glenohumeral ligaments has the largest diameter (Halder et al., 2000). It originates glenoid and inserts on the medial aspect of the neck of the humerus (Halder et al., 2000; Terry & Chopp, 2000). Its role is to restrict lateral rotation of the shoulder to a maximum of 90 degrees during abduction and while providing resistance against anterior and posterior translation in the midrange of abduction (Bakhsh & Nicandri, 2018; Peat, 1986).

The most consistent and thickest of the glenohumeral ligaments is the inferior glenohumeral ligament (Terry & Chopp, 2000). “The inferior glenohumeral ligament (IGHL) is a complex, with anterior, posterior, and superior bands” (Bakhsh & Nicandri, 2018). “It inserts into the anatomic neck of the humerus inferior to the cartilage in a U or V shaped fashion” (Halder et al., 2000). IGHL was considered the primary static stabilizer when the shoulder was in external rotation and abduction at 90 degrees (Cain et al., 1987). It is closely associated with injuries to the labrum with the inferior glenohumeral ligament attached along the anterior labrum injured by repetitive microtrauma or a single traumatic event (Bakhsh & Nicandri, 2018; Terry & Chopp, 2000). Treatment aims to surgically restore the functional integrity of the IGHL (Bakhsh & Nicandri, 2018).

The coracohumeral ligaments are one of the most crucial ligamentous structures associated with the superior, anterior shoulder (Bakhsh & Nicandri, 2018; Peat, 1986). The coracohumeral ligament extends from the lateral coracoid to the rotator cord/humerus (Peat, 1986). “Portions of the coracohumeral ligament form a tunnel for the biceps tendon on the anterior side of the joint” (Burkart & Debski, 2002). These structures prevent and stabilize translation when the shoulder is in flexion, adduction, and internal rotation, and when the shoulder is in adduction (Bakhsh & Nicandri, 2018; Terry & Chopp, 2000). Additionally, “The rotator interval, the region of the capsule between the anterior border of the supraspinatus and the superior border of the subscapularis muscle, is reinforced by the coracohumeral ligament” (Burkart & Debski, 2002).

### **1.11.7. Muscles Of The Shoulder Joint**

The rotator cuff is the muscle group located on the shoulder capsule and consists of 4 muscles: Supraspinatus, Infraspinatus, Teres minor and Subscapularis (McCausland et al., 2018). The cross-sectional area and size of the rotator cuff muscles are relatively smaller when compared to larger and more superficial muscles like the trapezius, deltoid, latissimus dorsi, and pectoralis major (Terry & Chopp, 2000). The rotator cuff muscles all originate from the scapula and attach to the proximal humerus anteriorly at the greater tuberosity (McCausland et al., 2018).

The supraspinatus muscle stabilizes the glenohumeral joint and abducts the arm up to 30 degrees (McCausland et al., 2018). “It provides the anterior/inferior border of the rotator interval, which is a space between the rotator cuff tendons that allows the shoulder to move as the cuff spans across the coracoid. The interval also acts as a sling and therefore pulley for the long head of the biceps brachii” (Bakhsh & Nicandri, 2018). The suprascapular nerve performs the innervation of the muscle (Halder et al., 2000).

The combined action of the infraspinatus and teres minor muscles accounts for 60% of the main force responsible for external rotation, while also contributing to the stability of the glenohumeral joint by preventing superior and posterior subluxation (Halder et al., 2000; McCausland et al., 2018). The suprascapular nerve performs the innervation of the muscle (Terry & Chopp, 2000).

The Teres minor muscle, makes an external rotation of the arm along with infraspinatus (McCausland et al., 2018). 45% of the external rotation force of the arm is provided by the teres minor and is innervated by the axillary nerve (Halder et al. 2000).

The subscapularis tendon is closely associated with the capsule because of the pathways that run along the anterior capsule (Terry & Chopp, 2000). “The axillary

nerve passes along the inferior border of the scapula and is, therefore, subject to trauma from anterior dislocation” (Terry & Chopp, 2000). The subscapularis muscle is responsible for an important role of restriction to anterior and inferior translation and for internal rotation and adduction of the humerus (Halder et al., 2000; McCausland et al., 2018).

The trapezius has an extensive origin from the superior aspect of the nuchal line in the occipital, cervical, and upper thoracic region and inserts on the lateral aspect of the clavicle, acromion, and scapular spine (McCausland et al., 2018). Its most important function is static stabilization of the scapula, retraction of the scapula, elevation of its lateral angle and upward rotation, and its innervation is carried out by the spinal accessory nerve (Halder et al., 2000).

The deltoid muscle overlies the shoulder superficially and essential motor components for the abduction with rotator cuff (Peat, 1986). The deltoid muscle consists of three parts. The muscle has different origins; the clavicle, the acromion, the spine of the scapula (McCausland et al., 2018). The three parts of the deltoid muscle fuse to enter the deltoid tuberosity on the humerus (Terry & Chopp, 2000; Precerutti et al., 2010). A significant function of the this muscle is contour of the shoulder (Bakhsh & Nicandri, 2018). Since there are anterior and posterior segments, the deltoid also assists in arm flexion, extension and external rotation (Precerutti et al., 2010). Innervation is by the axillary nerve (Halder et al., 2000).

The pectoralis minor originates from third, fourth and fifth ribs and inserts at the coracoid (Bakhsh & Nicandri, 2018; Precerutti et al., 2010). The function of the pectoralis minor is to rotate and protect the scapula downward. The medial pectoral nerve innervates the muscle (Terry & Chopp, 2000).

Other key muscles in shoulder movement is pectoralis major. Origins of the pectoralis major muscle: The clavicular part from the anterior surface of clavicle; The sternocostal part from the sternum, and from the sixth and fifth ribs (Terry & Chopp, 2000). The muscles attach to the intertubercular groove on the humerus (Halder et al.,

2000). The pectoralis major muscle participates in the movements of humeral adduction, internal rotation, and flexion (Bakhsh & Nicandri, 2018). Lateral and medial pectoral nerves innervate the muscle (McCausland et al., 2018).

“The latissimus dorsi is a broad, flat muscle originating from the mid-lower back, spanning 4 to 8 vertebrae and posterior ribs. It crosses the inferior angle of the scapula, often with attachments, and inserts along the humeral shaft medial to the pectoralis major and lateral to teres major.” (Bakhsh & Nicandri, 2018). Thoracodorsal nerve innervates the muscle (Halder et al., 2000). Its function is to support the joint, extend and rotate the humerus internally (Terry & Chopp, 2000).

The key function of the triceps muscle is elbow extension (Halder et al., 2000). The origins of the triceps are in the infraglenoid tubercle of the scapula, on the posterior surface of the humerus, and all the muscles attach together to the olecranon (Bakhsh & Nicandri, 2018; Halder et al., 2000). Innervated by the radial nerve (Bakhsh & Nicandri, 2018).

A key muscle of shoulder movement is the biceps brachii due to has a tendon of long head (Bakhsh & Nicandri, 2018). The biceps has two heads: the short head originates from the coracoid process, the long head originates from the supraglenoid tubercle (Halder et al., 2000). The most important function of the biceps muscle is flexion and supination of the forearm. In addition, the muscle take part in adduction, abduction and internal rotation, and depressor movements during abduction (Precerutti et al., 2010; Terry & Chopp, 2000). Innervation is from the musculocutaneous nerve (Precerutti et al., 2010).

### **1.12. The Relationship Between Shoulder And Digital Game**

Digital game playing typically requires gazing downward and flexing the head forward (Sekiguchi et al., 2018). This posture keeps some muscles in elongated positions while other muscles are in shortened positions. Changing the length of the

muscle in the elongated or shortened positions causes muscle weakness that causes muscle imbalance, and the muscles in the shortened position adapt to this muscle length over time (Novak, 2004). Digital game playing is not a inactive action and involves to focusing intensely on the screen and performing repetitive movements and inappropriate-weak postures can lead to negative consequences such as muscle overuse, shoulder joint overuse tendon pathologies, hardening of the shoulder capsule and ligaments, and restriction of mobility (Emara et al., 2020; Sekiguchi et al., 2018; Tiric-Campara et al., 2014).

Kenneth Ashok et al. (2020) have demonstrated that duration in playing game is a risk of developing forward head posture. The FHRS involves a combination of upper cervical extension, lower cervical flexion, internally rotated shoulders and protracted scapula (Shiravi et al., 2019). Upper extremity consequences of the forward head-round shoulder (FHRS) stance are decreased flexibility, decreased muscle strength, and narrowed subacromial space, all of which can cause shoulder dysfunction (Pheasant et al., 2018). People suffering from the forward rounded shoulder (FHRS) posture problem have muscle inactivity in the serratus anterior, forward bending, and more rotation of the scapula internally (Thigpen et al., 2010). Observations have indicated that the pectoralis minor length becomes further shortened due to the scapular anterior fascia shortening caused by a forward posture. The lack of muscular activation in the serratus anterior muscle restricts the range of external rotation in the shoulder (Borstad & Ludewig, 2005). For example, Kebaetse et al. (1999) found a 16.2% decrease in strength of the shoulder abductor muscle in the forward head round shoulder stance compared to the neutral sitting stance. Another similar examination, Smith et al (2006), found a 20% decrease in isometric strength of the shoulder external rotators when the scapula is protracted, in shoulder flexion up to 90 degrees and in shoulder external rotation up to 90 degrees, compared to the isometric strength in the neutral scapular position.

