T. C.
YEDİTEPE UNIVERSITY
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DEPARTMENT OF SPORT PHYSIOTHERAPY

THE RELATIONSHIP BETWEEN SENSORY AND PSYCHOLOGICAL COMPONENTS OF PAIN IN ELITE LEVEL VOLLEYBALL PLAYERS: A PROSPECTIVE COHORT STUDY

MASTERS THESIS

EDA ASLAN, PT.

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THESIS APPROVAL FORM

Institute : Yeditepe University Institute of Health Sciences

Program : Sport Physiotherapy

Title of the Thesis : The RelatIonship Between Sensory and Psychological Components of Pain In Elite Level Volleyball Players: A Prospective Cohort Study.

Owner of the Thesis : Eda Aslan

Examination Date : 19.04.23

This study have approved as a Master/Doctorate Thesis in regard to content and quality by the Jury.

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APPROVAL

This thesis has been deemed by the jury in accordance with the relevant articles of Yeditepe University Graduate Education and Examinations Regulation and has been approved by Administrative Board of Institute with decision dated ..... and numbered .....

Prof Dr. Bayram YILMAZ

Director of Institute of Health Sciences

DECLARATION

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree except where due acknowledgment has been made in the text.

19.04.23

Eda ASLAN

DEDICATION

I would like to dedicate my thesis to my mother and father who supported and cherished me through every step of my education.

ACKNOWLEDGEMENTS

First of all, I would like to express my respect and gratitude to my thesis advisor, Assist. Prof. Çiğdem Yazıcı Mutlu, for her guidance, patience, and advice on every stage of my thesis.

I want to thank our head of department, Prof. Dr. Feryal Subaşı, and all my lecturers who have supported me in all matters and contributed to my development since my undergraduate period.

I am grateful to my dearest friend Sahra Şirvan Can and Ata Tekin, for their motivational support.

I am grateful to Galatasaray Sports Club Womens' and Mens' Volleyball A Teams' physiotherapists Dinçer Kaya and Yalçın Ayhan for their supports.

I am grateful to İlbank Sports Club Womens' Volleyball A Team's physiotherapist Vildan Şişek for her support.

I am grateful to Kuzeyboru Sports Club Volleyball management and former coach Kamil Söz for their support.

I am thankful to dearest Dr. Beyza Tayfur for her guidance and mentorship whenever I needed it in my education and thesis.

I extend my best wishes to all my friends for believing in and encouraging me, especially Baran Hürsan.

I offer my love and respect to my whole family, especially my mother, Mediha Aslan, and my father, Seyhan Aslan, who always believed in the best of me and for their endless love and support.

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LIST OF SYMBOLS AND ABBREVIATIONS

IASP:	International Association for the Study of Pain
DOMS:	Delayed Onset Muscle Soreness
CPT:	Cold Pressor Test
PBQ:	Pain Beliefs Questionnaire
PCS:	Pain Catastrophization Scale
APSQ:	Athlete Psychological Strain Questionnaire
SAS-2:	Sport Anxiety Scale - 2
ANOVA:	Analysis of Variance

ABSTRACT

Aslan, E. (2023). The RelatIonship Between Sensory and Psychological Components of Pain In Elite Level Volleyball Players: A Prospective Cohort Study. Yeditepe University, Institute of Health Sciences, Department of Sports Physiotherapy, MSc Thesis, İstanbul.

The aim of this study is to investigate the relationship between the sensory and psychological components of pain in elite-level volleyball players. In the study 21 (9 male, 12 female) elite-level volleyball players take part between the ages of 18-35. The pain threshold and tolerance values were evaluated by cold pressor test (CPT) to evaluate the sensory component of pain. Athletes' pain beliefs, pain catastrophization, psychological strain, and anxiety were evaluated to evaluate the psychological components. The data were collected during four months in three measurements to investigate these parameters' relationship over a half athletic season. Statistical data analysis was performed using the SPSS analysis program using mean and standard deviation. Repeated measures analysis of variance (ANOVA) was used for comparisons of scale scores at measurement times. In case of significant results, multiple comparisons were made with the Bonferroni test. Psychologic and sensory data obtained from each measurement were compared. The relationships between numerical variables were evaluated with Pearson correlation coefficient There was no significant difference in athletes' pain catastrophizing and psychological strain between measurement times ($p>0.05$). In the first measurement, athletes had significantly higher pain thresholds and tolerance levels, with male athletes showing higher mean values than female athletes. ($p<0.05$). The concentration disruption was higher in the first measurement, and female athletes had a higher mean value than male athletes ($p<0.05$). Organic beliefs correlated negatively with the pain threshold and tolerance, while psychological beliefs correlated negatively with pain tolerance ($p<0.05$). It was found to be that pain tolerance is more related to the psychological components of pain.

Key words: Pain Perception, Pain Threshold, Cold Pressor Test, Elite Athletes, Pain Beliefs

ÖZET

Aslan, E. (2023). Elit Düzey Voleybolcularda Ağrının Duyusal ve Psikolojik Bileşenleri Arasındaki İlişki: Prospektif Kohort Çalışması. Yeditepe Üniversitesi, Sağlık Bilimleri Enstitüsü, Spor Fizyoterapisi Bölümü, Yüksek Lisans Tezi, İstanbul.

Bu çalışmanın amacı elit düzeydeki voleybolcularda ağrının duyusal ve psikolojik bileşenleri arasındaki ilişkiyi araştırmaktır. Çalışmaya yaşları 18-35 arasında 21 (9 erkek, 12 kadın) elit düzey voleybol oyuncusu dahil edilmiştir. Ağrının duyusal bileşenini değerlendirmek için ağrı eşiği ve tolerans değerleri soğuk presör testi (CPT) kullanılmıştır. Psikolojik bileşenleri için sporcuların ağrı inançları, ağrı katastrofizasyonu, psikolojik gerginlik ve anksiyeteleri değerlendirilmiştir. Veriler, bu parametrelerin yarım müsabaka sezonu boyunca ilişkisini araştırmak için üç ölçümde dört ay boyunca toplanmıştır. İstatistiksel veri analizi SPSS analiz programı kullanılarak ortalama ve standart sapma kullanılarak gerçekleştirilmiştir. Ölçüm zamanlarındaki ölçek puanlarının karşılaştırılması için tekrarlı ölçümlerde varyans analizi (ANOVA) kullanılmıştır. Sonuçların anlamlı çıkması durumunda Bonferroni testi ile çoklu karşılaştırmalar yapılmıştır. Sayısal değişkenler arasındaki ilişkiler Pearson korelasyon katsayısı ile değerlendirilmiştir. Her ölçümden elde edilen psikolojik ve duyusal veriler karşılaştırılmıştır. Ölçüm zamanları arasında sporcuların ağrı katastrofizasyonu ve psikolojik gerginliklerinde anlamlı bir fark olmadığı görülmüştür ($p>0.05$). Sporcuların ağrı eşikleri ve tolerans düzeyleri yapılan ilk ölçümde, diğer ölçümlere göre anlamlı derecede daha yüksek bulunmuş, ve erkek sporcuların kadın sporculardan daha yüksek ortalama değerler gösterdikleri görülmüştür ($p<0.05$). Konsantrasyon bozukluğunun ilk ölçümde daha yüksek olacak şekilde, kadın sporcuların erkek sporculardan daha yüksek ortalama değere sahip olduğu görülmüştür ($p<0.05$). Bunun yanında, organik inançlar, ağrı eşiği ve toleransı ile negatif korelasyon gösterirken, psikolojik inançlar, sadece ağrı toleransı ile negatif korelasyon göstermiştir ($p<0.05$). Ağrı toleransının ağrının psikolojik bileşenleri ile daha çok ilişkili olduğu bulunmuştur.

Anahtar kelimeler: Ağrı Algısı, Ağrı Eşiği, Soğuk Presör Testi, Elit Atletler, Ağrı İnançları

1. INTRODUCTON AND PURPOSE

The current definition of the International Association for the Study of Pain (IASP), the pain is defined as "an unpleasant sensory and emotional experience associated with or similar to actual or potential tissue damage" (1). Pain is part of the sport experience and a familiar problem among elite-level athletes, regardless of whether the sports discipline is contact or non-contact (2, 3).

Pain can affect athletes' peak performance in physiological and psychological aspects, motor control, and endurance in all sports branches (4). This makes the experience of pain a critical component of training or competition. In sports, pain is often associated with sports injuries. Although pain in sports is frequently associated with sports injuries, it may occur without the injury and persist after the injury heals (3). The understanding of pain has transformed from a Cartesian viewpoint that perceived pain solely caused by tissue damage to a multi-faceted perspective. Based on the most recent IASP definition, experiencing pain is a unique, complex, and dynamic process. Numerous elements, such as neurophysiological, immunological, cognitive, behavioral, and social/environmental events, have an influence on this experience (2). Therefore, this viewpoint considers various factors, such as tissue overload, nociceptive inflow, and emotional, behavioral, cognitive, and lifestyle factors, all interacting in intricate ways that can increase or decrease an individual's vulnerability to pain. It is recently recognized that persistent chronic pain cannot be accounted for by pathoanatomical transformations alone (5, 6). As such, focusing narrowly on biomechanical factors can create misconceptions about pain, elevate the perceived threat of pain, promote protective behavior, and result in avoidance and disability. It has been reported that imaging findings of asymptomatic people frequently reveal "abnormal" anatomical results, and patients frequently claim pain in the absence of related imaging findings (2, 7). Pain perception has been evaluated with pain threshold and tolerance measurements. According to the IASP definitions of pain threshold and tolerance, these terms describe individual, situation, and stimulus-specific experiences (1).

Although pain is common in sports, studies evaluating the pain felt by athletes, with physical and psychosocial aspects, are limited. A study that evaluated musculoskeletal pain and psychosocial status in different sports branches concluded that the pain threshold of volleyball players was the highest. Also, the depression rate of athletes competing in team sports was higher than that of athletes competing in individual sports branches. The rate of severe depression among team sports was the highest in female volleyball players. The same study observed that volleyball players had the lowest score in the psychological health assessment, and volleyball was the branch with the lowest quality-of-life score (8). It has been proposed that being exposed to regular, high-intensity physical activity may modify pain perception and tolerance (4,10,11). Such activity may improve or modify endogenous inhibitory processes, decreasing pain (10). Tesarz et al. concluded that athletes have higher pain thresholds and tolerance values than non-athletes (12).

Literature reported various ways to evaluate pain threshold and tolerance. A review has proposed physical tests assessing this sensory dimension of pain with electrical stimulation, delayed onset muscle soreness (DOMS), muscle pain due to exercise, noxic chemical injection, ischemic pain, thermal heat increase, cold press test, and pain pressure test. This review showed that contact sports athletes had higher pain tolerance than physically active controls and non-contact athletes (4). However, among the studies included in the review, no study evaluated the perceived pain levels in a team sport, such as volleyball, simultaneously with its psychological and sensory dimensions in a prospective plan.

