T. C.
YEDİTEPE UNIVERSITY
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MASTER THESIS

BÜŞRA AYDIN ERKILIÇ, PT

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İSTANBUL- 2019

THESIS APPROVAL FORM

TEZ ONAYI FORMU

Kurum : Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü

Program : Spor Fizyoterapisi

Tez Başlığı : Adölesan Amatör Futbolcularda FIFA 11+ Egzersiz Programının İzokinetik Kas Kuvveti ve Dengeye Etkisi

Tez Sahibi : Büşra AYDIN ERKILIÇ

Sınav Tarihi : 26.06.2019

Bu çalışma jurimiz tarafından kapsam ve kalite yönünden Yüksek Lisans Tezi olarak kabul edilmiştir.

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ONAY

Bu tez Yeditepe Üniversitesi Lisansüstü Eğitim-Öğretim ve Sınav Yönetmeliğinin ilgili maddeleri uyarınca yukarıdaki jüri tarafından uygun görülmüş ve Enstitü Yönetim Kurulu'nun 28./06../2019.... tarih ve 2019/11-53........ sayılı kararı ile onaylanmıştır.

Prof. Dr. Bayram YILMAZ
Sağlık Bilimleri Enstitüsü Müdürü

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.

Date: 04.09.2019

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ACKNOWLEDGEMENTS

With all the effort made and attention paid this thesis work has been such a devotion to me and my dedicated supervisor Assist. Prof. Feyza Şule BADILLI DEMIRBAS. She has been sincerely giving and always there whenever I needed her.

I would like to express my special thanks to Prof. Feryal SUBASI and to Prof. Serap INAL for all contributions during Master's educations.

I am thankful to my husband Arif Musa ERKILIC for his patience from the beginning to the end of my dissertation.

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LIST OF SYMBOLS AND ABBREVIATIONS

ACL	Anterior Cruciate Ligament
BW	Body weight
BMI	Body Mass Index
Cm	Centimeter
FIFA	Federation Internationale Football Association
F-MARC	Federation Medical Assessment and Research Centre
H	Hamstring
H / Q	Hamstring / Quadriceps ratio
kg	Kilogram
N	Number of participant
Nm	Newton- meter
Q	Quadriceps
PT	Peak Torque
PT / BW	The ratio of peak torque to body weight
RCT	Randomized controlled trial
SEBT	Star Excursion Balance Test
Sec	Second
SD	Standard Deviation
TFF	Turkey's Football Federation
UEFA	Union of European Football Associations
Z	Mann Whitney U test, z value
%	Percentage
°	Degree

ABSTRACT

ERKILIC, B (2019). The Impact of FIFA 11+ Exercise Program on Isokinetic Muscle Strength and Balance on Adolescent Amateur Soccer Players. Yeditepe University Institute of Health Sciences Master of Science Thesis in Sport Physiotherapy, Istanbul.

This study was carried out for a 9 weeks period in order to apply F 11+ football injury prevention program on an adolescent age group amateur football team and to enquire the impacts of it on muscle strength and balance. The footballers of a team from Turkey's Super Amateur League (N = 24) were included in the research. F 11+ exercise program was conducted for the study group for 9 weeks in addition to the routine training program. Control group continued routine program. Isokinetic and balance (SEBT) evaluations of the footballers were made before and after training. As a result of our study, there were not any differences between the groups in terms of age, body weight, height, body mass index values (p> 0.05). In the isokinetic evaluation, the right H / Q ratio at the 60 ° / sec was significantly higher in the control group than the study group (p <0.05) however, no difference was found between the groups after the training (p>0,05). After the training, at the 240 °/ sec, only the left quadriceps peak torque value of the study group was significantly higher than the other group (p <0.05). In isokinetic evaluations, in the comparison of the within groups in before and after training, there were not any significant differences in the other parameters while a difference was found in the right hamstring peak torque value of the study group at the 60 ° / sec and in the ratio of hamstring peak torque value and body weight (p>0,05). As a result of the SEBT, in the post-training comparisons of the groups, study group was found to be significantly higher (p<0,05) in the right anteromedial aspect whereas there were not any differences between the groups in the other aspects (p<0,05) In SEBT evaluation, in the comparisons of the within groups before and after training, there was a significant difference in almost all aspects in the study group (p <0.05) while there were not any differences in the improvement in the control group (p> 0.05). Consequently, it was understood that F 11+ exercise program was singly not effective in muscle strength development in adolescent amateur footballers but it was effective in SEBT balance assessment in some ways. We are of the opinion that this training program will guide the experts who work with amateur footballers lacking a regular training program.

Key words: FIFA 11+, muscle strength, balance, football

ÖZET

ERKILIÇ, B (2019). Adölesan Amatör Futbolcularda FIFA 11 + Egzersiz Programının İzokinetik Kas Kuvveti ve Dengeye Etkisi. Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Spor Fizyoterapistliği Programı Yüksek Lisans Tezi, İstanbul.