### 1.13. Volleyball

Volleyball is one of the most widely embraced sports branches and there is no direct contact like other team sports (Şahin et al., 2015). It is a dynamic and physical game in which intelligence and power are at the forefront, the tempo of the game is extremely high, basic skills such as speed, mobility, flexibility, endurance and jumping play an important role, and certain methods and techniques within the determined rules (Erhan, 1995; Şensoy, 2018 and Tunçel, 2021).

There are many factors that affect success in volleyball performances. These can be exemplified as sports-related factors, such as the technical service characteristics of volleyball (serve type and service speed), contact height, ball direction, ball speed, team category, number of attacks blocked by the opponent and number of reception errors (Pekyavaş et al., 2021). The rules have been developed to allow all these variables to affect the match result. There are also factors that affect the performance of the volleyball player. Some of these are physiological features (aerobic performance, agility, vertical jump ability, strength etc.) and physical features (body mass, height and lean mass, etc.) (Lidor and Ziv, 2010).

Volleyball players may have sport-specific physical characteristics. The most prominent of these are that, unlike non-athletes, they are significantly taller, have a higher fat-free mass and body mass (Lidor and Ziv, 2010). Young volleyball players are commonly characterized as having an ecto-mesomorphic somatotype (Sieroń et al., 2023). Body composition, height, fat-free mass and body mass are important physical characteristics that affect performance among athletes. For example, an increase in fat mass can increase energy expenditure for activities such as jumping, resulting in decreased performance (Hyatt and Kavazis, 2019). Nikolaidis et al. (2015) found notable variations in body composition among female volleyball teams, indicating that top-level athletes exhibit a higher proportion of lean muscle mass, lower body fat percentage, and a generally more slender physique. Lidor and Ziv (2010) found in their study that players of high skill levels are taller, heavier and have higher vertical jump values than players of a lower level.

Volleyball is a dynamic sport characterized by varying player effort levels throughout the game. It predominantly relies on the ATP-PCr system, contributing approximately 95% of the required energy, with the remaining 5% derived from glycolysis. This highlights the significant involvement of the anaerobic metabolic system, which is essential for the rapid reactions, high-intensity jumps, and multi-directional movements involved in the sport (Kasabalis et al., 2005). Although volleyball is an intermittent game, high aerobic capacity is an important physiological attribute as it is necessary to maintain a high level of performance over time, especially in multi-set games (Lidor and Ziv, 2010). Well-trained volleyball players have developed lipolysis, and slow twitch fibers contain more glycogen depletion compared to fast twitch fibers (Smith et al., 1992). Since volleyball has both anaerobic and aerobic components, both systems must be well developed to enable the volleyball player to perform at maximum. Volleyball players must be able to generate energy quickly and recover quickly in anticipation of the next point (VanHeest, 2003).

Muscle power and strength of both upper and lower extremities are elements that a good volleyball athlete aims to develop (Gortsila et al., 2013). Volleyball athletes are involved in defensive and offensive jumping activities. These activities can include spike jumps and jump setting, jousts, and blocking. They are considered crucial to success in performance in volleyball, and velocity generation, power generation and their ability to apply high relative force are important factors needed to perform jumps (Sheppard et al., 2008). In order to perform the jumping activity, the volleyball players must meet lower limb power and strength especially the knee and hip extensor muscle strength needs (Matavulj et al., 2001; Schaun et al., 2013). Also, elbow and shoulder strength are important for serving and spiking (Lidor and Ziv, 2010). In a study examining the upper extremity strength of inactive female and female volleyball athletes, it was observed that the peak torque of the external and internal rotator shoulder muscles, eccentric extensor and flexor elbow muscles of volleyball athletes was significantly higher (Alfredson et al., 1998).

Agility is the ability to maintain and control the body's position when moving and changing direction rapidly in response to a stimulus (Gortsila et al., 2013), and is

associated with athletic abilities such as strength, power, speed, jumping, sprinting (Barnes et al., 2007). The ability to perform quick and vigorous movements is a determinant of performance in volleyball (Schaun et al., 2013).

One of the most exciting features of volleyball; It is the ability to quickly change and integrate different and various game variations that follow each other quickly (Şensoy, 2018). Reaction time, foresight, executive control and perceptual speed are the keys to success in volleyball (Trecroci et al., 2021). Therefore, players have to work on executive functions such as proper planning and decision making in order to perform well (Alves et al., 2013).



## **2. MATERIALS AND METHOD**

### **2.1. Research Design**

In the thesis study, the quantitative method will be followed in a way that will serve the purpose of the research. The causal comparison research model, which is one of the quantitative methods, was preferred because it is the most appropriate method to measure the variables and to examine the effects and results of a factor determined to have an effect on the dependent variable.

### **2.2. Research Group**

The 1st and 2nd league volleyball players of İlbank Sports Club and Karayolları Sports Club voluntarily participated in the research. Participants were divided into 2 groups: For the 1st group; 25 volleyball athletes who played video games for a minimum of 4 hours per day for at least the past six months. For the 2nd group; 25 volleyball athletes who have played video games less than 4 hours a day for at least the past six months

The research group was determined through a subject information form. The form was filled by 54 volunteers. According to the results of the subject information form, 50 volleyball player who met the inclusion criteria were included and 4 volleyball player was excluded. Demographic data of participants is shown in table 2.1.

Inclusion criteria of volunteers:

1. Being a volleyball player
2. Being female
3. No current injury

4. Volunteering
5. For the 1st group; volleyball players who played video games for a minimum of 4 hours per day for at least the past six months
6. For the 2nd group; volleyball players who plays video games less than 4 hours a day for at least the past six months

Criteria for exclusion of volunteers from the study:

1. Experiencing acute respiratory illness or musculoskeletal injury during work
2. Any neurologic or visual disorder
3. Voluntary withdrawal from research
4. Not being a volleyball player
5. Having had shoulder surgery in the last 2 years
6. Taking medications known to having stimulant effects.

**Table 2.1.** Demographic data of participants

	1.Group		2. Group	
	M	Sd	M	Sd
<b>Number of Participant</b>	25	-	25	-
<b>Age</b>	17,36	3,3	20,48	4,57
<b>Height (cm)</b>	177,92	5,09	181	6,87
<b>Weight (kg)</b>	63,98	6,25	67,76	7,51

M: Mean; Sd: Standard Deviation

## 2.3. Data Collection Tools and Methods

### 2.3.1. Subject Information Form

The form created by the researchers consists of questions containing the following demographic information:

- Name surname
- Gender
- Date of birth
- Height
- Weight
- Smoking Habit
- Use of Antidepressant or Stimulant Drugs
- Current Shoulder Problem
- Shoulder surgery in the last 2 years
- Current Eye Disease (over 3.00 Astigmatism, Myopia...)
- Frequency and Duration of Exercise in a Week
- Dominant Arm
- Playing Digital Video Games
- Digital Video Game play history (year or month)
- Digital Video Game Play tool
- Actively Played Digital Video Games
- Participating in Tournaments Related to These Games Before
- Earning money from digital video games played or tournaments attended
- Digital Video Game Play Time in a Day (hours)
- Digital Video Game Play Time in a Week (hours)

### **2.3.2. Testing Shoulder Flexibility With Digital Goniometer**

In the study, flexion, hyperextension, abduction, internal rotation, external rotation shoulder joint range of motion were evaluated. A digital goniometer was used as a measurement tool. The Activ5© uses a Bluetooth-enabled sensor to measure the range of motion displayed to the user via a smartphone app. It enables a wireless connection to a mobile phone, providing the convenience of displaying the test score remotely. A study evaluating the reliability and concurrent validity of active shoulder flexion, abduction, external and internal rotation, digital goniometer measurements equivalent to the Activ5© digital hand dynamometer

demonstrated reliability coefficients (recommended threshold for making clinical decisions) exceeding 0.90 (Karagiannopoulos et al., 2022). The use of digital goniometer was made by Şeyma Güney, the author of the thesis. After the people were given the correct position for measurement, the movements were explained in detail and in practice. Measurements were made bilaterally and were repeated 3 times for a healthy measurement.

The volleyball player stood in the standing position and extended her arms to the side of her torso to measure the flexion angle. The digital goniometer was fixed to the wrist of the volleyball player with the tape apparatus of the device. When the device gave a ready for measurement warning, the volleyball player performed the flexion movement in sagittal plane without disturbing the movement. At the last point reached, the angle value on the smartphone was recorded.

The volleyball player stood in the standing position and extended her arms to the side of her torso to measure the hyperextension angle. The digital goniometer was fixed to the wrist of the volleyball player with the tape apparatus of the device. When the device gave a ready for measurement warning, the volleyball player performed the hyperextension movement in sagittal plane without disturbing the movement. At the last point reached, the angle value on the smartphone was recorded.