In light of the knowledge from current literature, there is limited evidence offering an understanding consensus on the pain experience of athletes. Literature reviews suggest that athletes' pain experience should be examined in both physical and psychosocial aspects (2, 3, 13). These studies suggest that psychosocial dimensions of pain experience should be considered for pain research. Thus, we designed a study to explore the relationship between the sensory and psychological components of pain over time in

elite-level athletes. Our study aimed to investigate the relationship between sensory and psychological components of pain in elite-level volleyball players.

Two hypotheses were determined in this study.

H0: There is no significant relationship between sensory and psychological components of pain in elite-level volleyball players.

H1: There is a significant relationship between sensory and psychological components of pain in elite-level volleyball players.

2. GENERAL INFORMATION AND THEORETICAL FRAMEWORK

The International Association for the Study of Pain (IASP) defined pain as "an unpleasant sensory and emotional experience associated with or resembling that associated with actual or potential tissue damage" (1). The definition by IASP highlights the multi-dimensional nature of pain as a physiological and psychosocial experience. A person's perception of pain is always unique and is affected by biological, psychological, and social variants. Pain is typically seen as a tissue damage indicator, either actual or potential. Even though the individual may describe the experience as if there had been an injury to the tissue, pain can still exist without it. Although pain often has an adaptive role, it can also negatively influence function as well as social and psychological well-being. The more pain continues, the more the chance that psychological, social, environmental, and contextual aspects will impact the pain and its related issues, such as functional incapability. Pain can be classified into several different types according to the mechanism of its origin. This classification allows us to predict the course and treatment of pain.

2.1. Types of Pain

2.1.1. Nociceptive pain

The word noxic is derived from the Latin word "nocere," meaning hurtful. A noxious stimulus is a term used to describe any stimulus that causes actual or potential tissue damage to the organism. Nociceptors are sensory nerve terminals of the peripheral somatosensory nervous system skilled at transmitting and encoding noxic stimuli. Nociceptors provide a 'first detection' system within the body's tissues. It plays a substantial role in the pain experience. Mechanical, thermal, or chemical state changes in tissues can activate the nociceptors. Nociception is the neural process of encoding noxic stimuli. The responses to noxic stimuli can be autonomic (e.g., high blood pressure, constricted pupils) or behavioral (motor withdrawal reflex or more complex nocifensive behavior) (1,9). Feeling pain is not necessarily indicated, and pain can occur

without activating nociceptors (phantom pains). Nociceptive pain is "pain that arises from actual or threatened damage to non-neural tissue and is due to the activation of nociceptors" (1,9). Nociceptive pain is associated with actual tissue damage and inflammatory processes activating peripheral nociceptors. Therefore, inflammatory pain is a type of nociceptive pain. However, tissue damage is not necessary for nociceptive pain to occur.

2.1.2. Neuropathic pain

Neuropathic pain is referred to as "pain caused by a lesion or disease of the somatosensory nervous system" (1,9). It is characterized by an unpleasant sensory and emotional experience related to damage to innervated tissues. Still, this damage may be due to peripheral or central nervous system dysfunction. According to the related area, it can be classified as peripheral neuropathic pain or central neuropathic pain. Descriptive terms like "burning" or "stabbing" are often used to describe neuropathic pain, but they do not necessarily indicate the presence of actual tissue damage. Neuropathic pain is not considered a diagnosis but rather a clinical explanation requiring a provable lesion or disease that meets proven neurological diagnostic measures. Neuropathic pain does not require nociceptor activation. It is widely seen after spinal cord injuries, peripheral nerve injuries, and strokes.

2.1.3. Nociplastic Pain

Nociplastic pain is defined as "pain that arises from altered nociception despite no clear evidence of actual or threatened tissue damage causing the activation of peripheral nociceptors or evidence for disease or lesion of the somatosensory system causing the pain." (1,9). Although it is thought to be based on the mechanism of central sensitization, a definite opinion has yet to be reported. The suggested definition classifies nociplastic pain as a distinctive category without existing or potential tissue or sensorial damage. However, there is evidence that nociceptive, neuropathic, and nociplastic pain overlap, indicating that nociplastic pain is not a separate category but a

continuum of chronic pain (3). The biopsychosocial model is known to be relevant for nociplastic pain disorders. Causal factors for altered nociceptive function are not yet significant. Nevertheless, predisposing factors may have a family history of pain, a history of pain experiences, and psychosocial factors (14).

2.1.4. Sensitization

In IASP terminology, sensitization refers to the "increased responsiveness of nociceptive neurons to their normal input, and/or recruitment of a response to normally sub-threshold inputs." (1, 9). Sensitization can take place at both the nociceptor level in the peripheral nervous system and at the level of the second-order neuron in the spinal cord. According to where it takes place, it is named peripheral or central sensitization.

2.1.5. Peripheral and central sensitization

In the peripheral nervous system, tissue damage has the potential to transform a high-threshold mechanoreceptor - one that typically responds solely to harmful mechanical stimuli - into a receptor that reacts to non-harmful stimuli in a similar manner as it would to noxious stimuli. Peripheral sensitization explains this "increased responsiveness of nociceptive neurons to their regular input and/or recruitment of a response to normally sub-threshold inputs" (1, 9). After soft tissue and/or peripheral nerve injury, some chemical mediators are released from the tissue. The secreted cytokines, histamine, bradykinin, growth factors, and neuropeptides combine to form the "inflammatory soup" on the injury site (15). This results in inflammation and sensitization of many components of the somatosensory system. Following peripheral sensitization, increased excitability of free nerve endings in the periphery causes primary afferents to generate ectopic impulses, and central sensitization occurs in the spinal cord. Stimuli that are usually not perceived as painful are recognized as such (allodynia), and/or there is an increased reaction to painful stimuli, either at the site of injury (primary hyperalgesia) or spreading to the neighboring uninjured tissue (secondary hyperalgesia) (16).

2.2. Pain Threshold and Tolerance

The threshold has often been described as the smallest stimulus intensity at which a subject feels pain. However, the threshold should be considered as a patient's experience, whereas the intensity measured is an exterior event. It has been common usage for most pain research to define the threshold in terms of the stimulus, but IASP advises avoiding this. Pain threshold is referred to as "The minimum intensity of a stimulus that is perceived as painful." by IASP. Therefore, the stimulus is not the pain itself and cannot be a measure of it on its own. Psychophysics defines *thresholds* as the level at which 50% of stimuli are recognized. Accordingly, the pain threshold would be the level at which 50% of stimuli would be recognized as painful.

Pain tolerance is "The maximum intensity of a pain-producing stimulus that a subject is willing to accept in a given situation." (1, 9). It has also been described as "the length of time an individual is willing to endure a noxious stimulus or by the maximum stimulus intensity that one will endure in a given situation." (17). Similar to the concept of pain threshold, the pain tolerance level is a personal experience unique to each individual. Therefore, the definition of pain tolerance level, much like the pain threshold, does not rely on external stimulation as the determining factor.

Various methods can be utilized to investigate pain threshold and pain tolerance experimentally. One example is the pain pressure test, which involves increasing mechanical pressure on a body part from the outside. Thermal pain, on the other hand, can be induced by either cold or hot stimuli. The cold pressor test involves immersing an extremity in cold water until the participant can no longer tolerate the pain. Similarly, cutaneous heat can be induced by immersing an extremity in water or by using radiant/ laser heat sources or contact probes. Transcutaneous electric stimulation is another method that can be used to induce pain. In addition to external methods, various options exist for inducing pain within muscles, including the application of topical stimuli or injection into the muscles to stimulate muscle nociceptors, as well as physical exercise. Muscle ischemia is another method that involves using a cuff to interrupt blood flow

and induce local hypoxia, thereby reducing clearance in the context of external stimuli application (4).

2.3. Pain In Sport and Athletes

Sports medicine primarily deals with identifying and treating injuries related to sports activities, while pain medicine concentrates on identifying and managing pain disorders. Pain is a common problem affecting peak performance in sports and among elite-level athletes and is often associated with and accompanied by a sports injury (3 12). The IOC has defined sports injury as "new or recurring musculoskeletal complaints incurred during competition or training that require medical attention, regardless of the potential absence from competition or training" (3, 14). Pain is also considered to influence rehabilitation length and outcomes after a sports injury negatively (18). Besides, evidence suggests that pain intensity is one of the most potent predictors of activity tolerance level, especially within rehabilitation (18). Pain provides valuable information about the body and how it is performing. Recognizing the character of pain is essential to understand what kind and type of pain should be listened to be helpful or safe to work through. While an injury may occur without any accompanying pain or persist even following the healing, the presence or absence of pain does not necessarily indicate the state of injury recovery (3). Pain can occur without tissue damage or persist after healing is completed (19). Injuries can occur without causing pain; conversely, pain can manifest without apparent evidence of injury. Also, literature presents evidence that when pain persists for an extended period, mainly if it is mild to extreme, it is often followed by psychological distress, such as anxiety and depression, as well as sleep disturbances, physical deconditioning, and limitations in physical, functional, and social roles (3, 12, 20).

2.4. Psychosocial Determinations of Pain in Athletes

In recent years, pain science has advanced from the Cartesian perspective of Descartes, which considers pain as a result of tissue damage, to a multi-dimensional perspective.

This new perspective views various factors contributing to pain, including overload, nociceptive activity, and behavioral, emotional, cognitive, and lifestyle aspects, which interact in intricate ways to make individuals more or less susceptible to experiencing pain. For this reason, research suggests that the pain experience should be evaluated based on complex systems, suggesting that pain experience results from dynamic and non-linear relations among many known and unknown factors (21).

Evidence suggests that it is advisable to consider techniques that enhance an athlete's emotional well-being and regular monitoring of the psychosocial factors during the rehabilitation phase of any injury (5, 22). This evidence highlights the importance of using a biopsychosocial approach that offers a broader understanding of pain in athletes. However, the biopsychosocial model has limitations that must be acknowledged, as it does not adequately investigate a range of factors that could impact an athlete's experience of pain. These factors include access to healthcare, the quality of sleep and nutrition, mental health, and psychosocial factors like remorse, stigma, emotional support, shame, perceived inequity, interpersonal relationships, and culture. The impact of these factors on an athlete's pain experience and perception remains unknown due to their limited exploration within the biopsychosocial model (21).