Bu çalışma F 11+ futbol yaralanmalarını önleme programının adölesan yaş grubu amatör bir futbol takımına 9 hafta boyunca uygulanması ve kas kuvveti ve denge üzerine olan etkilerinin araştırılması amacıyla yapıldı. Araştırmaya Türkiye Süper Amatör Liginden bir takımın (N=24) futbolcuları dahil edildi. Çalışma grubuna (N=13) 9 hafta boyunca rutin antrenman programına ek olarak F 11+ egzersiz programı uygulandı. Kontrol grubu (N=11) rutin antrenmanına devam etti. Futbolcuların eğitim öncesi ve sonrası olmak üzere izokinetik ve denge (SEBT) değerlendirmeleri yapıldı. Çalışmamızın sonucunda gruplar arasında yaş, vücut ağırlığı, boy uzunluğu vücut kitle indeksi değerleri arasında fark bulunmadı (p>0,05). İzokinetik değerlendirmede kontrol grubunun eğitim öncesi 60°/sn açısal hızda sağ H/Q oranı çalışma grubuna göre anlamlı olarak yüksek bulundu (p<0,05) ancak eğitim sonrasında gruplar arasında farklılık bulunamadı (p>0,05). Çalışma grubunun eğitim sonrasında 240°/sn açısal hızda yalnızca sol quadriceps pik tork değeri diğer gruba göre anlamlı olarak yüksek bulundu (p<0,05). Grupların kendi içerisinde eğitim öncesi ve sonrası izokinetik değerler karşılaştırmasında 60°/sn açısal hızda çalışma grubunun sağ hamstring pik tork değeri ile hamstring pik tork değerinin vücut ağırlığına oranında fark bulunurken (p<0,05) diğer parametrelerde anlamlı fark bulunamadı (p>0,05). SEBT sonucunda eğitim sonrası çalışma grubu sağ anteromedial yönde anlamlı olarak daha yüksek bulunurken (p<0,05) diğer yönlerde gruplar arasında fark yoktu (p>0,05). SEBT değerlendirmesinde gruplar kendi içinde eğitim öncesi ve sonrası karşılaştırmasında çalışma grubunda neredeyse tüm yönlerde anlamlı fark bulunurken (p<0,05) kontrol grubu gelişiminde fark yoktu (p>0,05). Sonuç olarak F 11+ egzersiz programının adölesan amatör futbolcularda kas kuvveti gelişiminde tek başına etkili olmadığı ancak SEBT denge değerlendirmesinde bazı yönlerde etkili olduğu görülmüştür. Bu eğitim programının düzenli bir antrenman programı olmayan amatör futbolcular ile birlikte çalışan uzmanlara yol göstereceği düşüncesindeyiz.

Anahtar kelimeler: FIFA 11+, kas kuvveti, denge, futboll

1.INTRODUCTION and PURPOSE

Doing sports has become a necessity in order to be healthy. Nowadays, sports, with a more comprehensive definition, is described as "movements which improve health status of people and maintain improved health status". Exercises, which used to be done in order to better the quality of life were tools for protecting health, increase inter-communal relations and provide integration. However, with the increase in competition among people, sport has become a sector rather than something done to be healthy (1).

Today, football is the most popular sports almost all over the world. In spite of many health advantages, taking part in a physically effort-requiring sport like soccer may result in bigger exposure to causal parameters of injury. The enhanced risk of injury caused by playing soccer is specifically relevant in cases in which growth and maturation are not still thoroughly developed like in childhood and adolescence. Especially, injury incidence in adolescent populations has lately been aligned to peak height velocity, when swift growth is apparent (2).

Performance measurements and evaluation provide information about the weak and strong sides of the players related to the sport they do (3, 4). Special exercises prepared using this data are used as basic information in training planning. This data also provides an opportunity to objectively evaluate the effectiveness of the training program with an appropriate test program.

Physical performance of the players carries a parallelism with their success, thus players need to train regularly at least twice a week to maintain and improve their physical performance (5). These training programs include parameters such as strength, cardiovascular endurance, balance, endurance and running. There is a training protocol called FIFA 11+ (F 11+) which covers all these parameters and is suggested by both Association of International Football Federation (FIFA) and Turkey's Football Federation (TFF) for football teams (6). This training program has been developed by a team of specialists from FIFA under the sponsorship of the Oslo Sports Injury Research Center, the Santa Monica Orthopedic and Sports Health Research Foundation and the FIFA Medical Assessment and Research Center. F 11 + program consists of sport-specific exercises which are simple, easily remembered, less time consuming and that increase fair play. The F 11 + training program is divided into 3 parts. The first section is composed of running exercises, the second one is made up of 6 exercises which improve strength, balance, muscle control and trunk stabilization, and the third one consists of advanced running exercises. This exercise program lasts approximately 20-25 minutes and is performed before generally known stretching exercises. Exercises focus on trunk stabilization, neuromuscular control and strengthening eccentric hamstring muscles and agility. These exercises should be done three times a week. The objective of this protocol is to increase the physical performance of the players and to protect them against injuries (7). In this study, the effect of F-11 + program, which was applied for 9 weeks, on physical performance of adolescent amateur footballers was investigated.

The hypothesis of this study is H-0 and H-1;

H-0 : F 11 + exercise program has no effect on balance and muscle strength in adolescent amateur footballers.

H-1: The F 11 + exercise program is effective at the level of balance and muscle strength in adolescent amateur footballers.

To determine the efficacy of the program, the performance levels of the players were evaluated with various parameters with the implementation of F 11 + football injury prevention program within 9 weeks.

2. GENERAL KNOWLEDGE

Soccer is the most favourite sport of many people world with almost for hundred million players in two hundred and eight countries, with a budget of about one trillion American dollars each year (8). It is estimated by FIFA that two hundred and seventy million football players are registered all over the world (9, 10). It is reported by The Brazilian Football Confederation that there are 2.1 million professional players and 11.2 million amateur players in Brazil, without considering the ones playing football just for fun (11). Yet; football is a contact sport which requires the ability and physical aptitude to play at high grade of intensity (12). Hence, football carries an important risk of injuries for players, just like in the case of other sports, irrespective of age (13).

2.1. Football Injury

Professional football players' injury epidemiology has lately gained significance owing to numerous footballers involved and economic interests related to professional football. Injuries have a profound economic effect on a club because averagely ten to fifteen percent of the team is always absent on account of injuries, and it is clearly not too difficult to speculate that the wages paid for these unavailable players are wasted.

Besides, it has been indicated that injuries have an effect on the consequences of the games (14,15) which is in a way an indirect impact on club's economy.

The way of decreasing injury incidences is named prevention. Applying an injury observation study is the essential of a proper program of prevention.

FIFA has applied some questionnaires during its games (16,17) while UEFA has exercised a prospective research on the Champions League, which is considered to be the most prestigious competition of UEFA at club level, (14,15) On the other hand, epidemiological researches have been conducted by some national federations too (16,17).

Reports taken from insurance claims and emergency departments have been utilized in early studies. It is evident that these definitions have a lot of restrictions; the most significant is that, relying on injuries that are referred to only a hospital or for which an insurance claim to a certain company has been performed. Secondly, only severe injuries are registered, while minor complaints are lost. In addition, the lack of exposure time prevents sums of the incidence (18).