The volleyball player stood in the standing position and extended her arms to the side of her torso with the palms facing forward to measure the abduction angle. The digital goniometer was fixed to the wrist of the volleyball player with the tape apparatus of the device. When the device gave a ready for measurement warning, the volleyball player performed the abduction movement in the frontal plane without disturbing the movement. At the last point reached, the angle value on the smartphone was recorded.

To measure the internal rotation angle, the volleyball athlete lay down on her back. The volleyball player was placed on the edge of the bed with her arm hanging out of the bed from the elbow in order not to hinder the rotation angle. The shoulder

was in neutral position and 90 degrees abducted in frontal plane, the elbow was perpendicular to the measurement bed and 90 degrees of flexion. The digital goniometer was fixed to the wrist of the volleyball player with the tape apparatus of the device. When the device gave the ready for measurement warning, the volleyball player performed internal rotation by moving her forearm towards the ground in the sagittal plane without disturbing the movement. In the meantime, pressure was applied to the shoulder to prevent the shoulder from tilting forward, which caused the shoulder to exceed the internal rotation angle. At the last point reached, the angle value on the smartphone was recorded.

To measure the external rotation angle, the volleyball athlete lay down on her back. The volleyball player was placed on the edge of the bed with her arm hanging out of the bed from the elbow in order not to hinder the rotation angle. The shoulder was in neutral position and 90 degrees abducted in frontal plane, the elbow was perpendicular to the measurement bed and 90 degrees of flexion. The digital goniometer was fixed to the wrist of the volleyball player with the tape apparatus of the device. When the device gave the ready for measurement warning, the volleyball player made external rotation by moving her forearm upwards in the sagittal plane without disturbing the movement. At the last point reached, the angle value on the smartphone was recorded.

### **2.3.3. Testing Shoulder Stability With Upper Quarter Y Balance Test (UQYBT)**

The Upper Quarter Y Balance Test (UQYBT) assesses the dynamic stability of the upper extremities. The maximum distance reached in three directions, the average of maximum distances have high test-retest reliability for the upper extremities (Degot et al., 2019). The test has been proven to be valid and reliable (with ICC 0.80- 1.0 for test-retest) (Gorman et al., 2012; Westrick et al., 2012).

Measurement and evaluation were made by Şeyma Güney, the thesis holder. Before starting the measurement, the volleyball athletes were allowed to try 2 times to help them warm up. Volleyball athletes started in a push-up position to perform the UQYBT. Therefore, they took the “plank” position with 1 hand in the middle of the stance plate and both feet on the ground. While maintaining the push-up position, the volleyball athlete kept her other arm straight and tried to move the reach box in 3 different directions without touching the ground with her hand: medial, superolateral and inferolateral. Length measured in cm in all directions. Measurements were made with both arms 3 times, with a 1 minute break between tests. After participant's arms were abducted 90 degrees in the frontal plane and their elbows were completely extended, the length between C7 spinous process and middle finger endpoint was measured with a tape measure. Reach distance was calculated using the this formula:  $[(\text{inferolateral} + \text{superolateral} + \text{medial}) / (3 \times \text{upper limb length})] \times 100$  (Gokalp & Kirmizigil, 2020).

#### **2.3.4. Testing Shoulder Muscle Strength With Digital Dynamometer**

Shoulder flexion muscle strength, hyperextension muscle strength, abduction muscle strength, external rotation muscle strength and internal rotation muscle strength were evaluated using The Activ5© Handheld digital dynamometer in the study. The Activ5© is a HHD which can measure isometric strength (N or kg) and uploads the data immediately to a smartphone app. The Activ5 showed excellent results in a test-retest using the Instron ElectroPuls mechanical tester (a gold standard system) and was considered reliable. (with ICC  $\geq 0.971$  for test-retest reliability) (Merry et al., 2021). Measurement and evaluation were made by Şeyma Güney, the thesis holder. Volleyball athletes resisted the applied force in the tested position. The value seen on the digital hand dynamometer was recorded as Newton (N). Measurements were applied to both the dominant arm and non-dominant arm.

Volleyball athlete sat down to measure flexion muscle strength. The shoulder, in the sagittal plane, was flexion to 90 degrees with the palms facing down, the elbows

kept straight. The dynamometer was placed on the arm, on the wrist. The volleyball athlete was asked to maximally flexion with all her strength into the Activ5© against the examiner's resistance.

To measure the hyperextension muscle strength, the volleyball athlete lay face down and put her arms by her torso. Dynamometer was placed on the wrist and the volleyball athlete was asked to maximally hyperextension in the sagittal plane with all her strength into the Activ5© against the examiner's resistance.

The volleyball athlete sat down to measure abduction muscle strength. The shoulder was abducted 90 degrees in the frontal plane with the palm facing the floor and keeping the elbow straight. Dynamometer was placed on her arm, on her wrist, and the volleyball athlete was asked to maximally abduction with all her strength into the Activ5© against the examiner's resistance.

The volleyball athlete lay on her back to measure internal rotation muscle strength. The shoulder was in a neutral position and abducted 90 degrees in the frontal plane, the elbow was perpendicular to the measuring bed and flexed 90 degrees. The dynamometer was placed on the wrist on the forearm. The volleyball athlete was asked to maximally internal rotation by moving her arm downwards in the sagittal plane with all her strength into the Activ5© against the examiner's resistance.

The volleyball athlete lay on her back to measure external rotation muscle strength. The shoulder was in a neutral position and abducted 90 degrees in the frontal plane, the elbow was perpendicular to the measuring bed and flexed 90 degrees. The dynamometer was placed on the outside of the arm above the wrist. The volleyball player was asked to maximally external rotation by moving her arm upwards in the sagittal plane with all her strength into the Activ5© against the examiner's resistance.

### **2.3.5. Testing Reaction Times With Visual-Cognitive Technology - BlazePod™**

The reaction times of the volleyball athletes in the hand-eye coordination test were carried out with the BlazePod™ Trainer Device (Play Coyotta Ltd., Tel Aviv, Israel), which consists of wireless light six discs that can be controlled with an application compatible with smart devices. The reliability and validity of the BlazePod system has been established in past studies (de-Oliveira et al., 2021; Hoffman, 2020). Athletes were instructed to turn off the light signal as quickly as possible by touching the light sensor with their dominant hand when the light signal was turned on. Light discs were placed on a plate/floor at 20 cm intervals from the designated starting point and 45 cm from the centre. Before starting the test, the athletes were allowed to take a pre-test. For each participant, the measurement began with the researcher manually tapping the "start now" button in the BlazePod phone app. After the "3-2-1-continue" warning sound stopped after the start command, the sensors started to flash randomly for 30 seconds. In this study, taking the measurement method of de-Oliveira et al. (2021) as an example, the athletes were contacted for 30 seconds to determine their reaction times and 1 minute rest was given between sets. Participants repeated this action until the end of the test period. The test was repeated three times. The best value obtained was recorded. The total number of hits and the mean reaction time were recorded.

### **2.3.6. Statistical Analysis**

IBM SPSS 24.0 package program (SPSS Inc., Chicago, IL, USA) was used in the statistical analysis of the data obtained from the study. The normality distribution of the data was carried out by Shapiro Wilk analysis since the number of participants was less than 50 in both groups. In the comparison of the within-group means, the Paired Sample t-Test, which is a parametric test, was used for the mean differences in the data where the mean differences were normal. Independent t-Test was applied for

statistical analysis of means between groups. Groups are expressed as means  $\pm$  standard error. The significance value was accepted as 0.05 in all statistical analyzes.



### 3. RESULTS

#### 3.1. Shoulder Flexibility

Shoulder flexibility values between groups are presented in Table 3.1. In the flexibility evaluations, the non-dominant shoulder flexion flexibility of the group playing digital games was found to be significantly higher than the group that do not play digital games ( $t=2.092$ ;  $P=0.042$ ). Among the groups that playing digital games and do not playing digital games; There was no significant difference in the flexibility of the dominant side Flexion, Hyperextension, Abduction, Internal Rotation, External rotation in both the dominant and nondominant side shoulder flexibility ( $p>0.05$ ).

**Table 3.1.** Comparison of shoulder flexibility values between groups.

		1.Group	2.Group	t	p
Flexion Flexibility	Dominant	192,065±11,48	188,03±10,89	1,273	0,209
	Non-dominant	194,7±9,84	188,8±10,09	2,092	<b>0,042*</b>
Hyperextansion Flexibility	Dominant	92,25±15,67	85,67±14,06	1,562	0,125
	Non-dominant	90,02±16,54	85,08±14,22	1,132	0,263
Abduction Flexibility	Dominant	184,72±19,84	186,72±12,6	-0,425	0,672
	Non-dominant	187,13±27,01	186,42±10,35	0,123	0,903
Internal Rotation Flexibility	Dominant	66,62±13,42	66,43±12,67	0,051	0,96
	Non-dominant	72,04±14,9	71,7±9,24	0,07	9,45
External Rotation Flexibility	Dominant	111,67±11,23	111,42±11,64	0,077	9,39
	Non-dominant	111,73±11,49	110,01±10,63	0,546	0,586

\* $p<.05$

Intra-group shoulder flexibility values of the group playing digital games are presented in Table 3.2. In the Flexion, Hyperextansion, Abduction, Internal Rotation and External Rotation shoulder flexibility evaluations made within the group playing

digital games, no significant difference was found between dominant and nondominant shoulder flexibility ( $p>0.05$ ).