Psychological factors are important and should be taken into consideration in pain and the athlete's perception of pain and responses to injury (3,14,18). Many studies have reported that pain perception is strongly modulated by psychosocial and psychological factors (17). Psychosocial factors that commonly have an impact on pain include anxiety, stress, catastrophizing (having highly negative evaluations of pain and its consequences), depression, and an inappropriate fear and avoidance of pain and re-injury, which can lead to avoiding activities that are perceived to either increase the pain, cause harm, or both (14).

2.4.1. Anxiety

Anxiety disorders are prevalent in the general population (at a rate of 10.6% to 12.0%) and among elite athletes (at a rate of 8.6%). These disorders involve emotional responses to perceived or actual threats, including fear, apprehension, worry, and

tension. Anxiety can impair attentional networks, leading to compromised executive function, processing of stimuli, and information sampling, all critical disciplines for elite-level competition. Studies revealed that being female, having a younger age, and having lower athletic experience were linked to higher levels of competitive anxiety in athletes. However, the distinct elements that contribute to anxiety disorders in elite-level athlete populations have not been documented. Also, elite athletes who experience higher competitive levels reported fewer anxiety symptoms than those in lower competitive levels (23).

2.4.2. Catastrophization

Pain catastrophization is a known and consistent psychosocial predictor that significantly impacts pain-related results, such as pain intensity, disability, and psychological function (24). It has been described as a "negative cognitive−affective response to anticipated or actual pain" (25) that can develop and maintain unfavorable emotions and amplify symptoms and distress. Rumination, pain magnification, and helplessness are elements of catastrophizing. These elements interfere with a person's ability to distract oneself from pain-related thoughts during the pain experience (26). In sports, pain experience, and injuries may compromise athletes' physical and mental performance. Thus, athletes tend to exhibit catastrophizing behavior, amplifying their pain perception as excessively negative (27). In persistent pain situations, this catastrophization may contribute to the chronification of the pain, making it impossible to continue the sports activity (28).

2.4.3. Stress

Stress is "a response to demands placed upon the body independent of the stressors' nature" (29). Many stressor types that are related to potential threats can induce stress. The main two of them are physiological and psychological stresses. Physiological stress is indicated by "an unpleasant sensory, emotional, and subjective experience associated with potential tissue damage and bodily threat.". Some examples of this type of stress as

bodily conditions like pain, hunger, and oxidative stress may fulfill these criteria. Social threats like peer pressure, social exclusion, and goal-directed performance conditions can lead to psychosocial stress. As a result, pain as a physiological stressor, achievement circumstances, and social rejection as psychosocial stressors result in comparable subjective, emotional, and peripheral stress responses. Physiological and psychosocial stresses are associated with situations threatening the survival and changing mesolimbic dopamine transmission in the striatum and the prefrontal cortex. Similar neural regions, such as the limbic-prefrontal circuit, are activated in processing psychosocial and physiological stress (30). Also, the hypothalamic-pituitary-adrenal gland axis (HPA) activates in response to physiological and psychological stressors and releases cortisol.

Pain experience can be evaluated as a stressor in both these terms. Having and coping with pain combines sensory and affective processing and has an arousing effect, increasing cortisol release and a negative affect (29). The athlete's stress level, whether physiological or psychological, generates a physiological response within the body and activates the HPA axis. Increased cortisol secretion creates oxidative stress, which affects the healing process in case of a sports injury, the quality of the granulation tissue, as well as the athlete's pain modulation, sleep-wake balance, and general mood.

2.4.4. Beliefs

Expectancies and beliefs are shaped by many factors, such as communication, culture, experiences, observation, and learning (31). Cultural variation includes differences in beliefs and practices concerning pain, reflecting unique histories in adapting to ecosystems and discovering solutions to the challenges of physical danger (16). Family interactions, socializing with peers, and exposure to media, especially the internet, may spread false information, dysfunctional beliefs, misconceptions regarding pain symptoms, maladaptive coping strategies, emotional distress, fear, and heightened sensitivity towards pain (16). Sullivan et al. (32, 33) have proposed that pain as an intrapersonal experience should be interpreted from an interpersonal perspective. On the other hand, it is also reported that athletes are more likely to refuse a psychological

standpoint of illness, to somatisize their concerns, and to deny the significance of their life stresses like training and competition. They pinpoint the importance of recognizing the potential relationship between anxiety, depression, and health-related attitudes and beliefs to assess injured athletes with accompanying psychological symptoms, however of the source of psychological stress (34).

2.5. Volleyball and Elite Athletes

Volleyball is a sport played between two teams on a court. The court is divided into two parts by a net. Volleyball aims to send the ball over the net into the opponent's playing area to ensure it touches the ground and prevent the opposing team from achieving the same goal. The game starts with a serve. The serving player sends the ball over the net into the opponent's court. The time until the ball touches the playing field, goes out of the designated lines, or one of the teams makes a mistake is called a rally. The team that wins a rally scores a point. When the team that receives the serve wins the rally, it has the right to serve and wins a point. The team players that win a point rotate one position clockwise (35). The attacks in the game require quick displacement, explosive power, aerobic fitness, and body control. The athlete needs good physical fitness and performance in volleyball, along with technique and tactics (36). The combination of many physiological, biomechanical, and psychological effects forms the maximal performance level of athletes in competitions. Volleyball players need to show high performance to be successful in the game. For this performance, the athlete should be developed psychologically and physically (37). Especially in team sports, the motivation of people who are different from each other for a single purpose, harmony between them, coordination, technical and physical skills, and personal characteristics affect team success. Athletes have emotional difficulties due to stress due to pressures and expectations in challenging matches. The situations experienced by athletes can cause them to feel emotions such as anxiety and stress. Athletes' emotions and psychological states are among the factors affecting their performance (38). Researchers and authors have employed several methods to define and track the performance of elite athletes. While some have used world records as a benchmark for exceptional

performance over time, others have monitored the top 10 or more performances each year. Elite athletes have been defined in diverse ways by different authors, including those who compete at the college or university level, national or international level, award winners, Olympians, professionals or semi-professionals, and world-class performers, accomplishing within a particular percentage of world records, highly experienced, training regularly, or surpassing certain measured physiological variables such as V˙O2max (39). Furthermore, research suggests that it should be taken into consideration that elite athletes participate in high-stress environment sports competitions. This high-stress environment may put the athlete in favorable or unfavorable psychological conditions, like inspiration or tension, and therefore modify the relationship with pain (40).

3. MATERIALS AND METHODS

3.1. Study Design

This study was conducted during the first half of Turkey's 2022-2023 men's and women's volleyball super leagues. The study planned as a cohort study and periodical measurements were taken for 4 months.

3.2. Study Setting

To test our hypotheses, these steps were followed:

- Six teams from Turkey's 2022-2023 men's and women's volleyball super leagues were participated in our study.
- The aim of the study, the study protocol, and the testing procedure were explained to the team physiotherapists via a Zoom video call since five teams were participating from different cities.
- After the explanatory video call, an online Google Forms questionnaire and an explanatory PDF document about the eligibility criteria were sent to the five team physiotherapists. This PDF included instructions for the application of the cold pressor test.
- The data were collected at three points over four months, with measurement times planned one week before the league started, the sixth or seventh week of the league, and the end of the first half of the league.
- The cold pressor tests for three participating teams were conducted by each team's physiotherapists, and the researcher conducted the cold pressor test for one team.
- The questionnaires were sent to each participating athlete via Google Forms. The data obtained from the questionnaires were automatically collected by the researcher on Google Forms.
- The data from the cold pressor test were manually recorded by each team's physiotherapist. After each measurement, they sent the data obtained from this test to the researcher.

3.3. Participants

The population of the study consists of Turkish volleyball players competing in the Turkish Volleyball Federation 2022-2023 super league teams. Four teams participated in our study.

Participants of the study were selected according to the following criteria:
Inclusion criteria:
-Taking part in Turkey's 2022-2023 men's and women's volleyball super leagues
-Volunteering to participate in the study
-To be between the ages 20-35

Exclusion criteria:
-Not speaking Turkish as mother language
-Having systemic diseases like Raynaud's phenomenon, diabetes, hypertension, and migraine
-Regular use of any medicine for pain management
-Having a lesion on the hand and forearm, which is to be tested in the cold pressor test

The sample size of the study; Using the G-Power program, the effect size was found as 0.4035466 based on the standard deviation and mean values of the relevant article. When $p<0.05$ was accepted, and the power of the study was taken as 80%, the total sample size of the study was found to be 40 (10). Due to the chance of drop outs through the study, 50 athletes were gathered at the first measurement. At the second measurement, the number was down to 34, and at the last measurement, the participant number was n=21 (12 female, 9 male) (Figure 3.1).

3.4. The Study Protocol

3.4.1. Evaluations

Demographic information and the psychological components of athletes' pain were gathered through an online questionnaire on Google Forms. This questionnaire included