The “medical attention” description dwells on those injuries that players look for the assist of a doctor or a physiotherapist, which might help to gather several injuries, besides the lesions which does not urge the footballer to quit his activity but can have an effect on lesions or at least on his performance. If this description maintains a broad picture of the effect on the injuries of the players, it also depends on parameters such as the pain threshold of the players and the availability of medical personnel (31).

The time-loss injury description demonstrates that the injury obliges the player to miss the following match or training session (19). Besides, this definition enables us to make a proper identification of the lesions affecting the player’s activity; however, its major restriction is that injuries, in spite of which the players goes on his soccer activity, are not registered and thus missed. Because players frequently compete with minimal injuries, this description might not suggest accurate data of the football injury epidemiology in soccer.

UEFA Champions League indisputably stands for the highest expression of club-level soccer in the world. It has conducted an injury analysis among some clubs taking part in this game since 2001 with the purpose of decreasing injuries with a high economic effect at this level.

Likewise, FIFA is also making use of some questionnaires in all of its major games at female, male and youth level (16,17,20- 22).

2.1.1 Football injury incidence

Estimations have shown that general risk of probable injury in soccer is almost one thousand times higher than in any typical industrial professions which are usually considered to be highly risky (23).

Despite the fact that the workout and game volume have gone up in the final decades, the risk of injury has not ascended, which is maybe due to the improvement of players’ practice of prevention programs and healthcare.

It is concluded from the statistics taken from UEFA Champions League injury research that a professional soccer team may expect to have around fifty time-loss injuries each season, and averagely, twelve percent of the team is unavailable because of injury at some periods within the season (24). Anyway, on average each footballer might be exposed to at least one injury in each season (25).

At club level, a higher incidence of injuries has been reported specifically as overuse at the threshold of the season, which could be owing to the fact that footballers might not have gained optimal physiological and physical levels then (26).

2.1.2. Reinjuries

Usually, a reinjury is described as an injury at the same location and side of a former injury. It is generally described as early reinjury and is frequently regarded as a failure of the treatment when it happens within two months from the return to game.

A reinjury rate varies between 12% and 30% according to the studies done lately (26- 30). Reinjuries are frequently connected with higher seriousness (get back to play time) in comparison to former injuries. This, as well as the comparatively high incidence, emphasizes the significance of the implementation of accurate guidelines decision of the get back-to-play. Therefore, it is quite evident that new football-specific physical and medical tests are needed to evaluate players before they are back to game (31).

2.1.3 Locations and Types of Injury

According to the data taken from epidemiological studies refer to a time-loss description of injuries, the most widespread injury area is the thigh, then the knee, ankle and groin, whereas the most widespread kind of lesion is strain, then sprain and contusion (24).

Hamstring injuries are the most widespread subtype of injuries. Typical 25 football player team may expect to have around seven hamstring strains each season (24).

Anterior cruciate ligament (ACL) lesions are the most attention injury in soccer on account of the long absence from activity that they imply. ACL injuries are usually treated surgically and the mean time to get back to game varies from six to seven months, while a few decades ago it was the end of career injury. The improvements in sport surgery and rehabilitation have enabled 90 % of the patients to get return to play football at the same level before the injury. Return to play, there is an enhanced risk of new knee pathologies, specifically overuse in etiology, however (32), which could signify knee abuse owing to the definite need of professional soccer players' getting back to game (33).

According to the epidemiological studies refer to time-loss injury definition; the groin and the hip are normally the one of the most widespread injury location (14,24). It appears that the actual severity of the question has been underestimated up to now because of the comparatively difficult identification of the injuries located in that region, which does not always allow them to be identified and classified clearly. In the UEFA Champions League study, it is estimated that each team has averagely seven groin injuries in each season (34).

The most widespread lesion location in most of sports is ankle (35). While first soccer epidemiological researches conducted were indicating that the most common injury location was ankle, more recent studies indicate a much inferior incidence rate (36).

2.1.4. Overuse and Traumatic Injuries

Injuries are divided into two. One results from overuse and the other is traumatic. A certain moment when the injury occurs cannot be determined for the injuries stemming from overuse (37). Overuse soccer injuries have a higher incidence before the season starts and there is evidence supporting this, which is most probably owing to the enhanced workload.

2.1.5 Injury Trends

It is hard to understand why whole workout rates, game injury rates and the rates of muscle injury and serious injury don't decrease even though the injury rate for ligament injuries diminishes because theoretically the boosting number of prevention programs could be a vital instrument for clinicians (31).

2.2. Football Injuries, Adolescent and Children Players

It has been indicated in the past recent years that playing football might have many helpful impacts on health risk factors together with on neuromuscular fitness and cardiovascular from childhood to older age (38, 39). Therefore, playing soccer has a huge potential to contribute to leading a healthy lifestyle. On the other hand, it is a high-intensity sport activity with frequent variations in activity, velocity, and direction in addition to strong effects and a lot of conditions of direct contact among footballers, which triggers the risk of injury. There are thereby also potential negative consequences both for individual footballers and for the healthcare system (40, 41). Negative experiences might discourage children from soccer and might cause parents not to allow them to play soccer. It is thus essential to apply preventive precaution to diminish the risk of injury, and, thereby to contribute to the health advantages connected to playing soccer

58% percent of all formally registered footballers in the whole world are younger than 18 (43). Hence, prevention of injuries in adolescent football provides many young players with a relevant direct benefit. Inadequate physical activity and injuries are considered to be a huge economic burden which requires the implementation of financial, medical and human resources (44,45). That is why proper injury prevention which begins early in life is also regarded with a long-run health perspective.

Information associated with young and children players appears to be less evident. Much of the existing literature in relation to soccer injuries up to 2001 was summarized by Giza and Micheli (42) underlining the pediatric population.

The current conspectus is based on a last studies on soccer lesions in adolescent and children players (46). The aims of this study were to define the present scientific data on soccer injuries in footballers under nineteen.

2.2.1. Injury Prevalence and Incidence

Most available data are connected to footballers aging from thirteen to nineteen years. Studies showing data for adolescent and children groups are limited. Overall injury incidence was between two and seven per one thousand hour of exposure (31).