**Table 3.2.** Comparison of in-group shoulder flexibility values of the group playing digital games.

	Dominant		Non-dominant		p
	M	Sd	M	Sd	
Flexion Flexibility	192,05	11,48	194,7	9,84	0,194
Hyperextension Flexibility	92,25	15,67	90,02	16,54	0,485
Abduction Flexibility	184,72	19,84	187,13	27,01	0,435
Internal Rotation Flexibility	66,62	13,42	72,04	14,9	0,051
External Rotation Flexibility	111,67	11,23	111,73	11,49	0,985

M: Mean; Sd: Standard Deviation.

Intra-group shoulder flexibility values of the group who do not play digital games are presented in Table 3.3. In the flexibility evaluations of the group that do not playing digital games, internal rotation flexibility of the shoulder was significantly lower in the dominant shoulder than in the nondominant shoulder ( $p=0.006$ ). No significant difference was found between dominant shoulder and nondominant shoulder flexibility in Flexion, Hyperextension, Abduction and External Rotation shoulder flexibility in the group who do not playing digital games. ( $p>0.05$ ).

**Table 3.3.** Comparison of in-group shoulder flexibility values of the group do not playing digital games.

	Dominant		Non-dominant		p
	M	Sd	M	Sd	
Flexion Flexibility	188,03	10,89	188,8	10,09	0,665
Hyperextension Flexibility	85,67	14,08	85,08	14,22	0,768
Abduction Flexibility	186,72	12,6	186,42	10,35	0,898
Internal Rotation Flexibility	66,43	12,67	71,8	9,24	<b>0,006*</b>
External Rotation Flexibility	111,42	11,64	110,01	10,63	0,581

M: Mean; Sd: Standard Deviation; \* $p<.05$

### 3.2. Shoulder Stability

Shoulder stability values between groups are presented in Table 3.4. In shoulder stability evaluations, reaching distance, limb length and maximal distance in medial direction, superolateral direction and inferolateral direction did not differ significantly between the groups that playing games and do not playing digital games, both on the dominant shoulder and non-dominant shoulder ( $p>0.05$ ).

**Table 3.4.** Comparison of shoulder stability values between groups.

		1.Group	2.Group	t	p
Medial Direction	Dominant	111,6±12,78	115,56±11,79	-1,138	0,251
	Non-Dominant	106,6±14,25	111,44±12,05	-1,296	0,201
Superolateral Direction	Dominant	73,44±10,07	74,48±10,43	-0,359	0,722
	Non-Dominant	71,84±10,97	75,09±9,10	-1,136	0,262
Inferolateral Direction	Dominant	81,48±11,27	81,76±10,61	-0,09	0,928
	Non-Dominant	81,16±11,37	81,36±10,61	-0,064	0,949
Limb Length	Dominant	90,8±2,71	91,21±3,69	-0,479	0,634
	Non-Dominant	90,62±2,54	91,26±3,58	-0,728	0,47
Reaching Distance	Dominant	97,92±11,82	99,25±9,57	-0,435	0,665
	Non-Dominant	95,57±12,67	97,80±8,79	-0,723	0,473

Intra-group shoulder stability values of the group playing digital games are presented in Table 3.5. In the shoulder stability evaluations of the digital game playing group, Maximal Distance in Medial Direction ( $p=0.009$ ), Limb Length ( $p=0.009$ ) and Reach Distance ( $p=0.048$ ) on the dominant shoulder were found to be significantly higher than the nondominant shoulder. The maximal distance in superolateral direction and maximal distance in Inferolateral direction of the group playing digital games did not differ significantly between the dominant side and nondominant side ( $p>0.05$ ).

**Table 3.5.** Comparison of in-group shoulder stability values of the group playing digital games.

	Dominant		Non-dominant		p
	M	Sd	M	Sd	
Medial Direction	111,6	12,78	106,6	14,25	<b>0,009*</b>
Superolateral Direction	73,44	10,07	71,84	10,97	0,293
Inferolateral Direction	81,84	11,27	81,16	11,37	0,803
Limb Length	90,8	2,71	90,62	2,54	<b>0,009*</b>
Reach Distance	97,92	11,82	95,57	12,67	<b>0,048*</b>

M: Mean; Sd: Standard Deviation; \*p<.05

Intra-group shoulder stability values of the group who do not play digital games are presented in Table 3.6. In the shoulder stability evaluations of the group that do not play digital games, the maximal distance in the medial direction on the dominant shoulder was found to be significantly higher than the nondominant shoulder (p=0.001). The maximal distance in superolateral direction, maximal distance in inferolateral direction, limb length and reach distance did not differ significantly between the dominant and nondominant shoulders of the group who do not play digital games (p>0.05).

**Table 3.6.** Comparison of in-group shoulder stability values of the group do not playing digital games.

	Dominant		Non-dominant		p
	M	Sd	M	Sd	
Medial Direction	115,56	11,79	111,44	12,05	<b>0,001*</b>
Superolateral Direction	74,48	10,43	75,08	9,1	0,586
Inferolateral Direction	81,76	10,61	81,36	10,61	0,81
Limb Length	91,24	3,69	91,26	3,58	0,77
Reach Distance	99,25	9,57	97,81	8,79	0,102

M: Mean; Sd: Standard Deviation; \*p<.05

### 3.3. Shoulder Muscle Strength

Shoulder muscle strength values between groups are presented in Table 3.7. In the muscle strength evaluations, the hyperextension muscle strength on the non-dominant shoulder of the group that playing digital games was found to be significantly lower than the group that do not playing digital games ( $t=-3.284$ ;  $p=0.002$ ). Among the groups that playing digital games and do not playing digital games; There was no significant difference in the Hyperextension muscle strength on the dominant side, Flexion, Abduction, Internal and External rotations in both the dominant and nondominant side shoulder muscle strengths ( $p>0.05$ ).

**Table 3.7.** Comparison of shoulder strength values between groups.

		1.Group	2.Group	t	p
Flexion MS	Dominant	99,94±19,53	97,01±9,63	0,673	0,504
	Non Dominant	90,75±19,33	91,85±12,82	-0,235	0,815
Hyperextansion MS	Dominant	80,34±12,13	84,64±7,19	-1,522	0,134
	Non Dominant	68,25±11,52	78,62±10,79	-3,284	<b>0,002*</b>
Abduction MS	Dominant	89,44±16,70	88,19±13,01	0,295	0,77
	Non Dominant	81,15±17,78	83,53±13,04	-0,54	0,591
Internal Rotation MS	Dominant	146,42±32,76	150,74±18,62	-0,573	0,569
	Non Dominant	138,47±27,65	141,02±15,87	-0,401	0,69
Eksternal Rotation MS	Dominant	117,14±16,26	126,81±19,15	-1,924	0,5
	Non Dominant	115,12±17,57	120,94±18,93	-1,128	0,265

MS: Muscle Strength; \* $p<0.05$

Intra-group shoulder muscle strength values of the group who playing digital games are presented in Table 3.8. In the shoulder muscle strength evaluations of the group that playing digital games, Flexion ( $p=0.002$ ) Hyperextension ( $p=0.001$ ), Abduction ( $p=0.001$ ) and Internal Rotation ( $p=0.031$ ) muscle strengths on the dominant shoulder were found to be significantly higher than on the nondominant shoulder. No significant

difference was found between the dominant side and nondominant side muscle strength in shoulder external rotation muscle strength ( $p>0.05$ ).

**Table 3.8.** Comparison of in-group shoulder muscle strength values of the group playing digital games.

	Dominant		Non-dominant		p
	M	Sd	M	Sd	
Flexion MS	99,94	19,53	90,75	19,33	<b>0,002*</b>
Hyperextansion MS	80,34	12,12	68,25	11,52	<b>0,001*</b>
Abduction MS	89,44	16,7	81,15	17,78	<b>0,001*</b>
Internal Rotation MS	146,42	32,76	139,47	27,65	<b>0,031*</b>
Eksternal Rotation MS	117,14	16,26	116,12	17,57	0,518

M: Mean; MS: Muscle Strength; Sd: Standard Deviation; \* $p<.05$

Intra-group shoulder muscle strength values of the group who do not playing digital games are presented in Table 3.9. In the shoulder muscle strength evaluations of the group that do not playing digital games, Flexion ( $p=0.014$ ) Hyperextension ( $p=0.022$ ), Abduction ( $p=0.044$ ), Internal Rotation ( $p=0.007$ ) and External Rotation ( $p=0.033$ ) muscle strength on the dominant side were found to be significantly higher than on the nondominant side.