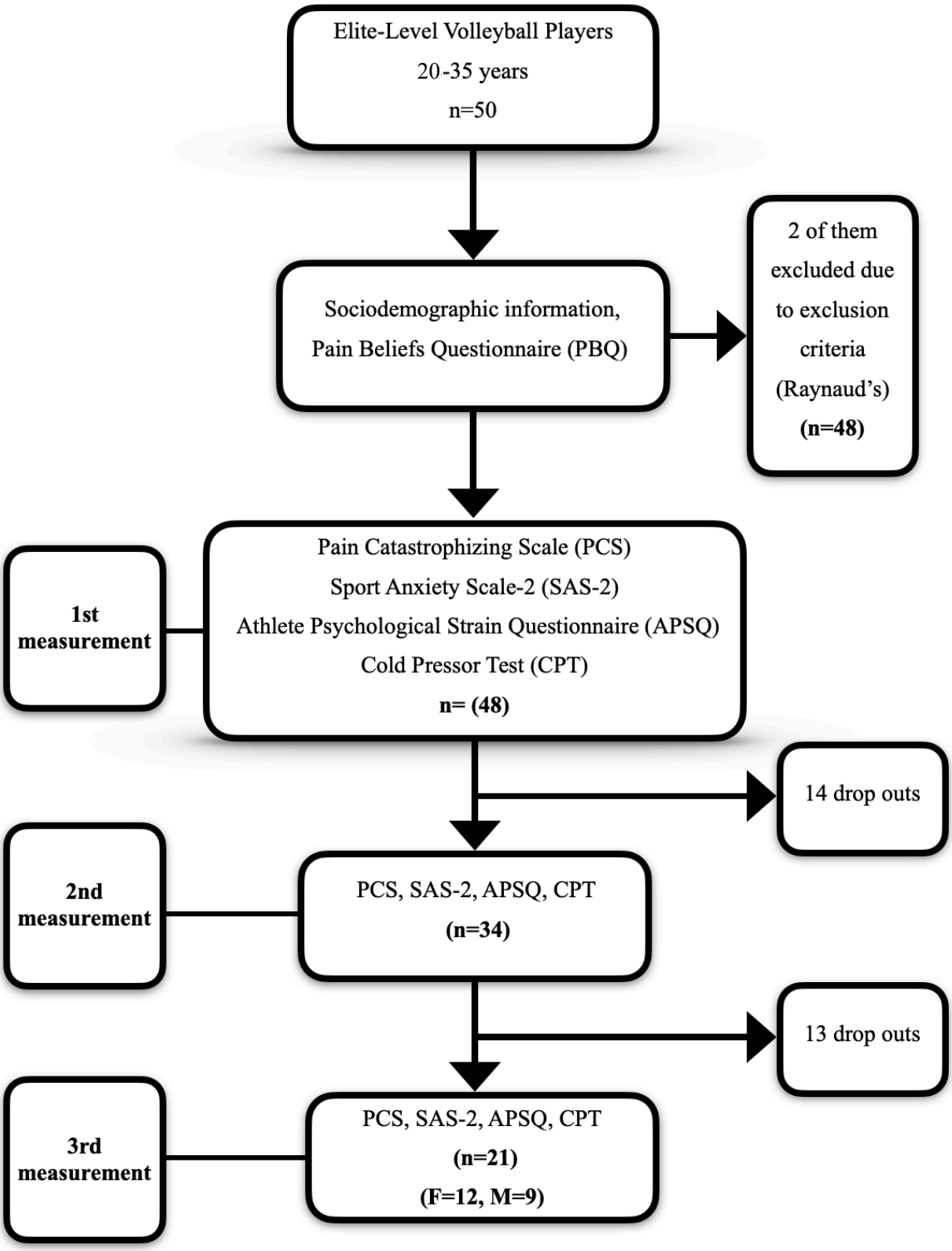

Figure 3.1. The flow chart of the study

demographic information, Pain Beliefs Questionnaire, Pain Catastrophizing Scale, Sport Anxiety Scale-2 and Athlete Psychological Strain Questionnaire. Pain tolerance and pain threshold values were recorded with cold pressor test. Cold pressor test results were recorded manually.

3.4.2. Demographic information

As demographic information, participants were asked to fill out an online Google Forms about their age, height, and weight, the position they are currently playing, previous or current injury status, systemic diseases, and prescribed medicine usage.

3.4.3. Questionnaires

3.4.3.1. Pain beliefs questionnaire (PBQ)

The Pain Beliefs Questionnaire (PBQ), designed by Edwards et al. in 1992, evaluates psychological and organic belief attributions about the source and outcome of pain. There are two subtest groups on the scale: The organic beliefs sub-scale consisting of 8 items, and the psychological beliefs sub-scale consisting of 4 items. Each sub-scale item is evaluated with a 6-point Likert-type rating (1: Never, 2: Rarely, 3: Sometimes, 4: Often, 5: Almost Always, 6: Always). Turkish validity and reliability study was completed and published by Berk and Bahadır in 2006 (41).

3.4.3.2. Pain catastrophizing scale (PCS)

The Pain Catastrophizing scale (PCS) was designed by Sullivan et al. in 1995. It was designed to measure the degree of individual pain catastrophizing level. The Pain Catastrophizing Scale assesses a person's thoughts, feelings, and emotions associated with pain and catastrophizing. This self-administered scale has thirteen items and three sub-scales: helplessness, magnification, and rumination. It is evaluated with a 5-point Likert-type rating (1: Not at all, 2: To a Slight Degree, 3: To a Moderate Degree, 4: To a Great Degree, 5: All the Time). The scores for each item are added to determine the

subscales, and the summation of all items calculates the total score. The PCS scores range from 0 to 52 points. The Turkish validity and reliability study was conducted and published by Süren et al. in 2014 (26, 42, 43)

3.4.3.3. Sport anxiety scale-2 (SAS-2)

The Sport Anxiety Scale-2 (SAS-2) was developed by Smith et al. in 1990 and revised in 2006 by the same researchers. It consists of sub-scales of somatic anxiety, worry, and concentration disruption, each consisting of 5 questions. Somatic anxiety refers to the physiological and emotional responses that individuals experience when faced with competitive threats. Research suggests that athletes who exhibit higher levels of trait anxiety are more likely to experience significant somatic anxiety and reduced self-confidence. Somatic anxiety is one of three types of anxiety symptoms, along with cognitive and behavioral anxiety. Physical manifestations, such as muscle tension, sweaty palms and feet, increased heart rate, perspiration, and a sensation of butterflies in the stomach, are typical indicators of somatic anxiety. These symptoms tend to escalate when an individual experiences physical nervousness in response to a perceived threat. Concentration disruption is the inability of an athlete to maintain their focus on the essential components of a task, resulting in a lack of mental clarity during competition. This condition is characterized by the athlete's difficulty directing their mental effort toward the critical aspects of the task. It can have a significant impact on their performance. Worry refers to feeling anxious or concerned about actual or potential issues. In elite-level athletics, experiencing a certain degree of worry can lead to various unfavorable outcomes, such as negative cognitive processes and physiological symptoms, such as heightened pulse, muscle tension, and sweating. These effects can negatively affect an athlete's performance, potentially hindering them from performing at their best (44). Fifteen questions in total, evaluated by a 4-point Likert-type scale (1: Not at all, 2: Somewhat, 3: Moderately So, 4: Very Much So); The Turkish validity and reliability study was conducted and published by Karadağ et al. in 2020 (44)(45).

3.4.3.4. Athlete psychological strain questionnaire (APSQ)

This questionnaire, developed by Rice et al. in 2020, aimed to help evaluate the sport-specific psychological strain. The APSQ contains ten items measuring sport-specific psychological strain. 5-point Likert-type scores for each item (ranging from 1=none of the time to 5=all of the time) assessing self-regulation (e.g., "I was less motivated"), performance (e.g., "I found training more stressful"), and external coping (e.g., "I took unusual risks off-field"). While the minimum score is 10, the maximum is 50. Rice et al. reported cut-off scores of APSQ for moderate ≥15, high ≥17, and very high ≥20. Higher scores indicate a more significant psychological strain. Lima et al. conducted and published a Turkish validity and reliability study in 2022 (46).

3.4.4. Cold pressor test

Cold Pressor Test was applied to measure the athletes' sensory pain threshold and tolerance values. The Cold Pressor Test was designed to evaluate autonomous responses in the cardiovascular system. The test starts with immersing a hand or entire forearm in ice water for a period, stimulating noxic pain and the autonomic nervous system's response. The Cold Pressor Test has been widely adopted in the literature as a model for nociceptive pain (4, 47). In our study, for the test:

- A bucket or a water container in which the participant's forearm can easily fit, and a stopwatch was used for time measurement.
- The water temperature was prepared at 0°C-2°C and checked after each participant with a thermometer.
- Participants were asked to put their dominant hand in the water up to their elbows.
- When they first felt pain, they were asked to inform the physiotherapist performing the test without removing their forearms from the water.
- They were asked to keep their forearms in the water as long as they could tolerate the pain.

The test was applied within 5 minutes time limit. If the participant were about to exceed 5 minutes, the test was terminated by the researcher. Participants were not informed

about the time limit. The first reading of time (sensory pain threshold) was recorded when the participant said they 'feel pain,' while the second reading (sensory pain tolerance) was recorded when the forearm was pulled out of the water. Readings were recorded as they were seen on the stopwatch.(10, 47).

3.4.5. Statistical Method

Our study analyzed data using the statistical package IBM SPSS Statistics Standard Concurrent User V 26 (IBM Corp., Armonk, New York, USA). Descriptive statistics were given as the number of units (n), percentage (%), mean ± standard deviation (*Mean±SD*), median (M), minimum (min), and maximum (max) values. The normal distribution of numerical variable data was evaluated by the Shapiro Wilk normality test. Parametric tests were used because numerical descriptive characteristics and variables were normally distributed. Repeated measures analysis of variance (ANOVA) was used for comparisons of scale scores at measurement times. In case of significant results of repeated measures ANOVA, multiple comparisons were made with Bonferroni test. The relationships between numerical variables were evaluated with Pearson correlation coefficient. Mixed Design ANOVA was used to compare the follow-ups of the scales obtained from the athletes at three different times according to gender. The results of multiple comparisons of the differences obtained as a result of Mixed Design ANOVA were found with Bonferroni correction. The level of significance was accepted as $p \leq 0,05$.

4. RESULTS

4.1. Descriptive Characteristics of Participants

This study was conducted with elite-level volleyball players in Turkish Volleyball Superleague (N=21), between the ages of 20-35, between the beginning of the 2022-2023 volleyball season and the end of the first half of the season in 4 month period. The participants' demographic characteristics, including mean age, weight, height, BMI, and pain beliefs are presented in Table 4.1 and 4.2.

According to Table 4.1, 21 athletes participated in the study. 9 (42.9%) were male, and 12 (57.1%) were female. The median age was 27 years. The mean height was 188.86±11.57 cm, the mean weight was 79.05±12.02 kilograms, and the mean body mass index was 22.06±1.69 kg/m2. The positions played by the athletes were as follows: 5 (23,8%) Libero, 7 (33,3%) Middle Blocker, 2 (9,5%) Setter, 2 (9,5%) Opposite, 5 (23,8%) Spiker.Participants' descriptive characteristics of pain beliefs are presented in Table 4.2.

Table 4.1. Demographic characteristics of participating athletes (*N*=21).

		Statistics
Gender	Male	9 (42,9%)
	Female	12 (57,1%)
Age (years)	*Mean±SD*	26,62±4,43
	M (min-max)	27 (20-35)
Height (cms)	*Mean±SD*	188,86±11,57
	M (min-max)	190 (164-210)
Weight (kg)	*Mean±SD*	79,05±12,02
	M (min-max)	78 (60-105)
BMI	*Mean±SD*	22,06±1,69
	M (min-max)	22,1 (18,8-25)
Position	Libero	5 (%23,8)
	Middle Blocker	7 (%33,3)
	Setter	2 (%9,5)
	Opposite	2 (%9,5)
	Spiker	5 (%23,8)

Summary statistics are given as mean ± standard deviation and Median (minimum, maximum) for numerical data and Number (Percentage) for categorical data.

4.2 Comparison of Scales and Measurements

According to Table 4.2., the PBQ Organic Beliefs subtest mean score was 3.08±0.75 points, the lowest score was 1.9, and the highest score was 4.8. The mean score of the Pain Beliefs Questionnaire Psychological Beliefs subtest was 3.38±1.03 points, the lowest score was 1.5, and the highest score was 5.3.

Table 4.2. PBQ descriptive characteristics (N=21).