Despite the fact that there exists an agreement on methodological topics in researches on soccer injuries, its implementation in adolescents and children is in a way restricted because standardized injury surveillance, specifically for minor, together with documentation of soccer exposure is complicated (46,47).

2.2.2. Mechanisms of Injury

Almost 50 % of whole injuries in young soccer are contact injuries. That is, footballers have a contact with another player in the opponent team or with an object .On the other hand, contact injuries happen mostly during game play, noncontact injuries is higher during workout it is observed that injuries stemming from player contact with each other increase with age, while contact with an object occurs less relevant in older footballers (40).

Almost 75% of all injuries result from by one traumatic event, while the rest of the injuries are caused by repetitive micro trauma. Traumatic lesions tend to be much more frequent during games (31).

2.2.3. Location of Injury

Injuries in young players also happen most frequently at the lower extremities (almost eighty percent of all injuries) with the knee, thigh and ankle being mostly affected. 50% percent of the rest of the lesions are generally located at the trunk. The incidence of upper extremity injuries is not more frequent than in the head/face region. Head injuries might have severe outcomes for an individual, especially with regard to the long term development of main nervous system structure and functioning. A significant and interesting observation is that upper extremity frequent during game play (26). Especially, the count of injuries to the upper body (almost 15%) together with the ones to the head could be increasing during play (31).

The percentage of upper extremity injuries was lower in footballers over 14 (eleven-twenty one percent) than in kids under fifteen (twenty-twenty nine). This difference was basically because of a higher percentage of upper body injuries (nine-thirteen percent and three-eight percent respectively). A decline in the percentage of injuries with age has been revealed in other studies (46). Probable reasons for such a finding are coordination and less developed skills of younger players and immaturity skills as well as less playing experience which lead to a higher probability of falls, and, thus, to more fractures (40).

2.2.4. Type of Injury

The most widespread injury kinds were sprains (joint–ligament injuries), strains (muscle– tendon injuries) and contusions. The percentage of these injuries changes between ten percent and forty percent in studies. Studies on boys (48- 51) showed a similar percentage of sprains (seventeen–thirty three percent), strains (five-thirty two percent) and whereas in girls (52- 55) lower strains (fifteen-twenty five percent) then sprains (twenty seven-forty seven percent) were reported.

Concussions and fractures are less frequent; however such injuries could have severe outcomes. The risk of maintaining a concussion or fractures is higher during game play and there is evidence about this (31).

(a) Strains and Sprains

In adolescent footballers sprains and strains are not differently often as known from adult soccer. Injuries of ligament generally occur at ankles and knees, while muscle injuries most frequently concern hamstring muscles (31).

The most significant and severe ligament injury in soccer is rupture of the anterior cruciate ligament (ACL). ACL injuries are especially frequent in youth girls and typically cause layoff times of almost six months and could potentially lead to severe long- term outcomes. Hence, it is highly significant in terms of early preventing ACL injuries (56).

(b) Fractures

One of the most frequent serious injuries in adolescent soccer are fractures. Children are specifically undefended to shearing injuries at the growth plates at the epiphyseal – metaphysical junction (57). Such physical injuries could have profound long- term outcomes for kids therefore prevention program of these injuries is highly significant (31).

(c) Overuse Complaints Related to Maturation and Growth

Osteochondral disorders are one of the overuse injuries that are widespread among growing kids (31). Generally, such complaints take place with a gradual beginning and get worse with practice, especially while jumping, running and kneeling. Hence, such injuries are widespread in strong effect sports such as soccer.

In adolescent and child players, occurs frequently at the tibial or calcaneal apophysis (Osgood- Schlatter syndrome). Such disorders are more widespread among boys in comparison to girls. Osgood- Schlatter peaks throughout after phases of puberty (almost twelve years in girls, up to fifteen years in boys) (58, 59).

(d) Head Injuries

The frequency of face and head injuries is maximal during game play in adolescent football. The frequency of concussion alters between one to seven percent (46). Harmon et al. predicted that nearly 4 million sports concussions occur in America each year with many unreported concussions (60).

2.3. Risk Factor in Football Injury

In soccer, injury risk has many parameters (23). Determining the personal risk parameters for every single kind of injury is a compulsory step for the consistent development of prevention programs. The injury mechanism and risk factors must be determined as soon as the injury has been identified.

Risk parameters (intrinsic and extrinsic) must be taken into account. These risk factors can be modifiable or non-modifiable (31).

2.3.1. Intrinsic Risk Factors

According to intrinsic risk parameters, career duration, age and former injuries have been indicated to have a negative impact on the players' injury risk. Footballers with having injury history have been reported to be twice or more times more probable suffer from a similar injury in the following season (30). Despite the fact that some studies have revealed no relations between former injury and injury risk, many researches have suggested a correlation. Especially, studies which made use of a multivariate analysis, a method which is definitely more suitable in the risk parameter analysis, approved these outcomes (31).

2.3.2. Extrinsic Risk Factors

Physical and psychosocial stress seems to enhance the injury risk. Yet, the importance of testing the stress level of the soccer players is still usually underestimated. At least, load monitoring and close training, thus seems to be essential so as to prevent injuries (31).

As expressed formerly by Ekstrand (61) and confirmed by following researches (62,63,64,65), a high workout/game rate is a protective parameter in soccer.

Today the economic value of soccer is certainly higher than before. Besides, the consistent stress of the media enhances the stress on soccer players and hence might put them at anymore risks. Furthermore, enhanced performance during the game, various technical and tactical innovations and training methodologies are other factors to be taken into account in modern soccer (31).

Soccer pitches must be definitely taken into account as a extrinsic risk parameter even though the consequences of the scientific studies are still contradictory (31).

In addition, pitch and weather conditions appear to impact injuries, leading to local differences in game injury incidence. Southern European players have a lower risk of injury than Northern European ones, probably because of surface conditions and poorer climate

While several of above-mentioned risk parameters cannot be easily fixed, the type of life the footballers stand for a major risk parameter which might be changed or improved swiftly. Moreover, an extreme use of drugs so as to keep on sports activity in spite of an injury or to accelerate the recovery time ought to be regarded as a significant risk parameter to the health of the players (63).