**Table 3.9.** Comparison of in-group shoulder muscle strength values of the group do not playing digital games.

	Dominant		Non-dominant		p
	M	Sd	M	Sd	
Flexion MS	97,01	9,63	91,85	12,82	<b>0,014*</b>
Hyperextansion MS	84,64	7,19	78,67	10,79	<b>0,022*</b>
Abduction MS	88,19	13,01	83,53	13,04	<b>0,044*</b>
Internal Rotation MS	150,74	18,62	141,02	15,87	<b>0,007*</b>
Eksternal Rotation MS	126,81	19,15	120,94	18,93	<b>0,033*</b>

M: Mean; MS: Muscle Strength; Sd: Standard Deviation; \* $p<.05$

### 3.4. Reaction Times

Reaction Time values between groups are presented in Table 3.10. In the reaction time evaluations, the reaction time of the group playing digital games was found to be significantly lower on the dominant side ( $t=-2.135$ ;  $p=0.038$ ) and on the non-dominant side ( $t=-2.460$ ;  $p=0.018$ ) compared to the group do not playing digital games. The reaction hits on the non-dominant side of the group playing digital games were found to be significantly higher than the group that do not playing digital games ( $t=2.245$ ;  $p=0.029$ ), but the reaction hits on the dominant side did not differ significantly ( $p>0.05$ ).

**Table 3.10.** Comparison of reaction times values between groups.

		1.Group	2.Group	t	p
Reaction Time	Dominant	421,36±30,40	440,08±31,57	-2,135	<b>0,038*</b>
	Non Dominant	434,60±33,60	457,00±30,71	-2,46	<b>0,018*</b>
Reaction Hits	Dominant	66,12±4,11	63,36±4,13	2,366	0,22
	Non Dominant	64,28±4,26	61,68±3,91	2,245	<b>0,029*</b>

\* $p<.05$

Intra-group reaction times values of the group who playing digital games are presented in Table 3.11. In the reaction time evaluations of the digital game playing group, the reaction time on the dominant side was found to be significantly lower than on the nondominant side ( $p=0.001$ ). In the digital game playing group, Reaction Hits on the dominant side were found to be significantly higher than on the nondominant side ( $p=0.001$ ).

**Table 3.11.** Comparison of in-group reaction times values of the group playing digital games.

	Dominant		Non-dominant		p
	M	Sd	M	Sd	
Reaction Time (ms)	421,36	30,4	434,6	33,6	<b>0,001*</b>
Reaction Hits	66,12	4,11	64,28	4,26	<b>0,001*</b>

Sd: Standard Deviation; M: Mean; \*p<.05

In-group reaction times values of the group who did not play digital games are given in Table 3.12. In the evaluations of the reaction time of the group who do not play digital games, the reaction time on the dominant shoulder was significantly lower than on the non-dominant shoulder ( $p=0.002$ ). In the group that do not play digital games, Reaction Hits on the dominant side were found to be significantly higher than on the non-dominant side ( $p=0.004$ ).

**Table 3.12.** Comparison of in-group reaction times values of the group do not playing digital games.

	Dominant		Non-dominant		p
	M	Sd	Mean	Sd	
Reaction Time (ms)	440,08	31,57	457	30,71	<b>0,002*</b>
Reaction Hits	63,36	4,13	61,68	3,91	<b>0,004*</b>

M: Mean; Sd: Standard Deviation; \*p<.05

## 4. DISCUSSION

The aim of our study was to examine the effects of playing digital games on shoulder flexibility, shoulder stability, shoulder muscle strength and reaction speed of female volleyball players. Flexibility evaluation results revealed that the non-dominant side flexion flexibility of the group that playing digital games increased significantly compared to the group that do not playing digital games. However, playing digital games; Compared to those who do not play digital games, no significant effect was found on the flexibility of the dominant shoulder Flexion, Hyperextension, Abduction, Internal Rotation, External rotation on both the dominant and nondominant side shoulder flexibility. It was found that playing digital games did not create a significant difference in medial, superolateral and inferolateral maximum reach distances, limb lengths and reach distances, compared to non-players, and the hypothesis that playing digital games increases shoulder stability in volleyball players could not be confirmed. Digital gaming was found to significantly reduce hyperextension muscle strength on the non-dominant shoulder compared to the non-digital gaming group. Playing digital games did not make a significant difference in the hyperextension muscle strength on the dominant side, flexion, abduction, internal rotation, and external rotation in both dominant and non-dominant shoulder muscle strength compared to the group that do not play digital games. In the reaction time evaluations, it was found that the reaction time of the group playing digital games improved significantly on the dominant shoulder and on the non-dominant shoulder compared to the group do not playing digital games. Reaction hits on the non-dominant side were found to be significantly higher in the group that played digital games compared to the group that do not, but reaction hits on the dominant side did not differ significantly.

This research revealed that shoulder flexibility, except flexion flexibility, is not affected by digital game playing. However, when we evaluated the group that do not playing digital games within itself, it was seen that the internal rotation was lower in the dominant shoulder than in the non-dominant shoulder. However, internal rotation did not differ significantly between the parties in the group playing digital games. It

can be said that playing digital games can increase the flexibility of internal rotation on the dominant side. It is likely that digital games are played sitting down due to their nature, and that those who play the digital game maintain a certain posture by sitting for a long time can play an important role in the change of shoulder flexibility (Tholl et al., 2022). Similar to our study, Straker et al. (2008), in a study investigating the posture and muscle activities of young children during the use of tablet computers, desktop computers and paper; found that shoulder flexion increased significantly especially during tablet use. Bullock et al. (2005), in his study investigating the effects of sitting position on shoulder pain and range of motion in 28 subjects with shoulder impingement; significantly greater flexion ROM was recorded in an erect sitting posture compared to in a slouched posture. Especially digital games played by handleless tools narrow the distance between the arms, increase the internal rotation of the shoulders and cause rounded shoulders (Lam et al., 2022). The study of Kanlayanaphotporn (2014) on 30 asymptomatic subjects supports our study of internal rotation flexibility change that occurs with the preservation of a certain sitting position. The study showed that the mean shoulder internal rotation ROM was increased by approximately 20% in a slouched posture as compared to an erect posture.

Another reason for the decrease in shoulder flexibility may be microtraumas caused by repetitive actions. Hakala et al. (2006) observed that excessive engagement in gaming and computer usage are associated with increased risk of experiencing body pain, while TV viewing does not exhibit the same correlation. Players need to rapidly move their upper extremities when playing games, and these physical burdens cause muscle stiffness in the shoulder girdle (Sekiguchi et al., 2018). The overload can lead to stiffness in the trapezius muscle, causing the scapula to become displaced (Tazawa and Okada, 2001). The scapular position is believed to influence overall shoulder girdle function because there are many muscle connections between the spine, humerus, scapula and collarbone (Kebaetse et al., 1999). Kebaetse et al. (1999) investigated the effects of thoracic posture on scapular movement patterns, shoulder range of motion and strength in 34 asymptomatic subjects. Significantly less active shoulder abduction ROM was noted in a slouched posture. Contrary to this study, no significant change was observed in shoulder abduction flexibility in our study.

However, in our study, individuals maintain a certain sitting posture by playing digital games for at least 4 hours a day for at least 6 months. This may result in persistent changes in the shoulder flexibility.

The trapezius provides appropriate posture and alignment to the shoulder complex and provides in the stabilizing motion of the shoulder (Go and Lee, 2016). Trapezius weakness, which occurs with repetitive overloading during the game, negatively affects the scapula movement and impairs the stabilization of the shoulder. Because the movement of the scapula maintain effective length-tension relationship and function to move and stabilize the humerus (Kisner et al., 2017, p. 549; Tazawa and Okada, 2001). For this reason, we evaluated the relationship between playing digital games and shoulder stabilization.

Şahin, (2003) in his study titled Cognitive Functions and Posture Analysis of University Students who Play Video Games, Athletes and Musicians, found no significant difference in the results of bilateral Y Balance Test applied to the lower extremities between the group that played video games and the group that do not participate in any activity. In our study, we compared the shoulder stability of the group that played digital games and the group that do not, and we could not find a difference between the two groups, similar to the results of Şahin (2003) study.

When evaluated within its own group, the group that plays digital games, unlike those who do not playing digital games; dominant limb length and dominant shoulder stability (due to significantly higher reach distance) was found to be significantly higher. Constant contraction of the shoulder stabilizers maintains the accuracy and precision of the joint angles in the upper extremity based on the movements required by the digital game (Migliore & Beckman, 2021). Therefore, playing digital games can contribute to shoulder stabilization by improving shoulder stabilizers.