		Statistics
Organic Beliefs	*Mean±SD*	3,08±0,75
	M (min-max)	3 (1,9-4,8)
Psychological Beliefs	*Mean±SD*	3,38±1,03
	M (min-max)	3,5 (1,5-5,3)

Summary statistics are given as mean ± standard and Median (minimum, maximum) values. PBQ: Pain Beliefs Questionnaire

Table 4.3 shows no statistical difference in the total score and sub-scales of the PCS at the measurement times. There was no statistical difference in the Somatic Anxiety and Worry sub-scales of the SAS-2 at the measurement times, while the mean score obtained as a result of the first measurement in the Concentration Disorder sub-scale was statistically higher. The total score of the APSQ did not show statistical differences between the measurement times. The mean scores obtained from the first measurement in the cold pressor test's pain threshold and pain tolerance sub-tests were statistically higher than second and third measurements.

Table 4.3. Comparison of scales and measurements collected from athletes at measurement times (N=21).

		Time			Test Statistics		
		1st	2nd	3rd	*F*	*p*	η^2
PCS	Rumination	4,86±2,82	4,1±3,45	4,29±2,95	0,523	0,597	0,025
	Magnification	4,05±3,15	3,43±2,8	3,67±2,24	0,891	0,418	0,043
	Helpnessness	5,43±3,91	4,14±2,92	4,86±3,48	1,543	0,226	0,072
	Total Score	14,43±9,04	11,52±7,3	12,81±7,72	1,382	0,263	0,065
SAS-2	Somatic anxiety	7,38±1,72	7,05±1,88	7,10±2,19	0,427	0,656	0,021
	Worry	8,62±3,28	7,48±3,17	7,71±2,99	1,653	0,204	0,076
	Concentration Disruption	7,76±2,12 ^{a}	6,43±1,99 ^{b}	7,33±2,44 ^{ab}	**5,175**	**0,010 ***	**0,206**
APSQ		16,48±5,42	15,24±5,43	18,14±6,95	2,259	0,118	0,101
Cold Pressor Test	Pain Threshold	46,81±31,44 ^{a}	29,05±18,11 ^{b}	29,05±17,69 ^{b}	**11,320**	**<0,001 ***	**0,361**
	Pain Tolerance	128,0±89,15 ^{a}	87,0±68,17 ^{b}	80,7±64,45 ^{b}	**13,182**	**<0,001 ***	**0,397**

*: p<0.05; F: Repeated Measurements ANOVA, Effect Size (η2), Summary statistics are given as mean ± standard deviation. a>b: Different letters or letter combinations in the same row indicate a statistically significant difference (p<0.05). PCS: Pain Catastrophization Questionnaire, SAS-2: Sports Anxiety Scale-2, APSQ: Athlete Psychological Stress Questionnaire

Table 4.4 compares the PCS according to the gender groups of the athletes at three follow-up measurements. There was no statistically significant difference between and within sub-scales in the total score and Rumination, Magnification, and Helpfulness

sub-scales of the PCS (p>0.05).

Table 4.4. Comparison of PCS by gender at measurement times (N=21).

		Gender		Test Statistics †		
		Male n=9	Female n=12	F	p	η^2
Rumination	1st	5,44±2,13	4,42±3,26	0,674	0,422	0,034
	2nd	5,33±4,36	3,17±2,37	2,147	0,159	0,102
	3rd	4,33±3,35	4,25±2,77	0,004	0,951	0,000
Test Statistics ϕ		F=0,802 p=0,464 η^2=0,082	F=0,677 p=0,521 η^2=0,07			
Magnification	1st	4,00±2,35	4,08±3,75	0,003	0,954	0,000
	2nd	3,67±1,94	3,25±3,39	0,109	0,745	0,006
	3rd	3,78±1,86	3,58±2,57	0,037	0,850	0,002
Test Statistics ϕ		F=0,083 p=0,921 η^2=0,009	F=0,684 p=0,517 η^2=0,071			
Helpnessness	1st	5,00±3,67	5,75±4,20	0,182	0,675	0,009
	2nd	3,89±2,52	4,33±3,28	0,114	0,740	0,006
	3rd	4,11±3,92	5,42±3,18	0,712	0,409	0,036
Test Statistics ϕ		F=0,367 p=0,698 η^2=0,039	F=1,318 p=0,292 η^2=0,128			
Total Score	1st	14,67±7,95	14,25±10,13	0,010	0,920	0,001
	2nd	12,78±7,46	10,58±7,37	0,451	0,510	0,023
	3rd	12,22±8,23	13,25±7,66	0,087	0,771	0,005
Test Statistics ϕ		F=0,4 p=0,676 η^2=0,043	F=1,155 p=0,337 η^2=0,114			

F: Mixed Design ANOVA, Effect Size (η2), ϕIntergroup comparison, †Intragroup comparison, Descriptive statistics are given as mean ± standard deviation.

Table 4.5. shows the comparison of the SAS-2 according to the gender groups of the athletes at three follow-ups. There was no statistically significant difference between and within groups in the Somatic Anxiety and Worry sub-scales of the Sports Anxiety Scale (p>0.05).

While there was no statistically significant difference between the groups in the Concentration Disorder sub-scale, the mean score from the first measurement was statistically higher than second and third measurements in women (p<0.05). In men, there was no statistically significant difference between groups (p>0.05)

Table 4.5. Comparison of SAS-2 by gender at measurement times (*N*=21).

		Gender		Test Statistics †		
		Male *n*=9	Female *n*=12	*F*	*p*	η^2
Somatix Anxiety	1st	7,00±1,41	7,67±1,92	0,766	0,392	0,039
	2nd	6,33±0,50	7,58±2,35	2,427	0,136	0,113
	3rd	6,33±1,00	7,67±2,67	2,004	0,173	0,095
Test Statistics ϕ		*F*=0,482 *p*=0,625 η^2=0,051	*F*=0,044 *p*=0,957 η^2=0,005			
Worry	1st	7,11±1,96	9,75±3,67	3,798	0,066	0,167
	2nd	6,56±2,13	8,17±3,71	1,350	0,260	0,066
	3rd	6,89±1,83	8,33±3,58	1,217	0,284	0,060
Test Statistics ϕ		*F*=0,168 *p*=0,847 η^2=0,018	*F*=1,63 *p*=0,224 η^2=0,153			
Concentration Disruption	1st	7,22±1,39 *ab*	8,17±2,52 *a*	1,023	0,325	0,051
	2nd	6,22±1,48 *ab*	6,58±2,35 *b*	0,162	0,691	0,008
	3rd	7,11±1,83 *ab*	7,50±2,88 *b*	0,125	0,727	0,007
Test Statistics ϕ		*F*=2,27 *p*=0,132 η^2=0,201	***F*=7,011 *p*=0,006 η^2=0,438**			

F: Mixed Design ANOVA, Effect Size (η2), ϕIntergroup comparison, †Intragroup comparison, Descriptive statistics are given as mean ± standard deviation. Bolded sections are statistically significant (p<0.05). a>b: Different letters or letter combinations in the same row indicate statistically significant differences (p<0.05).

Table 4.6. shows the comparison of the APSQ scale according to the gender groups of the athletes at three follow-ups. There was no statistically significant difference between and within groups in the total score of the APSQ scale (*p*>0.05).

Table 4.6. Comparison of APSQ by gender at measurement times (*N*=21).

		Gender		Test Statistics †		
		Male *n*=9	Female *n*=12	*F*	*p*	η^2
APSQ	1st	14,56±5,32	17,92±5,25	2,086	0,165	0,099
	2nd	14,00±4,47	16,17±6,07	0,811	0,379	0,041
	3rd	15,00±4,30	20,50±7,76	3,645	0,071	0,161
Test Statistics ϕ		*F*=0,086 *p*=0,918 η^2=0,009	*F*=2,086 *p*=0,153 η^2=0,188			

F: Mixed Design ANOVA, Effect Size (η2), ϕIntergroup comparison, †Intragroup comparison, Descriptive statistics are given as mean ± standard deviation. APSQ: Athlete Psychological Strain Questionnaire

Table 4.7. compares the Cold Pressor test at three follow-ups according to the gender groups of the athletes. While there was no statistically significant difference between the groups in the pain threshold measurement of the Cold Pressor test, the mean score obtained from the first measurement was statistically higher in men than in women ($p<0.05$). In women, there was no statistically significant difference between groups ($p>0.05$).

While there was no statistically significant difference between the groups in the Cold Pressor test pain tolerance measurement, the mean score obtained from the first measurement was statistically higher in men than in women ($p<0.05$). In women, there was no statistically significant difference between groups ($p>0.05$).

Table 4.7. Comparison of Cold Pressor test measurements according to gender (N=21).

		Gender		Test Statistics †		
		Male n=9	Female n=12	F	p	η^2
Pain Threshold	1st	63,33±10,39 ^{a}	34,42±36,45 ^{ab}	5,280	0,033	0,217
	2nd	30,89±12,99 ^{b}	27,67±21,65 ^{b}	0,156	0,697	0,008
	3rd	25,89±4,83 ^{b}	31,42±23,19 ^{b}	0,489	0,493	0,025
Test Statistics ϕ		**F=23,62 p<0,001 η^2=0,724**	F=1,012 p=0,383 η^2=0,101			
Pain Tolerance	1st	161,56±65,71 ^{a}	102,83±98,48 ^{ab}	2,386	0,139	0,112
	2nd	84,56±51,04 ^{b}	88,83±80,91 ^{b}	0,019	0,891	0,001
	3rd	72,33±33,90 ^{b}	87,00±81,34 ^{b}	0,256	0,618	0,013
Test Statistics ϕ		**F=24,542 p<0,001 η^2=0,732**	F=1,011 p=0,384 η^2=0,101			

F: Mixed Design ANOVA, Effect Size (η2), ϕIntergroup comparison, †Intragroup comparison, Descriptive statistics are given as mean ± standard deviation. Bolded sections are statistically significant ($p<0.05$). a>b: Different letters or letter combinations in the same row indicate statistically significant differences ($p<0.05$).

Table 4.8. shows no statistically significant relationship between the PCS total score, Rumination, Magnification, and Helpfulness sub-scales and the PBQ Organic and Psychological Beliefs sub-scales ($p>0.05$).

There was no statistically significant relationship between the somatic anxiety, anxiety, and concentration disorder sub-scales of the SAS-2 and the organic beliefs and psychological beliefs sub-scales of the PBQ (p>0.05).

There was no statistically significant relationship between APSQ and PBQ Organic and Psychological Beliefs sub-scales (p>0.05).

A statistically significant negative correlation existed between the Cold Pressor test Pain Threshold and PBQ Organic Beliefs and Psychological Beliefs sub-scales (p<0.05).