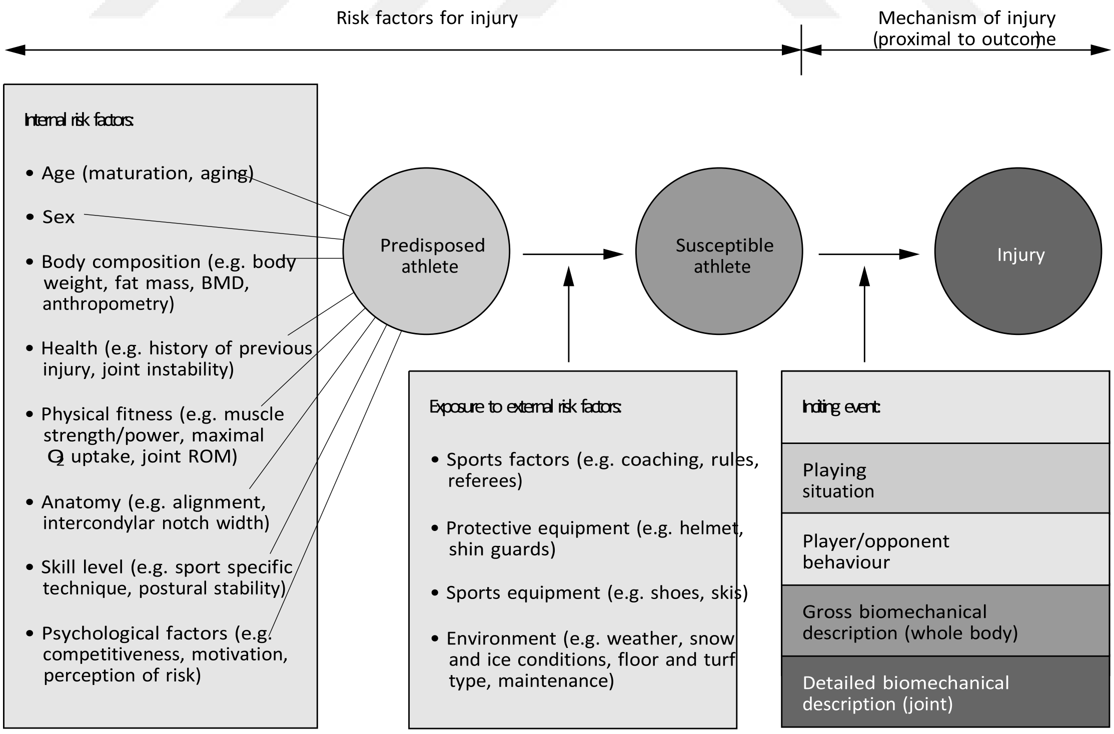


Figure 2.1. History of factors determined by Meeuwisse (101)

2.4 Physical Fitness in Football Players

The fitness of a footballer depends on a couple of motor abilities such as strength, endurance, speed, flexibility, coordination and agility. Motor fitness must be measured by performance. Performance consists of a lot of parameters. Most sports, certainly, require a contribution from numerous constituents of fitness in diverse degrees. Balance, speed, power, agility, reaction time, strength and kinesthetic perception are the features of motor performance, and these features play main role in increasing the performance of any play's skills (66).

Speed

In soccer, speed of the action of different body segments, speed for a very short distance is highly significant. Speed is the capacity to perform a movement in a short term of time. In pitch, it is essential that the parts in the body should move properly both offensively and defensively during the game (66).

Agility

Agility is the capacity to shift the direction of trunk or its parts quickly, which depends on reaction time, strength, speed of muscular coordination and movement. Rapid starts and stops and rapid shifts in direction are basic for a good performance in soccer (67). Today, matches at the peak ranking level are very hard and closely competed. A footballer thus must withstand the high pressure workout load each day in order to reach the top position in high level games. Tolerance of high pressure workout-load depends on the capability of any footballer to recover swiftly (66).

Flexibility

Muscle flexibility is a fundamental constituent of related fitness, also one of the major constituents of the performance most of sports (68); in football, limitation in some ranges of motion could restrict specific technical ability and diminish players' performance (69,70). Even though there is not consistent scientific proof about the relationship between injury risk and flexibility, it appears that less range of motion values in footballers might also enhance the risk of muscle injuries (71). A usual trend against to the flexibility reduction over years has been suggested by former studies implemented on non-player population (72). The knowledge of flexibility alters in relation to the year of football players might indicate the variation of this skill throughout the various stages of sport specialization, supplying benefical information about the critical flexibility phases and the main affected muscles to trainers.

Endurance

Physiological and physical fatigue may be described as the strength of players. Football is a long- lasting sports, it ability to withstand fatigue and to keep burdens of high fatigue for a long time. Endurance is one of the significant factors which have impacts on the performance of sports. Football players who do not get tired easily and who can be recovered rapidly are usually more preferred (73).

Strengths

Strength further enhances the performance of a players. In soccer, it supports in effective shooting into the rival's goal and occupying a larger space with the kicks. Strength in lower extremity is an evident concern in soccer, the hamstring and quadriceps group of muscles ought to produce high force for kicking and jumping.

Although the strength is its precondition, which has to be improved at the very beginning, it has later to be changed directly into explosive strength (66).

When assessing the football players in terms of strengths, we frequently use isokinetic systems (73). Computer aided muscle-testing dynamometers are utilized for measuring muscle force and this provides us with an assessment of muscles and group of muscle in an isokinetic manner. Isokinetic muscle testing is conducted with a stable speed of angular motion yet variable resistance. Isokinetic dynamometers have been revealed to generate comparatively reliable force data while testing basic uniaxial joints, like the knee, and while performing test the knee or spine in extension and flexion and (74, 75).