In our study, it was determined that playing digital games significantly reduced shoulder hyperextension muscle strength on the nondominant side. In addition, when

all evaluated muscle strengths are compared, all muscle strengths in all directions except external rotation are high in the dominant shoulder for both groups. However, there was no significant difference in the dominant shoulder in the group playing digital games. The decrease in external muscle strength in the dominant shoulder of the group playing digital games may suggest the effect of digital game on reducing muscle strength. Puolitaival et al. (2020) compared adolescent men who played video games for more than 3 hours a day on weekdays, similar to our study method, with adolescent men who played 3 hours or less per day on weekdays. As a result of the research, it was found that the grip strength of the participants who played video games for more than 3 hours a day on weekdays was 2.1% less. This may be due to abnormal repetitive movements or constant static postures while playing digital games (Sekiguchi et al., 2018). Maintaining postures while playing digital games causes several muscles to be in elongated positions while other muscles are placed in shortened positions. This change in length between the muscles is assumed to cause muscle weakness that causes muscle imbalance (Novak, 2004). One of the most common problems that occur as a result of these certain postures when playing digital games is forward head posture. Examining the prevalence problem of forward head posture in electronic players and related factors among electronic players, Kenneth Ashok et al. (2020) found that there was no relationship between the gaming device and forward head posture, and that the risk of developing forward head posture in gamers was significantly high. Villanueva et al. (1997), in their study examining the relationship between sitting stance and shoulder and neck muscle activities, found increased muscle load in shoulder and neck electromyographic (EMG) activities of forward-leaning posture by changing screen height. Even a minor deviation from a neutral shoulder position has been associated with increased shoulder muscle load (Villanueva et al., 1997). Less active muscles have less load, more active muscles have more load (Kouzaki and Shinohara, 2006). A systematic review found that muscle activity in the shoulder and forearm region increases as repeated upper extremity movements activate a sustained muscle contraction while using a smartphone (Eitvpart et al., 2018). Niemi et al. (1996) found that computer use required static loading of the upper extremities and was positively associated with shoulder pain in women. There are studies in which sitting

posture significantly affects shoulder muscle strength (Kebaetse et al., 1999; Pheasant et al., 2018).

In this study, significant changes were detected in hyperextension and external rotation muscle strength; No significant changes were detected in flexion, abduction and internal rotation muscle strengths. However, this and some studies in the literature support that playing digital games causes a decrease in muscle strength. One of the reasons for digital gaming to reduce muscle strength is the sedentary lifestyle required by the game. There is a correlation between the duration of digital game screen time and variables related to body mass as well as physical activity (Ballard et al., 2009). A sedentary lifestyle and decreased physical activity cause the risk of developing sarcopenia (loss in muscle structure and strength) (Harding and Noorbhai, 2021). DiFrancisco-Donoghue et al. (2022), in their study titled "Esports players, got muscle? Competitive video game players' physical activity, body fat, bone mineral content, and muscle mass in comparison to matched controls", found that esports players have significantly less lean body mass than non-esports players.

Video games require speed and concentration and these skills significantly reduce correct reaction times (Emara et al., 2020). People typically do 30 to 300 actions per minute (APM), which increases with player skill, with professional players often going over 500 APM (Vinyals et al., 2017). In terms of athletes, reaction times play a key role in achieving high performance and preventing injuries (Ersin et al. 2022; Poliszczuk et al., 2013). Therefore, the improvement in reaction time can positively affect the performance of the volleyball player.

There are many studies investigating the effect of playing digital games on reaction time. Ersin et al. (2022), in their study investigating the relationship between gaming time and reaction time in e-sports players in 53 subjects; subjects with better visual and aim reaction times were found to be players who played more than 14 hours a week. Lager and Bremberg (2005) reported that digital games have supportive effects on reaction time and spatial perception in 30 studies they examined. The study noted improvement in reaction times for players who played video games for 14 to 33 hours

over a few months. Orosy-Fildes et al. (1989) in their study with 20 subjects, in which they aimed to investigate the reaction time effect of video game players to visual stimuli under the title of psychology of computer use; confirmed the hypothesis that playing video games reduces reaction time. Doğan (2022) compared the reaction time of Taekwondo athletes who play digital games with those who do not play digital games, and it was found that Taekwondo athletes who play digital games have a significantly faster reaction time. Yuji (1996) stated that video game players had faster reaction times to stimuli on discrimination perception tests using computers compared to non-players. In a study conducted by Goldstein et al. (1997), older adults were randomly assigned to either an experimental group, where they played video games for 5 or more hours per week for a duration of 5 weeks, or a control group that did not engage in video gaming. The results of pre-experimental and post-experimental reaction time assessments revealed that participants in the experimental group exhibited significantly faster reaction times compared to those in the control group. The results of our study found that digital game improves reaction time and supports the literature. While the reaction hits on the non-dominant side of the playing digital game group were found to be significantly higher than the do not playing digital game group; The reaction time was significantly lower in both the dominant shoulder and nondominant shoulder of the digital gaming group.

## 5. CONCLUSION AND RECOMMENDATIONS

In this study, the effects of playing digital games on shoulder flexibility, shoulder stability, shoulder muscle strength and reaction time in female volleyball players were investigated. It was found that playing digital games significantly increased shoulder flexion on the nondominant side. In addition, it was found that internal rotation flexibility on the dominant side may increase in digital game players. However, the digital game had no significant effect on shoulder hyperextension, abduction and external rotation. As a result, the hypothesis "Digital game increases shoulder flexibility in volleyball players" has been partially accepted. For stability, no significant difference was found between the groups in the effects of digital game on shoulder stability. The hypothesis of "Digital game increases shoulder stability in volleyball players" was not accepted. However, when evaluated within its own group, the dominant shoulder stability of the group playing digital games was found to be significantly higher compared to the non-dominant side, unlike the group that could not play. For muscle strength; It was observed, among groups, that playing digital games significantly reduced hyperextension muscle strength on the non-dominant shoulder. It is also thought that digital game affects external muscle strength on the dominant side. However, no significant effect of digital game on shoulder flexion, abduction and internal rotation muscle strength was observed. Therefore, the hypothesis of "Digital game increases shoulder muscle strength in volleyball players" has been partially accepted. Finally, it has been shown that playing digital games provides improvements by reducing reaction time. As a result, the hypothesis of "Digital game reduce reaction time in volleyball players" was accepted.

Athletes who have sports branches where upper extremity flexibility, stabilization, muscle strength and reaction time are important can benefit from the results of this research. Because each individual has a unique genetic, the results may not be the same for every athlete. Digital games can improve volleyball players' performances that require flexibility, such as spike and serve, which affect success. It can increase sports performance, especially by improving reaction speed. The length-

tension relationship maintained during the game can increase the success of sports by providing muscle development. On the other hand, the lack of physical activity required by the digital game and the loss of muscle strength caused by the digital game can be compensated by the training program of the athlete. At the same time, this study may serve as a warning to digital game players, as the fixed posture maintained during the game may cause musculoskeletal problems.

There are studies that affect digital games on individuals, but there are very few studies on fitness parameters that affect sports performance of individuals interested in sports. The time spent on digital games, especially played by young athletes, cannot be underestimated. Volleyball players participating in this research are players who play digital games for less than 4 hours a day, and it is very possible that there will be some changes in their fitness parameters. However, the volleyball athletes in the study are the athletes from the 1st and 2nd leagues who do intense training. Therefore, the emergence of changes arising from the digital game may vary according to the content of the athlete's training program. Therefore, comparing the training programs of the athletes whose measurement results are compared can increase the effectiveness of the study.

Athletes in different positions in volleyball offer different physical skills. Fitness parameters affected by digital games may differ between these positions. Therefore, it may be healthier to compare volleyball athletes or athletes in any branch with their colleagues from the same position.

On the other hand, in this study, the menstrual cycles of the athletes were not taken into account and it has been reported in the literature that the menstrual cycle has effects on tendon ligaments and joints (Güler et al., 2020). Therefore, while measuring the fitness parameters of digital games, the menstrual cycles of female athletes should be taken into account in future research.

## SUMMARY

### **Investigation of the Playing Digital Games on Shoulder Flexibility, Stabilization and Reaction Speed in Volleyball Players**

Volleyball is a sport that requires high and low intensity activities, technical and tactical skills, and versatile performance such as high endurance, strength, speed, flexibility and balance. While the actions performed by the players may differ in terms of the technical and tactical requirements of their individual roles, common movements include acceleration and deceleration, jumping and multi-directional movement. To perform well, players must have advanced physical and physiological capacities and important motor control and cognitive functions. In volleyball, especially during attack, coordinative abilities such as quick strength and continuity in strength are important. Technology has affected sports and provided the emergence of new sports branches. One of these sports branches is e-sports. E-sports is any activity that is participated in online or offline, individually or as a team, via electronic device. E-sports, like volleyball, requires quick movements to control the game. One of the determinants of speed is muscle strength. Muscle strength can increase in direct proportion to the performance of the video game. Playing games on the console for a long time will increase shoulder-muscle activity; It has been scientifically proven that sitting in the anterior position of the head for five minutes causes a significant reduction in shoulder external rotator muscle strength. It is known that strength development in the shoulder area directly affects the functional capacity of shoulder stabilizers, which in turn increases joint stability. The stability of the glenohumeral joint during acceleration, deceleration and continuation of the stroke becomes one of the most important functions for e-sports. Considering that the competitions last for hours, the importance of flexibility in e-sports. The seated athlete will have shortening of certain muscles of the body while lengthening other muscles based on their postural position. One of the important factors in e-sports is the ability to react quickly. Neurocognitive research has shown that video game gamers display some superior cognitive characteristics. Video games require speed and concentration. These skills significantly reduce correct reaction times. Developing cognitive abilities in this way is vital to the success of the volleyball player; Good performance is directly related to their capacity to anticipate and respond to changes in the environment. The existence of a practice implementation that affects reaction speed, joint stabilization, strength and endurance performance in volleyball athletes has a great importance in the quality of sports skills. E-sports; While it can contribute to reaction time, joint stabilization and strength development in volleyball players, it can reduce flexibility. This study aims to examine the effects of digital game playing status of volleyball players on shoulder stabilization strength, flexibility, and reaction times.