No statistically significant relationship existed between Cold Pressor test Pain Tolerance and PBQ Organic Beliefs (p>0.05).

A negative statistically significant relationship exists between Cold Pressor Test Pain Tolerance and PBQ Psychological Beliefs (p<0.05).

Table 4.8. Relationships between pain beliefs of athletes and other scales (*N*=21).

		Pain Beliefs Questionnaire (PBQ)	
		Organic Beliefs	Psychological Beliefs
PCS	Rumination	*rho*=-0,168 *p*=0,467	*rho*=-0,295 *p*=0,195
	Magnification	*rho*=0,089 *p*=0,702	*rho*=-0,119 *p*=0,607
	Helpnessness	*rho*=0,121 *p*=0,602	*rho*=-0,248 *p*=0,279
	Total Score	*rho*=0,024 *p*=0,917	*rho*=-0,287 *p*=0,208
SAS-2	Somatic Anxiety	*rho*=-0,332 *p*=0,142	*rho*=-0,352 *p*=0,118
	Worry	*rho*=-0,094 *p*=0,685	*rho*=0,001 *p*=0,999
	Concentration Disruption	*rho*=0,116 *p*=0,617	*rho*=0,229 *p*=0,318
APSQ		*rho*=-0,339 *p*=0,132	*rho*=-0,161 *p*=0,487
Cold Pressor Test	Pain Threshold	***rho*=-0,464 *p*=0,034**	***rho*=-0,600 *p*=0,004**
	Pain Tolerance	*rho*=-0,392 *p*=0,079	***rho*=-0,532 *p*=0,013**

rho: Pearson correlation coefficient, Bolded sections are statistically significant (p<0.05). PCS: Pain Catastrophization Scale, SAS-2: Sport Anxiety Scale 2, APSQ: Athletic Psychological Strain Questionnaire

5. DISCUSSION

The study examined elite-level volleyball players' pain in psychological and sensory scopes in a half-season period of four months. The aim of the study was to investigate the relationship between sensory and psychological components of pain in elite-level volleyball players. The sample group, elite-level volleyball players, was formed by athletes with a minimum of ten years of experience playing volleyball and competing in one of the highest-ranked volleyball leagues in the world. They were evaluated measures of cold pain threshold and tolerance alongside pain beliefs, pain catastrophization, psychological strain, and anxiety and analyzed their relationship over a half athletic season.

Regarding the data obtained from the demographic information of the athletes participating in the study, the mean values of the PBQ organic beliefs sub-scale and the psychological beliefs sub-scale were low. Levels of pain catastrophization, anxiety, psychological strain, and beliefs were also low at the beginning of the study (Table 4.2 and 4.3). In other words, our participants' psychological pain perception and anxiety levels were low. In the literature, no other study has investigated the relationship between psychological and sensory components of pain among elite-level volleyball players, sub elite-level or with a control group. A number of studies focused on comparing the pain perception of athletes to non-athletes. These studies concluded that athletes differ from non-athletes in pain perception. They have higher pain thresholds and tolerance levels comparing to non-athletes (4,12). Very few the studies in literature considered pain a multi-dimensional experience, with psychosocial factors contributing.

The study found that athletes' mean pain threshold and tolerance values were higher at the first measurement at the beginning of the season than the following two measurements. These results suggest that athletes become significantly less pain tolerant of cold pain at the second and third measurements compared to the first. Thornton et al. conducted a study on athletes' pain tolerance and participation in contact sports. They

have used the same testing as our study to test pain tolerance levels; the cold pressor test for eight months. Their results differed from ours by not finding a significant difference in measurements at the beginning of the season, four months, and eight months in participating athletes. Their study also followed the participating and non-participating athletes' pain thresholds and tolerances separately. Similar to the study in our way, non-participating athletes' pain tolerances were continuously lower throughout the follow-up. They had stated that participating athletes would become habitant to training and, therefore, differ in pain tolerance with comparing non-participating athletes (10). We did not separate the participating and non-participating athletes due to the nature of the volleyball. Because in volleyball, starting six and substituting six players may vary according to the opponent at every game.

In addition, according to our results, male athletes' mean pain threshold and tolerance values are founded higher than female athletes. Literature supports our findings. Manning et al. found that male athletes have a higher cold and ischemic pain threshold and tolerance level than female athletes and non-athlete males and females (48). This evidence suggests male athletes have higher pain threshold and tolerance level than female athletes. Literature supports this finding also in sedentary population (20, 49)

In our research, we may explain the fact that the pain threshold and tolerance of the athletes is higher at the beginning of the season and its decrease compared to the first measurement between the second measurement and the third measurement. The first explanation is that in the second and third measurements, the athletes may not have given the cold pressor test as much importance as in the first measurement, if it were, we could expect the third measurement to be lower. The second explanation is that their resilience to physical (noxic) pain decreases throughout the season. In addition, in our study, a significant negative correlation was found between the pain threshold and the organic and psychological belief sub-scales of the PBQ. However, the pain tolerance value was only negatively correlated with the psychological beliefs sub-scale. Although the scarcity of studies on elite athletes in the literature makes it difficult to discuss our results, our results suggest that pain tolerance is more related to the receptor threshold, thus it is more of a neurophysiological event. Pain tolerance, on the other hand, is more

related to cognitive processes such as willingness, perseverance and determination. No studies in the literature have examined the relationship between organic and psychological pain beliefs and pain threshold and tolerance levels in elite athletes, sub-elite athletes, and collegiate or adolescent athletes. We think that our results should be supported by other studies.

Pain catastrophization in the participating athletes was measured with the pain catastrophization scale, and no change was found during the season. In other words, the athletes did not catastrophize their pain. This result may be related to the fact that the athletes participating in the study were elite-level professional athletes. In the literature, the studies investigated the catastrophization levels of athletes to non-athletes or injured or sufferers of chronic pain to not injured athletes. Evidence shows that catastrophization becomes less with the increase in athletes' experience and level of professionalism (50, 51). This evidence supports our findings regarding the steady and relatively low levels of catastrophization in our study. Moreover, Sciascia et al. investigated the relationship between pain and catastrophization in collegiate athletes. Their results showed negligible correlations between the PCS score and numeric pain rating. However, they found that currently injured or previously injured athletes had significantly higher PCS scores compared with uninjured athletes. Also, the study of DiBartola et al. found that the symptom chronicity is positively correlated with pain catastrophization among athletes with knee problems. This evidence suggests that catastrophization is higher in the injured or suffering athlete population (52, 53). The injury background of participating athletes was not in the scope of our study.

In our study, we did not find a significant difference in sport-related anxiety. Only the Concentration Disruption sub-scale of SAS-2 was significantly lower in the second and third measurements. This result may indicate that athletes were more focused, with the effect of the competitive nature of the season.

Also, female athletes' mean value for concentration disruption was higher than males at the beginning of the season. Although we didn’t find supporting evidence for the changing concentration disruption results, some studies showed that somatic anxiety

differed with gender and athletic experience (54, 55). Hocaoğlu et al. found a significant difference in somatic anxiety sub scale between male and female athletes but not in other sub scales. Jensen et al. investigated competitive anxiety with SAS-2 among junior and adult elite level athletes and found a negative correlation between age and the competitive anxiety. This result may suggest a stronger competitive anxiety among less experienced athletes.

Our results showed no significant change in athletes' psychological strain scores throughout the measurement period. Our study is the first to investigate this parameter's change for half of a match season. Also, our study is the first to investigate the relationship between the psychological strain of athletes and their pain thresholds and tolerances.

The difference of our study: No other study investigated the relationship between sport-related anxiety, psychological strain, pain threshold, and tolerance. Also, no study investigated the change in sport-related anxiety and psychological strain throughout a half-match season. Our study is the first in the literature to find statistical evidence that pain threshold correlates negatively with organic and psychologic pain beliefs and pain tolerance negatively correlates with psychological pain belief. Another strength of our study is to be able to do follow-up measurements on the elite level volleyball players in the different periods of the season.

In light of our results, changes in concentration, pain threshold, and tolerance values should be considered for treatment and training planning throughout the game season. Elite-level volleyball players do not have anxiety and pain catastrophizing in the first half of the season. Pain threshold and tolerance at the beginning of the season decreased at mid-season and the end of the first half. Pain threshold and tolerance were negatively correlated with organic and psychological pain beliefs. It is important to take this into consideration in post-injury rehabilitation practices. Literature may benefit from the relationship between pain belief sub-scales and pain threshold and tolerance levels. Further research is necessary to understand better the relationship between psychological and sensory component pain in the elite-level athlete population.

Our study is not without limitation. We could not collect performance and in-season injury information from the participating athletes for the study. Also, we did not have a control group to compare our results. Drop outs before the second and third measurement decreased our sample size and became one of our limitation.

6. CONCLUSION

The main outcomes of this study were

- athletes' mean pain threshold and tolerance values were higher at at the beginning of the season than the following part of season.
- the concentration disruption was higher at the beginning of the season.
- as the pain threshold increases, organic and psychological pain beliefs decrease; psychological pain beliefs decrease as pain tolerance increases.

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8. APPENDICES

8.1. Appendix 1. Informed Voluntary Consent Form

6.1 BİLGİLENDİRİLMİŞ ONAM FORMU

Araştırmanın Adı: Elit Düzey Voleybolcularda Ağrının Duyusal ve Psikolojik Bileşenleri Arasındaki İlişki/ Prospektif Kohort Çalışması

Sayın Katılımcı, *

Yukarıda adı yazılı araştırmaya katılmak üzere davet edilmiş bulunmaktasınız. Bu araştırmada yer almayı kabul etmeden önce, araştırmanın ne amaçla yapılmak istendiğini anlamanız ve bu bilgilendirme sonucunda kararınızı vermeniz gerekmektedir. Aşağıdaki bilgileri lütfen dikkatlice okuyunuz, sorularınız olursa sorunuz ve açık yanıtlar isteyiniz.

Bu araştırma ile **TVF 2022-2023 voleybol sezonunun ilk yarısı içindeki hissettiğiniz ağrı değerleriniz ile anksiyete skorlarınız arasındaki ilişkinin araştırılması** amaçlanmıştır. Bu araştırma, **sporcuların ağrı eşik ve toleranslarının sezon içinde dönemsel olarak nasıl etkilendiğinin gözlemlenebilmesine** yarar sağlayacaktır. Sizden bu çalışmada **ağrı inançlarınız, ağrıyı felaketleştirme düzeyiniz ve sporda kaygı seviyenize ilişkin sorulara her anketin başında belirtildiği şekilde değerlendirme ve işaretleme yapmanız** istenecektir. Bu işlem **5** dakikanızı alacaktır. Bunun size ve yakınlarınıza hiçbir zararı olmayacaktır. Çalışmaya katılmada gönüllü olmanız esastır. Çalışmaya katılmakla parasal yük altına girmeyeceksiniz ve size de herhangi bir ödeme yapılmayacaktır.