Knowledge of anticipated consequences at every position might assist athletic trainers and physicians determine or prevent potential problems which will be caused by the next injury because certain variables like hamstring/quadriceps ratio (H/Q ratio) might be predictive of hamstring muscle lesion. For instance, some former researches convey that strength imbalance among the quadriceps and hamstrings and may foresee future injury (76- 84). These researches reported that an H/Q ratio lower than 0.6 proposed a pathological state which could be important in estimating lower body injury, covering anterior cruciate ligament injury or hamstring muscle strain (77- 80, 82, 84).

Balance

The volume of injuries in the soccer requires the necessity for prevention via determination of risk for injuries. Previous researches suggest that the risk of lower body injuries might be foreseen by diminished dynamic postural control, evaluated with the Star Excursion Balance Test (SEBT) (85) and the Y-Balance Test (86).

Plisky et al. (85) displayed that women basketballers evaluated with SEBT composite (COMP) scores under ninety four percent had 6.5 times higher risk of lower extremity injury, while Butler et al. (86) estimated that collegiate footballers evaluated with Y-Balance Test COMP scores under almost ninety percent had 3.5 times higher risk of noncontact lower extremity injury.Dynamic postural control is mostly evaluated using the SEBT on account of its high reliability, simplicity and cheap clinical application (87).

2.5 Programs for the prevention of football injuries

Injury prevention in the match is a significant mission of the Medical Committee Of FIFA. FIFA established its Medical Assessment and Research Centre (F-MARC) with an objective "to prevent soccer injuries and to promote football as a health improving free time activity, enhancing social behavior" in 1994 (88).

Influence of injury prevention in footballers was conducted by Ekstrand et al. in 1983 (89). Junge et al. (2002) published controlled trial studies on injury prevention in soccer (90). Heidt et al. discovered that neuromuscular training program covering strength, plyometrics, cardiovascular conditioning and flexibility decreased injuries in female young soccer players (91). Emery et al suggested that this program had positive preventive impacts in general, especially on the severe emergence of injury in young female and male soccer players (92).

2.5.1. Why Is Injury Prevention Significant?

Besides the slogan "prevention is more important than cure", there exist certain discussions contributing to injury prevention studies and application.

According to medical perspective, each injury enhances the risk for a following injury and serious injuries (like ACL or cartilage) may enhance the risk of osteoarthritis (31).

Another advantage is that prevention programs might play a role in increasing performance, and this may also enhance the harmony of players and coaches (93).

Another perspective, the load of injuries leads to an important effect on the health costs (31).

2.5.2. The "FIFA 11+"

A group of international specialists from the FIFA Medical Assessment and Research Center (F-MARC). Oslo Sports Trauma Research Centre (Norway), and Santa Monica Orthopedic and Sports Medicine Research Foundation (USA) developed the "FIFA 11+" in 2006 (94).

"FIFA 11+" includes FIFA 11(F-11) program published by F-MARC in 2004 therefore, the term F 11 is used in studies before 2006.

The "FIFA 11+" is consist of warm-up exercises specifically designed for footballers, female or male; professional or amateur, of all levels with over 14 years. This program should be conducted minimum two times per week and lasts approximately twenty minutes to complete.

This program has useful impacts in preventing injuries and it also further helps the improvement of physical performance and motor skills of footballers (94).
Its influence in preventing injuries, importantly diminishing the number of injuries, was indicated in a study issued by Soligard et al in 2008 (52). Another reviewed article published by Bizzini et al. in 2015, they also revealed the preventive efficacy of the "FIFA 11+" (95).

2.5.3. Structure of the "FIFA 11+"

The "FIFA 11+" has three parts consisting of fifteen exercises which should be conducted in a certain sequence following a progressive and intentional warm- up. The exercises are based on scientific studies and good practice.

A significant issue in the program is to implement the proper technique during all of the exercises. Full attention should be paid to correct posture and good body control. The coach should be supervising footballers' performance and correct their mistakes when necessary.

The first part covers running exercises combined with controlled partner contacts and active stretching at a slow speed.

The second part covers 6 sets of exercises aiming to improve leg and core strength, plyometrics/agility and balance. All of them have three levels of increasing difficulty.

There were 3 basic running exercises in the third part; 75- 80% pace in the first running exercise.

Every part includes three levels. Footballers should start with level 1 and they should continue with the next level only when the exercises are finished with ease during a number of repetitions and specific time.

As for level upgrade, it must ideally be identified by every footballer. Alternatively, the team may go on with some exercises at the same level with others. In short, all the players may continue with the following level in all exercises after an average of 3-4 weeks of practicing (100).

3. MATERIALS AND METHODS

3.1. Individuals

This study aimed to apply the F 11+ football injury prevention program to an adolescent amateur football team and to enquire the impact of this exercise program on isokinetic muscle strength and balance parameters. By paying a specific attention to the fact that they are between the ages of 15 and 18, the male soccer players of a team in Turkey's Super Amateur League category were selected to participate in this study.

A pre-informing consent form was received from each individual and their parents at the beginning of the study.

Inclusion Criteria;

1. To accept being a member of a case study.
2. Being in the 15-18 age range.
3. To be currently a soccer player in amateur league clubs with an experience for at least one year.
4. Having no systemic diseases.
5. Having the necessary mental and physical activity level in order to be able to take and complete the tests.

Exclusion Criteria;

1. Refusing to be a member of a case study.
2. Having visual impairment and perceptual disorder in a severe level
3. Having pain that prevents testing.
4. Having diseases with neurological dysfunction.
5. Footballers who stop playing active football during the study period and disrupt the training program by not participating in 3 exercises in a row.
6. Having an injury in the research process.
7. Having an injury in the last six months before the research

During the whole study, in total, three players, two of whom for missing three consecutive workouts and one of whom for having an injury were excluded from the research. The study and control group were formed by selecting players from the U 18 Alibeyköy Sports Club Football Team. Physical fitness assessment tests were applied to the control group. The players in the control group carried out their own training programs and the data were gathered at the beginning and end of the study. At the beginning of the study, physical fitness assessment tests were conducted to the study group then the F11 + exercise program, which was adapted to the players, was applied in addition to the routine training program and at the end of 9 consevutive weeks, the evaluations were repeated and the data between the two groups were compared. Routine training program was the same for both groups. The training group started to work out 30 minutes earlier because F 11+ exercise program was applied to them.