**Keywords:** volleyball, digital game, strength, flexibility, stabilization, reaction time

## ÖZET

### **Voleybolcularda Dijital Oyun Oynamanın Omuz Esnekliği, Stabilizasyonu ve Reaksiyon Hızı Üzerine İncelenmesi**

Voleybol, yüksek ve düşük şiddet düzeylerinde aktivitelerin olduğu, teknik ve taktik beceriler ile üst düzey dayanıklılık, kuvvet, sürat, esneklik, denge gibi çok yönlü performans gerektiren bir spor branşıdır. Oyuncular tarafından gerçekleştirilen eylemler, bireysel rollerinin teknik ve taktik gereksinimleri açısından farklılık gösterebilse de ortak hareketler arasında hızlanma ve yavaşlama, zıplama ve çok yönlü hareket yer alır. Oyuncuların iyi performans gösterebilmeleri için gelişmiş fiziksel ve fizyolojik kapasitelere ve önemli motor kontrol ve bilişsel işlemlere sahip olması gerekir. Voleybolda özellikle hücum esnasında çabuk kuvvet ve kuvvette devamlılık gibi koordinatif yetenekler önemlidir. Teknoloji sporu etkilemiş, yeni spor dallarının ortaya çıkmasını sağlamıştır. Bu spor dallarından biri e-sporudur. E-spor, elektronik cihaz aracılığıyla çevrimiçi veya çevrimdışı, bireysel ya da takım halinde katılım gösterilen her türlü aktivedir. E-spor da voleybol sporuna benzer olarak oyunu kontrol etmek için hızlı hareketler gerektirir. Hızın belirleyicilerinden biri kas kuvvetidir. Kas kuvveti, video oyununun performansı ile doğru orantılı olarak artabilir. Konsolda uzun süre oyun oynamanın omuz-kas aktivitesinde artış sağlayacağı; başın anterior pozisyonda beş dakika oturmanın, omuz dış rotator kas kuvvetinde önemli bir azalmaya neden olduğu bilimsel olarak ispatlanmıştır. Omuz bölgesi kuvvet gelişiminin, omuz stabilizatörlerinin fonksiyonel kapasitesini doğrudan etkilediği, bunun da eklem stabilitesinin artmasını sağladığı bilinmektedir. Hızlanma, yavaşlama ve vuruşun devamı sırasında glenohumeral eklem stabilitesi e-spor için en önemli fonksiyonlardan biri haline gelir. Müsabakaların saatlerce sürdüğü düşünüldüğünde e-spor oyuncularındaki esnekliğin önemi ortaya çıkar. Oturan sporcunun vücudunun belirli kaslarında kısılma olurken, diğer kaslarında ise duruş pozisyonuna göre uzama olur. E-spor da önemli bir faktörlerden biri de hızlı tepki verme yeteneğidir. Nörobilişsel araştırmalar, video oyunu oyuncularının bazı üstün bilişsel özellikler sergilediğini göstermiştir. Video oyunları, hız ve konsantrasyon gerektirir. Bu beceriler, doğru tepki verme sürelerini önemli ölçüde azaltır. Bu şekilde bilişsel yeteneklerin geliştirilmesi, voleybol sporcusunun başarısı için hayati önem taşır; iyi bir performans, çevrede meydana gelen değişiklikleri öngörme ve yanıtlama kapasiteleriyle doğrudan ilgilidir. Voleybol sporcularında reaksiyon hızını, eklem stabilizasyonunu, kuvvet ve dayanıklılık performansını etkileyen bir uygulamanın varlığı, spor becerilerinin kalitesinde büyük öneme sahiptir. E-spor; Voleybolcularda reaksiyon süresi, eklem stabilizasyonu, kuvvet gelişimine katkı sağlayabilirken esnekliği azaltabilir. Bu çalışma, voleybolcuların dijital oyun oynama durumlarının omuz esnekliği, omuz stabilizasyonu, omuz kas kuvveti ve reaksiyon zamanı üzerindeki etkilerini incelemeyi amaçlamaktadır.

**Anahtar Sözcükler:** Voleybol, Dijital Oyun, Omuz Esnekliği, Kuvvet, Stabilizasyon, Reaksiyon Hızı.

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# APPENDIX

## Appendix 1. Ethics Committee Approval



T.C.  
ANKARA ÜNİVERSİTESİ REKTÖRLÜĞÜ  
Etik Kurulu Başkanlığı

Sayı : 56786525-050.04.04/1605805  
Konu : Etik Kurul Kararı Hakkında

28.09.2022

Sayın Şeyma GÜNEY  
Spor Bilimleri Fakültesi

İlgi: 20/07/2022 tarihli başvurunuz.

"Investigation Of The Effect Of Playing Digital Games On Shoulder Flexibility, Stabilization, Strength And, Reaction Speed In Volleyball Payers" başlıklı tezi ile ilgili olarak Ankara Üniversitesi Etik Kurulunun 19/09/2022 tarihli toplantısında alınan 14/142 sayılı kararın bir örneği ilişikte gönderilmektedir.

Bilgilerinizi saygılarımla rica ederim.

Prof. Dr. Ercan BAYAZITLI  
Rektör a.  
Rektör Yardımcısı

EKLER:  
Karar Örneği (1 sayfa)

ANKARA ÜNİVERSİTESİ  
SAĞLIK BİLİMLERİ ALT ETİK KURULU  
KARAR ÖRNEĞİ

Karar Tarihi : 19/09/2022  
Toplantı Sayısı : 14  
Karar Sayısı : 142

**142-**Üniversitemiz Spor Bilimleri Fakültesi öğretim üyesi **Prof. Dr. Neşe ŞAHİN**'in danışmanlığını yaptığı, yüksek lisans öğrencisi **Şeyma GÜNEY**'in "Investigation Of The Effect Of Playing Digital Games On Shoulder Flexibility, Stabilization, Strength And, Reaction Speed In Volleyball Players" başlıklı tezi ile ilgili 29/01/2022 tarihli "İnsan Üzerinde Yapılan Klinik Dışı Araştırmalar Başvuru Formu" Etik Kurulumuzca incelenmiştir.

Yapılan görüşmeler ve incelemeler sonucunda **Prof. Dr. Neşe ŞAHİN**'in danışmanlığını yaptığı, yüksek lisans öğrencisi **Şeyma GÜNEY**'in "Investigation Of The Effect Of Playing Digital Games On Shoulder Flexibility, Stabilization, Strength And, Reaction Speed In Volleyball Players" başlıklı tezi ile ilgili COVID-19 salgını nedeniyle; çalışma takviminiz de dahil araştırmanızda oluşabilecek tüm değişikliklerin Etik Kurulumuza yazılı olarak bildirilmesi, araştırma protokolüne uyulması ve etik onay tarihinden itibaren geçerli olması koşuluyla uygulanmasının etik açıdan uygun olduğuna oybirliği ile karar verildi.

ASLININ AYNIDIR  
19/09/2022

Prof. Dr. Muharrem ÖZEN  
Ankara Üniversitesi  
Etik Kurulu Başkanı

## Appendix 2. Informed Consent Form

### Aydınlatılmış Onam Formu

**Araştırmanın adı:** Voleybolcularda Dijital Oyun Oynamanın Omuz Esnekliği, Stabilizasyonu, Kuvveti ve Reaksiyon Zamanına Etkisinin Araştırılması

Investigation Of The Effect Of Playing Digital Games On Shoulder Flexibility, Stabilization, Strength And, Reaction Time In Volleyball Players

Sayın gönüllü,

Yüksek Lisans Tezi kapsamında planlanmış olan yukarıda adı yazılı araştırmaya katılmak üzere davet edilmiş bulunuyorsunuz. Bu araştırmada yer almayı kabul etmeden önce, araştırmanın ne amaçla yapılmak istendiğini anlamanız ve kararınızı bu bilgilendirme çerçevesinde özgürce vermeniz gerekmektedir.

Aşağıdaki bilgileri lütfen dikkatlice okuyunuz, sorularınız olursa sorunuz ve açık yanıtlar isteyiniz.

Bu çalışma, voleybolcuların dijital oyun oynama durumlarının omuz stabilizasyonu, omuz kas kuvveti, omuz esnekliği ve reaksiyon hızları üzerindeki etkilerini incelemeyi amaçlamaktadır. Omuz esnekliği değerlendirmesi için gonyometre, omuz ekleminin dinamik stabilitesinin değerlendirilmesinde Üst Çeyrek Y Denge Testi (UQYBT), omuz kas kuvveti değerlendirmesi için Activbody Activ5 Handheld dijital dinamometre, reaksiyon hızını incelemek için BLAZEPOD marka teknolojik ekipman kullanılacaktır. Araştırmaya voleybol branşında, herhangi mevcut sakatlığı olmayan toplam 102 kadın sporcu dahil edilecektir. Araştırma katılımcıların fiziksel ve ruhsal sağlıklarını tehdit edici riskler taşımamaktadır. Gönüllünün bu araştırmanın gereklerini yerine getirebilmek için harcayacağı süre yaklaşık olarak 30 dakikadır. Gönüllü kişi araştırmadan kendi isteği ile ayrılabilir. Çalışma için size ödeme yapılmayacak, sizden de ücret talep edilmeyecektir.