Bu araştırmaya katılıp katılmamakta tümüyle özgürsünüz. Gerek duyduğunuz tüm bilgileri istemeye ve doğru, açık, anlaşılır bilgi almaya hakkınız vardır. Araştırmaya katılmayı istemezseniz burada size verilen hizmet olumlu veya olumsuz şekilde etkilenmeyecektir. Gerekli gördüğü takdirde araştırmanın herhangi bir kısmında katılımcı araştırmadan çıkabilir, araştırmacı çalışmayı sonlandırabilir. **Araştırmanın tüm aşamalarında kimlik bilgileriniz gizli tutulacaktır. Araştırmacı dışında üçüncü kişiler, antrenörler, yöneticiler ile paylaşılmayacaktır. Araştırma kapsamında elde edilen bilgiler bilimsel amaçlarla kullanılabilir gizlilik kurallarına uyulmak kaydıyla sunulabilir ve yayınlanabilir.**

Araştırma ile ilgili daha fazla bilgiye ihtiyaç duyarsanız araştırmacıya **eda.aslan@std.yeditepe.edu.tr** e-posta adresi veya [redacted] numaralı telefondan ulaşabilirsiniz.

Yukarıda yer alan ve araştırmaya başlanmadan önce katılımcılara verilmesi gereken bilgileri içeren metni okudum (ya da sözlü olarak dinledim). Araştırma 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.
- ◯ Kabul etmediğimi beyan ederim.

8.2. Appendix 2. Ethical Committee Approval

T.C.
MARMARA ÜNİVERSİTESİ
Sağlık Bilimleri Fakültesi
Girişimsel Olmayan Klinik Çalışmalar Etik Kurulu

PROJENİN ADI	: "Elit Düzey Voleybolcularda Ağrının Duyusal ve Psikolojik Bileşenleri Arasındaki İlişki: Prospektif Kohort Çalışması"
PROJENİN YÜRÜTÜCÜSÜ	: Dr. Öğr. Üyesi Çiğdem YAZICI MUTLU
PROJEDEKİ ARAŞTIRICILAR	: Eda ASLAN
ONAY TARİHİ VE SAYISI	: 24.11.2022/94

Sayın: Dr. Öğr. Üyesi Çiğdem YAZICI MUTLU

"94" protokol numaralı "Elit Düzey Voleybolcularda Ağrının Duyusal ve Psikolojik Bileşenleri Arasındaki İlişki: Prospektif Kohort Çalışması" İsimli projeniz Fakültemiz Etik Kurulu tarafından incelenmiş oy birliği ile etik yönden uygun olduğuna karar verilmiştir.

Marmara Üniversitesi Sağlık Bilimleri Fakültesi 34854 Başıbüyük/Maltepe /İSTANBUL
0 (216) 399 62 42 (Faks)
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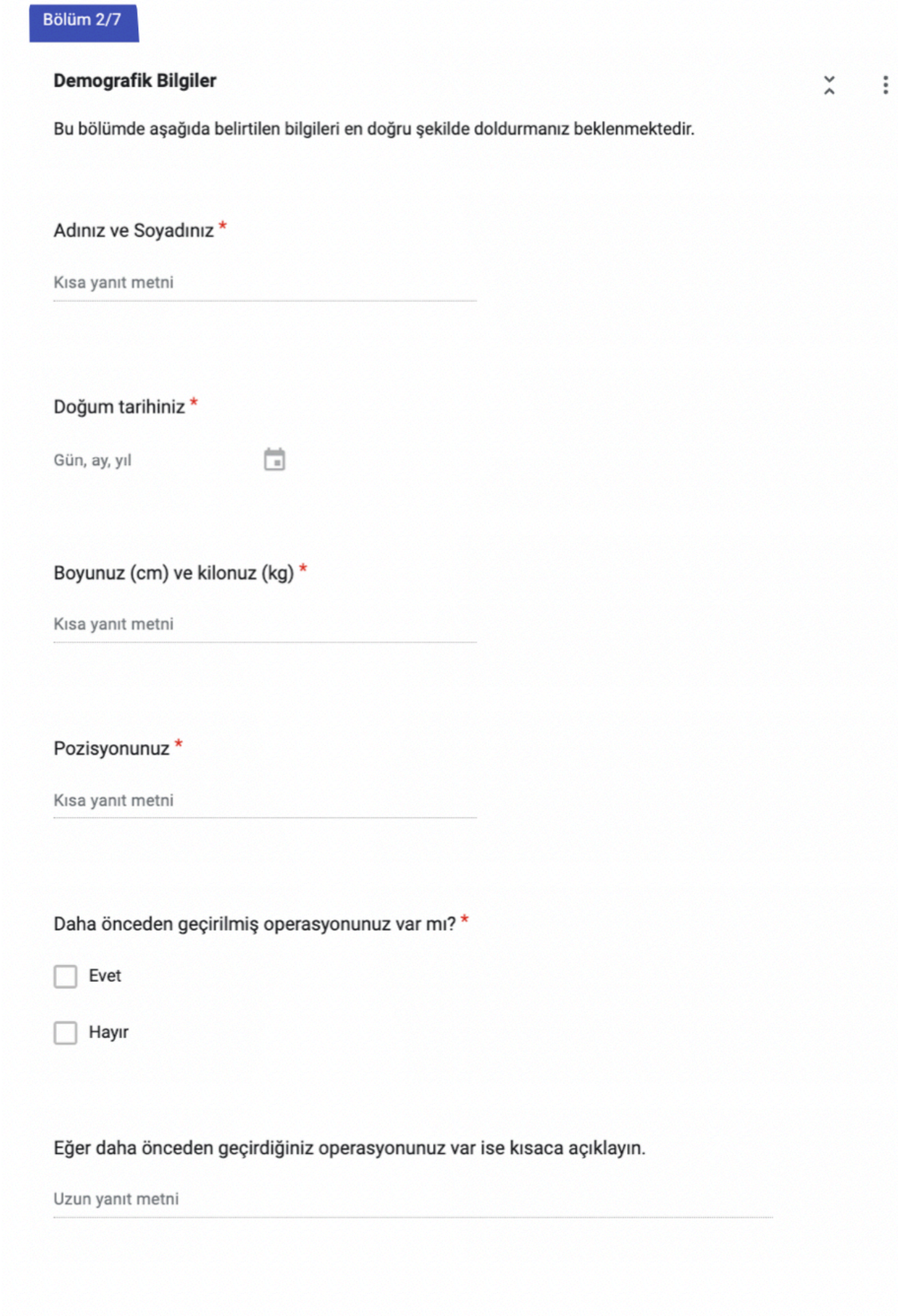
Ayrıntılı bilgi için: Melek KARADAĞ AKYOL
sbfetikkurul@gmail.com
http://sbf.marmara.edu.tr

8.3. Appendix 3. Demographic Form



Bölüm 2/7

Demografik Bilgiler

Bu bölümde aşağıda belirtilen bilgileri en doğru şekilde doldurmanız beklenmektedir.

Adınız ve Soyadınız *

Kısa yanıt metni

Doğum tarihiniz *

Gün, ay, yıl

Boyunuz (cm) ve kilonuz (kg) *

Kısa yanıt metni

Pozisyonunuz *

Kısa yanıt metni

Daha önceden geçirilmiş operasyonunuz var mı? *

- [ ] Evet
- [ ] Hayır

Eğer daha önceden geçirdiğiniz operasyonunuz var ise kısaca açıklayın.

Uzun yanıt metni

Bilinen bir sakatlığınız var mı? *

- [ ] Evet
- [ ] Hayır

Eğer bilinen bir sakatlığını var ise kısaca açıklayın.

Uzun yanıt metni

Şu anda bu anketi doldururken herhangi bir ağrınız var mı? *

- [ ] Evet
- [ ] Hayır

Eğer ağrınız varsa kısaca açıklayın.

Uzun yanıt metni

Eğer ağrınız varsa doğrusal ölçekte 0 "hiç" ile 10"en fazla" değerleri arasında ağrınızı ölçeklendiriniz.

	0	1	2	3	4	5	6	7	8	9	10	
Hiç	○	○	○	○	○	○	○	○	○	○	○	En fazla

Yüksek tansiyon, diyabet, Raynaud's fenomeni gibi sistemik bir rahatsızlığınız var mı? *

- [ ] Evet
- [ ] Hayır

Sistemik bir rahatsızlığınız var ise lütfen kısaca açıklayınız.

Uzun yanıt metni

Düzenli olarak kullandığınız bir ilaç var mı? *

- [ ] Evet
- [ ] Hayır

Düzenli olarak kullandığınız bir ilaç var ise lütfen açıklayınız.

Uzun yanıt metni

8.4. Appendix 4. Pain Beliefs Questionnaire1

Ağrı İnançları Anketi

Lütfen her madde için fikrinizi şu ifadelerden bir tanesini seçerek belirtiniz.

Doğru ya da yanlış cevap yoktur. Önemli olan neye inanmanız gerektiğine dair hislerinize ya da bizim sizden neye inanmanızı beklediğimizle ilgili düşüncelerinize göre değil, **gerçek inançlarınıza göre** cevap vermenizdir.

	Hiçbir zaman	Nadiren	Bazen	Sık sık	Neredeyse her zaman	Her zaman
Ağrı vücuttaki dokuların hasar görmesi sonucu oluşur.	○	○	○	○	○	○
Fiziksel egzersiz ağrıyı daha da kötüleştirir.	○	○	○	○	○	○
Kişinin ağrıyı hafifletmek için kendi kendine bir şeyler yapması imkansızdır.	○	○	○	○	○	○
Kaygılı olmak ağrıyı daha da kötüleştirir.	○	○	○	○	○	○
Ağrı çekmek vücutta bir şeylerin ters gittiğinin işaretidir.	○	○	○	○	○	○
Rahatken ağrıyla baş etmek kolaydır.	○	○	○	○	○	○
Ağrılı olmak sizin hobilerinizden ve sosyal yaşamınızdan zevk almanızı engeller.	○	○	○	○	○	○
Ağrının miktarı hasarın miktarına bağlıdır.	○	○	○	○	○	○
Ağrıyı düşünmek onu daha da kötüleştirir.	○	○	○	○	○	○
Ağrıyı kendi başınıza kontrol etmek imkansızdır.	○	○	○	○	○	○
Ağrı bir hastalığın işaretidir.	○	○	○	○	○	○
Depresif hissetmek ağrıyı daha da kötüleştirir.	○	○	○	○	○	○

8.5. Appendix 5. Pain Catastrophization Scale

Ağrı Felaketleştirme Ölçeği

Aşağıda ağrıyla ilişkili olabilecek farklı duygu ve düşünceleri tanımlayan 13 cümle bulunmaktadır. Lütfen aşağıdaki skalayı kullanarak **ağrınız olduğunda hissettiğiniz düşüncelerinizi ve duygularınızı** derecelendiriniz.