The assessments were made in the Physical Therapy and Rehabilitation Unit of Okmeydanı Training and Research Hospital and in Alibeyköy Sports Club.

The research was evaluated by the Ethics Committee of Clinical Research of Yeditepe University at the meeting dated 26.09.2018 with the registration number 1522 and was regarded as appropriate in terms of medical ethics.

3.2. Method

3.2.1. Assessment

Applicable test battery was prepared by doing some research on the literature of tests via which the players would be evaluated.

1- Evaluation of the characteristics of the players.
2- Balance Assessment
3- Muscle Strength Assessment (Isokinetic assessment and vertical jump)

The first test was applied at the beginning of the season and the second one was repeated at the end of the 9th week.

Gathering Data Regarding the Characteristics of Players

- Current information (address, phone, e-mail)
- Age (year)
- Body weight (kg)
- Height (cm)
- Dominant foot
- Systemic diseases

3.2.1.1. Balance Assessment

Dynamic postural control was measured with Star Excursion Balance Test (SEBT) which was applied with a system of 8 lines (Figure 1). The foot was placed in the center of the testing system, in order that the foot could be bisected equally in the medial-lateral anteroposterior planes. SEBT is made up of 8 directions: anterior, anterolateral, lateral, posterolateral, posterior, posteromedial, medial and anteromedial (Figure 2) Players were asked to reach as much as possible throughout the established lines slightly touching the line on the floor with the most distal segment of the extending foot, then getting back to the extending leg back to two leg stance, while keeping a single leg stable with the other leg within the center of the system. Players performed the SEBT test in a counterclockwise or clockwise manner, depending on the left or the right leg, respectively. Players were asked to keep the heel of their stable leg on the ground and to keep their two hands on iliac crests at during testing. Before the test, players performed 6 practice trial test to accomplish any learning impact and provide warm-up. After the practice trials, players had a five-minute pause for some relaxation before performing the test. They were provided as much time as players needed between trials, in order that fatigue could be refrained. The reach distances were saved with a sign at the point of maximum reach and measured from the starting point of the system on the band line. Test repeated 3 times in each direction the avarage cm saved in (96).

The most widely used process for the SEBT was developed by Hertel et al. (136) Hertel et al. and Plisky et al. (85) reported high intraclass correlation coefficients (ICC) ranging from 0.78 to 0.96. Hyong et al. (137) reported that SEBT has shown good-to-excellent intrarater (ICC: 0.67-0.96) and strong-to-excellent interrater reliability for both normalized (ICC: 0.84-0.93) and raw scores (0.89-0.94).

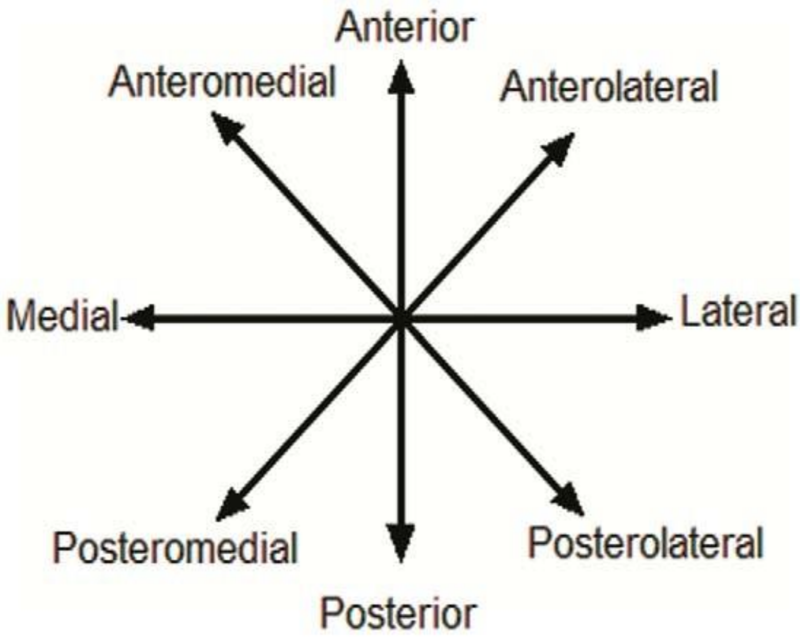


Figure 3.1.Star Excursion Balance Test (SEBT) (96)

Figure 3.2. Application of Star Excursion Balance Test (SEBT)

3.2.1.2. Muscle Strength Assessment

Isokinetic assessment

Isokinetic testing evaluated maximal hamstring and quadriceps muscle performance utilizing an isokinetic dynamometer (Cybex Norm). Before all measurements, 10-minute standard warm up program was applied on an ergometric bicycle after dynamic stretching exercises was applied to flexor and extensor muscle (figure3.3). Each player firstly was seated and assumed his best comfortable position to perform the best tests. Then the player was fixed with straps across the hip, chest and shoulder. The cuff of the isokinetic dynamometer's pry arm was bonded proximally to the malleoli of the ankle. Dynamometer orientation was adjusted at 90° and tilted at 0°, while the seat orientation was adjusted at 90° and the seatback was tilted at 70°-85°. The dynamometer rotational axis was visually collimated with the lateral epicondyle of the knee. Player positioning and device set-up were as per the manufacturer's guidelines, which were also parallel to former studies. All the testing and seating positions of the each players were registered and repeated during post-test. Before evaluation, starting repetitions routinely preceded every test speed. The test protocol covered concentric effort (angular speeds of 60 and 240°/sec) of both extensor and flexor muscles. Then players performed concentric knee flexion and extension 5 times at speeds of 60°/sec ,15 times at 240°/sec. They had also a one-minute pause for some relaxation between different angular velocities and then a three-minute pause when the system setting was altered for the opposite leg. The row of testing was randomized for the non-dominant and dominant legs. All players were stimulated by visual feedback and verbal coaching (figure 3.4). End of all tests quadriceps and hamstring peak torque (PT) values newton-meter (Nm), the ratio of peak torque to body weight (PT / BW) values newton-meter / kilogram (Nm / kg) and H / Q ratio percent were recorded (97,98).