Bu araştırmada yer almak tümüyle sizin isteğinize bağlıdır. Araştırmada yer almayı reddedebilirsiniz ya da başladıktan sonra yarıda bırakabilirsiniz. Bu araştırmanın sonuçları bilimsel amaçlarla kullanılacaktır. Araştırmadan çekilmeniz ya

da arařtırmacı tarafından arařtırmadan ıkarılmanız halinde, sizle ilgili veriler kullanılmayacaktır. Ancak veriler bir kez anonimleřtikten sonra arařtırmadan ekilmeniz mmkn olmayacaktır. Sizden elde edilen tm bilgiler gizli tutulacak, arařtırma yayınlandığında da varsa kimlik bilgilerinizin gizlilięi korunacaktır.

“Yukarıda yer alan ve arařtırmaya bařlanmadan nce gnlllere verilmesi gereken bilgileri ieren metni okudum (ya da szl olarak dinledim). Eksik kaldığını dřndğm konularda sorularımı arařtırmacılara sordum ve doyurucu yanıtlar aldım.

Yazılı ve szl olarak tarafıma sunulan tm aıklamaları ayrıntılarıyla anladığım kanısındayım. alıřmaya katılmayı isteyip istemediğim konusunda karar vermem iin yeterince zaman tanındı.

Bu kořullar altında, arařtırma kapsamında elde edilen řahsıma ait bilgilerin bilimsel amalarla kullanılmasını, gizlilik kurallarına uyulmak kaydıyla sunulmasını ve yayınlanmasını, hibir baskı ve zorlama altında kalmaksızın, kendi zgr irademle kabul ettiğimi beyan ederim.”

Sayın veli,

alıřmanın ierięi belgelerde belirtilmiř olup, ocuęunuza bu arařtırma hakkında anlayacağı řekilde bilgilendirme yapılacak ve arařtırmaya katılımı iin rızası alınacaktır.

Bu alıřmada ocuęunuza herhangi bir tedavi ya da uygulama yapılmayacaktır. Bu arařtırmanın ocuęunuza doęrudan yararı olmayıp alıřmanın amacı ocuęunuzun aıklamada belirtilen omuz fonksiyonlarını deęerlendirmektir.

İmza/Tarih

Ergenin adı/soyadı

İmza/Tarih

Arařtırmacının adı/soyadı

## Informed Consent Form

### Aydınlatılmış Onam Formu

**Araştırmanın adı:** Voleybolcularda Dijital Oyun Oynamanın Omuz Esnekliği, Stabilizasyonu, Kuvveti Ve Reaksiyon Zamanına Etkisinin Araştırılması

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Bu araştırmada yer almak tümüyle sizin isteğinize bağlıdır. Araştırmada yer almayı reddedebilirsiniz ya da başladıktan sonra yarıda bırakabilirsiniz. Bu araştırmanın sonuçları bilimsel amaçlarla kullanılacaktır. Araştırmadan çekilmeniz ya da araştırmacı tarafından araştırmadan çıkarılmanız halinde, sizle ilgili veriler

kullanılmayacaktır. Ancak veriler bir kez anonimleştikten sonra arařtırmadan çekilmeniz mümkün olmayacaktır. Sizden elde edilen tüm bilgiler gizli tutulacak, arařtırma yayınlandığında da varsa kimlik bilgilerinizin gizliliđi korunacaktır.

“Yukarıda yer alan ve arařtırmaya başlanmadan önce gönüllülere verilmesi gereken bilgileri içeren metni okudum (ya da sözlü olarak dinledim). Eksik kaldığını düşündüğüm konularda sorularımı arařtırmacılara sordum ve doyurucu yanıtlar aldım.

Yazılı ve sözlü olarak tarafıma sunulan tüm açıklamaları ayrıntılarıyla anladığımı kanısındayım. Çalışmaya katılmayı isteyip istemediğim konusunda karar vermem için yeterince zaman tanındı.

Bu koşullar altında, arařtırma kapsamında elde edilen şahsıma ait bilgilerin bilimsel amaçlarla kullanılmasını, gizlilik kurallarına uyulmak kaydıyla sunulmasını ve yayınlanmasını, hiçbir baskı ve zorlama altında kalmaksızın, kendi özgür irademle kabul ettiğimi beyan ederim.”

İmza/Tarih

Gönüllünün adı/soyadı

İmza/Tarih

Arařtırmacının adı/soyadı

## Appendix 3. Survey Form

6.09.2022 14:52

E-sporcu voleybol oyuncusu belirleme formu

### E-sporcu voleybol oyuncusu belirleme formu

Sayın Katılımcı,

Bu çalışmayla, severek oynadığınız e-Spor oyunlarında profesyonel bir e-Sporcu kriterlerine sahip olup olmadığınızı değerlendirmek istiyoruz. Yaklaşık olarak 2 dakikanızı alacak bu anketi düşünerek cevaplamaya çalışınız.

Katılımınız için teşekkür ederiz.

\* Gerekli

1. E-posta \*

---

2. E-posta Adresi \*

---

3. Ad Soyad \*

---

4. Cinsiyet \*

*Yalnızca bir şıkkı işaretleyin.*

Kadın

Erkek

Diğer: \_\_\_\_\_

5. Doğum Tarihi \*

---

*Örnek: 7 Ocak 2019*

6. Boy \*

---

7. Kilo \*

---

8. Sigara Kullanımı \*

*Yalnızca bir şıkkı işaretleyin.*

Evet

Hayır

9. Antidepresan ya da Uyarıcı Etkili İlaç Kullanımı \*

*Yalnızca bir şıkkı işaretleyin.*

Evet

Hayır

10. Herhangi bir omuz problemine sahip misiniz? \*

*Yalnızca bir şıkkı işaretleyin.*

Evet

Hayır

11. Son 2 yıl içerisinde omuz cerrahisi geçirdiniz mi? \*

*Yalnızca bir şıkkı işaretleyin.*

Evet

Hayır

12. Herhangi bir göz rahatsızlığına sahip misiniz? (3.00 üzeri Astigmat, Miyop vs...) \*

*Yalnızca bir şıkkı işaretleyin.*

- Evet  
 Hayır

13. Haftada kaç gün ve ne kadar süreyle spor yaparsınız?

*Yalnızca bir şıkkı işaretleyin.*

- Haftada 1-2 kez (0-60 dk)  
 Haftada 3-5 kez (0-60 dk)  
 Haftada 5+ kez (0-60 dk)  
 Diğer: \_\_\_\_\_

14. Dominant Taraf (Hangi elinizi daha aktif kullanıyorsunuz?) \*

*Yalnızca bir şıkkı işaretleyin.*

- Sağ  
 Sol

15. Dijital Video Oyunları Oynuyor musunuz? \*

*Yalnızca bir şıkkı işaretleyin.*

- Evet  
 Hayır

16. Ne kadar süredir oynuyorsunuz? (YIL ya da AY olarak belirtiniz) \*

\_\_\_\_\_

17. Dijital video oyunlarını en çok hangi araç üzerinden oynuyorsunuz? \*

*Yalnızca bir şıkkı işaretleyin.*

- Bilgisayar  
 PlayStation  
 Telefon/Tablet  
 Xbox  
 Nintendo WII  
 Diğer

18. Hangi oyunları aktif olarak oynuyorsunuz? \*

*Uygun olanların tümünü işaretleyin.*

- Player Unkonwn's Battle Grounds (PUBG)  
 League of Legends (LOL)  
 Counter Strike: Global Offensive (CS:GO)  
 DOTA 2  
 Fortnite  
 Overwatch  
 Rainbow Six: Siege  
 Heartstone  
 Heroes of the Storm (HoTS)  
 Realm Royale  
 FIFA  
 PES  
 World of Warcraft (WoW)  
 Vainglory  
 Starcraft  
 Call of Duty  
 The SIMS  
 Euro Truck Simulator  
 Valorant  
 NBA  
 Diğer

19. Bu oyunlardan en az biriyle ilgili daha önce turnuvaya katıldınız mı? \*

*Yalnızca bir şıkkı işaretleyin.*

- Evet  
 Hayır

20. Katıldığınız turnuva veya oynadığınız oyunlardan daha önce hiç maddi kazanç \* elde ettiniz mi?

*Yalnızca bir şıkkı işaretleyin.*

- Evet  
 Hayır

21. Günde kaç saat dijital video oyunlarını oynuyorsunuz? \*

*Yalnızca bir şıkkı işaretleyin.*

- 0-3  
 4-6  
 7-9  
 10-12  
 Daha fazla

22. Haftada ortalama kaç saat oyun oynuyorsunuz? \*

*Yalnızca bir şıkkı işaretleyin.*

- 0-3  
 4-6  
 7-9  
 10-13  
 14 ve üzeri