*

	Hiç	Biraz	Orta derecede	Ciddi şekilde	Her zaman
Ağrının bitip bitmeyeceği hakkında sürekli endişelenirim.	○	○	○	○	○
Bu duruma daha fazla katlanamayacağımı hissederim	○	○	○	○	○
Bu ağrının korkunç olduğunu ve hiçbir zaman iyileşmeyeceğini düşünürüm..	○	○	○	○	○
Bu ağrının berbat olduğunu ve beni mahvettiğini hissederim.	○	○	○	○	○
Buna daha fazla dayanamayacağımı hissederim.	○	○	○	○	○
Ağrı daha da kötüleşecek diye korkarım.	○	○	○	○	○
Başka ağrılı durumları düşünüp dururum.	○	○	○	○	○
Tedirgin bir şekilde ağrının geçmesini isterim.	○	○	○	○	○
Ağrıyı aklımdan bir türlü çıkaramadığımı fark ederim.	○	○	○	○	○
Sürekli ağrının ne kadar acı verdiğini düşünürüm.	○	○	○	○	○
Ağrının durmasını ne kadar çok istediğimi düşünürüm.	○	○	○	○	○
Ağrının şiddetini azaltmak için yapabileceğim hiçbir şeyin olmadığını düşünürüm.	○	○	○	○	○
Ciddi bir durumun ortaya çıkıp çıkmayacağını merak ederim.	○	○	○	○	○

8.6. Appendix 6. Sport Anxiety Scale-2

Spor Kaygı Ölçeği

Birçok sporcu, müsabaka öncesi veya müsabaka sırasında kendini gergin veya telaşlı hissedebilir. Bu profesyonel oyuncular için de geçerlidir. Lütfen her bir soruyu okuyun ve genel olarak müsabaka öncesi veya müsabaka sırasında nasıl hissettiğinizi, ilgili sayının olduğu kareyi seçerek işaretleyiniz. Vereceğiniz cevaplar doğru veya yanlış değildir. Lütfen olabildiğince gerçekçi ve samimi olunuz.

Yarışma öncesi veya yarış esnasında... *

	Hiç (1)	Biraz (2)	Fazla (3)	Çok fazla (4)
Oyuna konsantre olmak zordur.	○	○	○	○
Vücudumun gergin olduğunu hissederim.	○	○	○	○
İyi oynayamayacağım diye endişelenirim.	○	○	○	○
Yapmam gereken şeye odaklanmakta zorlanırım.	○	○	○	○
Başkalarını hayal kırıklığına uğratacağım diye endişelenirim.	○	○	○	○
Midemde gerginlik hissederim.	○	○	○	○
Oyunda dikkatimi/konsantrasyonumu kaybederim.	○	○	○	○
En iyi performansımı gösteremeyeceğim diye endişelenirim.	○	○	○	○
Kötü oynayacağım diye endişelenirim.	○	○	○	○
Kaslarımın titrediğini hissederim.	○	○	○	○
Oyun sırasında her şeyi berbat edeceğimden endişelenirim	○	○	○	○
Midem bozulur.	○	○	○	○
Oyun sırasında açık/net bir şekilde düşünemem.	○	○	○	○
Gergin/sinirli olduğumdan kaslarım gerilir.	○	○	○	○
Antrenörümün bana yapmamı söylediği şeye odaklanmakta güçlük çekerim.	○	○	○	○

8.7. Appendix 7. Athlete Psychological Strain Questionnaire

Sporcu Psikolojik Gerilim Anketi

Lütfen **son dört haftayı tekrar düşünün** ve her maddeyi sizin için ne sıklıkta geçerli olduğunu düşünerek yanıtlayın.

*

	Hiçbir zaman (1)	Az bir zaman (2)	Kimi zaman (3)	Çoğu zaman (4)	Her zaman (5)
Takım arkadaşlarımın etrafında olmak zordu.	○	○	○	○	○
Yapmam gerekeni yapmayı zor buldum.	○	○	○	○	○
Daha az motive olmuştum.	○	○	○	○	○
Sinirli, öfkeli veya agresiftim.	○	○	○	○	○
Yaralanmak veya performansım hakkında endişelenmeden duramadım.	○	○	○	○	○
Antrenman yapmayı daha stresli buldum.	○	○	○	○	○
Takıma seçilme baskılarıyla başa çıkmakta zorlandım. (İlk 6 ya seçilmek olarak yazsak sorun olur mu?)	○	○	○	○	○
Spordan sonraki hayatım konusunda endişelendim.	○	○	○	○	○
Rahatlamak için alkol veya başka maddelere ihtiyaç duydum.	○	○	○	○	○
Saha dışında olağandışı riskler aldım.	○	○	○	○	○

8.8. Appendix 8. The Explanatory PDF Document

Soğuk pres testi, elin veya ön kolun soğuk suya daldırılmasını içeren, fiziksel ağrı eşiği ve ağrı toleransını ölçme imkanı sağlayan, yaygın olarak kullanılan deneysel bir tekniktir. Test için, **ısısı 0°C - 2 °C arasında olan su ve buz dolu bir kaba** ihtiyaç vardır. **Suyun ısısının her katılımcıdan sonra tekrar kontrol edilmesi ve belirtilen aralıkta tutulması test sonuçlarının her katılımcıda tutarlı olması için oldukça önemlidir.**

Dahil Etme Kriterleri:

- ***İlgili spor branşının 2022-2023 yılı süper/en üst seviyedeki liginde yer almak***
- ***Çalışma için gönüllü olmak***
- ***18-35 yaş aralığında olmak***

Hariç Tutma Kriterleri

- ***Yabancı uyruklu olmak***
- ***Katılımcı sporcuların Raynaud's fenomeni, migren, hipertansiyon, potansiyel sinir hasarına sebep olabilecek bir hastalık (örn: diyabet), kardiyovasküler bir rahatsızlığı olması***
- ***Katılımcı sporcunun herhangi bir ağrı kesiciyi düzenli olarak kullanıyor olması***
- ***Soğuk press testine tabii tutulacak el ve ön kol üzerinde bir lezyon olması***

Test ortamını hazırlamak ve ölçüm yapmak için aşağıdaki adımları takip etmeniz yeterlidir. Bu adımları katılımcı teste başlamadan önce okuyup katılımcıyı adımlar ile ilgili bilgilendirmeniz beklenmektedir.

1- Katılımcının ön kolunun tamamının içinde rahatlıkla girebileceği bir kova / su kabı ve süre ölçümü için kronometre kullanmanız gerekmektedir.

2- Katılımcı gözlemci tarafından teste nasıl girileceği konusunda bilgilendirilmelidir.

3- Buz ve su oranını suyun son ısısı 0°C - 2 °C olması kaydıyla size bırakılmıştır. **Ancak katılımcının elinin buz ile direkt temasta olmaması gerekmektedir.**

4- İlk olarak, katılımcı gözlemci tarafından teste nasıl girileceği konusunda bilgilendirilmelidir. Test, katılımcının **dominant eli ve dirseğinin bir parmak üstü** suya girdiği anda başlar. Katılımcının eli suya girdiği an kronometre ile ölçüme başlamalısınız. Katılımcıdan ağrıyı ilk hissettiği anda gözlemciye haber vermesi talimatı verilmeli ve testin başlaması ile ilk ağrı bildirimi arasındaki zaman farkı katılımcının "**ağrı eşiği**" olarak kaydedilmelidir. Süre kronometre ekranında görüldüğü cinsinden kaydedilmelidir. Dakika ise dk olarak, saniye ise sn olarak belirtilmelidir. Bu kayıttan sonra katılımcı elini suyun içinde tutmaya devam etmelidir. Katılımcı ağrının "dayanılmaz" hale geldiği noktada gönüllü olarak elini çekmelidir - testin başlangıcı ile elini gönüllü olarak çekme arasındaki süre, katılımcının "**ağrı toleransı**" olarak kaydedilmelidir.

Katılımcı elini gönüllü olarak sudan çekmediği takdirde testin maksimum uygulanma süresi 5 dakikadır. Katılımcı 5 dakika içinde ağrı hissettiğini belirtmezse test 5.dakikada sonlandırılır. Bu durumda katılımcının ağrı eşik ve tolerans değerini >5dk olarak kaydetmelisiniz.

8.9. Appendix 9. Curriculum Vitae

Adı	Eda	**Soyadı**	Aslan

Öğrenim Durumu

Derece	Alan	Mezun Olduğu Kurumun Adı	Mezuniyet Yılı
Doktora			
Yüksek Lisans			
Lisans	Fizyoterapi ve Rehabilitasyon	**Yeditepe Üniversitesi**	2019
Lise	-	**İstek Özel Kaşgarlı Mahmut Fen Lisesi**	2015

Bildiği Yabancı Dilleri	**Yabancı Dil Sınav Notu (#)**
İngilizce	YDS 89.75 (2019)

Başarılmış birden fazla sınav varsa(KPDS, ÜDS, TOEFL; EELTS vs), tüm sonuçlar yazılmalıdır

İş Deneyimi (Sondan geçmişe doğru sıralayın)

Görevi	Kurum	Süre (Yıl - Yıl)
Araştırma Görevlisi	Yeditepe Üniversitesi	2023 - devam etmekte
Takım Fizyoterapisti	Kuzeyboru Gençlik ve Spor Kulübü Kadın Voleybol A Takımı	2020-2023

Bilgisayar Bilgisi

Program	Kullanma becerisi
IOS Keynote	Çok iyi
IOS Pages	Çok iyi
Microsoft Word	İyi
Microsoft Powerpoint	İyi

*Çok iyi, iyi, orta, zayıf olarak değerlendirin

Bilimsel Çalışmaları
SCI, SSCI, AHCI indekslerine giren dergilerde yayınlanan makaleler

Diğer dergilerde yayınlanan makaleler

Uluslararası bilimsel toplantılarda sunulan ve bildiri kitabında (*Proceedings*) basılan bildiriler

Hakemli konferans/sempozyumların bildiri kitaplarında yer alan yayınlar

Diğer (Görev Aldığı Projeler/Sertifikaları/Ödülleri)

Boyun Ağrısı ve Propriosepsiyon Arasındaki İlişkinin Üniversite Öğrencilerinde İncelenmesi, Biruni Üniversitesi Bir FTR Projesi, 9 Mayıs 2019, İstanbul. İkincilik ödülü