Figure 3.3. Warming up before isokinetic evaluation

Figure 3.4. Isokinetic evaluation test application

Vertical Jump

The players were informed about the vertical jump and then they were tested after 2-3 attempts were made at the beginning. The test was started with the marking of the highest point where the player was able to reach his feet and heels without leaving the floor. Then he left the wall 20 cm apart, was crouched and asked to touch the point where he reached as far as possible (figure 3.5).

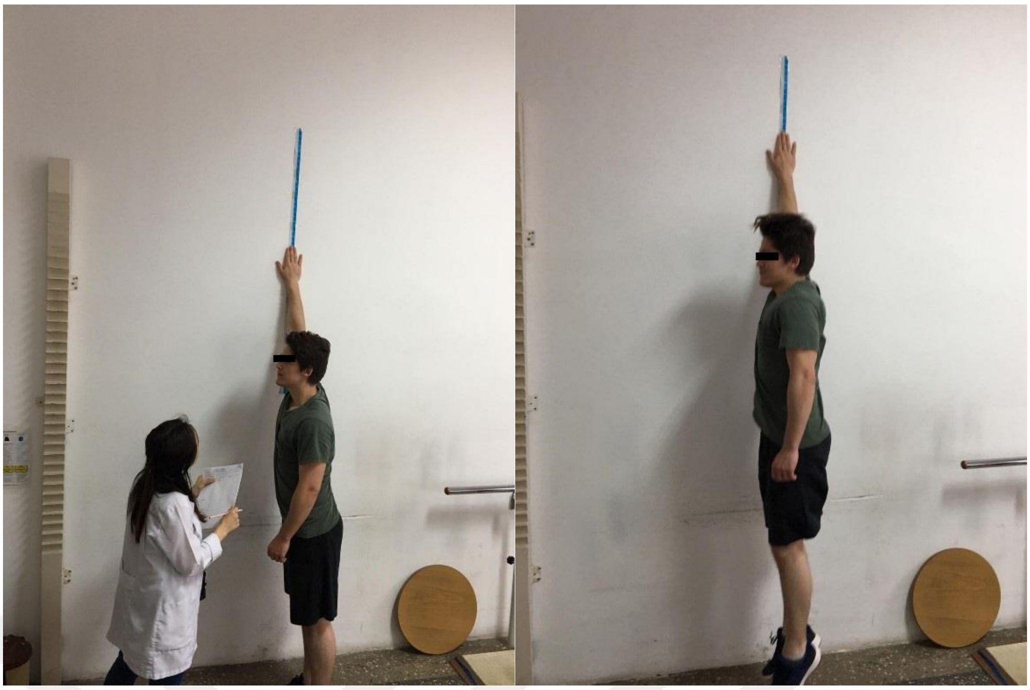


Figure 3.5. Vertical jump test start and jump positions.

The length between the first touch point and the jump point was measured and recorded. The second and then the third were performed approximately 1-2 minutes after the first jump. This was recorded with the average of three jumps (99).

3.2.2. FIFA 11+ Exercise Programme

The FIFA 11 + training program was applied to the study group. This training program was developed by a team of specialists from FIFA, sponsored by the Oslo Sports Injury Research Center, Santa Monica Orthopedics and Sports Health Research Foundation, and the FIFA Medical Assessment and Research Center (F-MARC). F 11+ program; It consists of simple, easily remembered and time-consuming, sport-specific exercises underlying fair play.

The F 11+ consisted of 3 parts: the first part consisted of running exercises (part 1); the second part included 6 exercises, which were made up of three levels of difficulty and aiming at enhancing balance, strength, muscle control and core stability (part 2). The final and the third part covered advanced running exercises (part 3).

Table 3.1: The FIFA 11+. Exercises, duration and intensities of the structured warm-up program used (F-MARC) (10)

Exercise	**Duration**
PART 1: running	**8 minutes**
Straight ahead, hip out, hip in, circling partner, shoulder contact, quick forward & backwards (6 running items, each item 2 sets	
PART 2 : strength, plyometric and balance	**10 minutes**
The bench: Static, alternate legs and one leg lift and hold (3 items, each item 3 sets)	
Sideways bench: Static, raise & lower hip, with leg lift (3 items, 3 sets on each side)	
Hamstring: Beginner (3–5 repetition, 1 set), intermediate (7–10 repetition, 1 set), advanced (12–15 repetition, 1 set). (3 items)	
Single-leg stance: Hold the ball, throw the ball to a partner, test your partner (3 items, each item 2 sets)	
Squats: With toe raise, walking lunges, one-leg squats (3 items, each item 2 sets)	
Jumping: Vertical jumps, lateral jumps, box jumps (3 items, each item 2 sets)	
PART 3: running exercise	**2 minutes**
Across the pitch, bounding, plant & cut (3 items, each item 2 sets)	
Total	**20 minutes**

Players were provided with a video demonstration of the F 11+ exercise program and a copy of the text before the exercise. The F 11+ training program was applied to the training group 3 times a week, besides with the routine training program, which were usually held on Monday, Wednesday and Friday for 9 weeks and completed in 20-25 minutes.

The control group kept on doing their own routine workout. This routine program consist of 15 min. jogging, stretching exercises and mini soccer game. At the end of 9 weeks, the evaluations made at the beginning of the season were repeated.

The field was composed of six pairs of parallel cones, nearly five – six meters apart. Two players started at the same time from the first pair of cones, jogged along the inside of the cones and did the various exercises on the way. After the last cone, they ran back along the outside.

Figure 3.6. Some parts of the F-11+ football injury prevention program

The first part started with straight running. Then, each of the players was asked to run two sets by pulling their hips inward when a cone came. In the same way the hip was asked to run two sets outward. First, 4th, 5th and 6th exercises were carried out in a paired manner. Players were asked to start running at the same time at the beginning point and to turn among each other at the mid-point of the cones and go back to the point where they started running. In the 5th exercise, he was asked to meet at the mid-point of the cones and hit shoulder to shoulder and continue running again. The exercise was quickly asked to come back forward with a cone length of 2 cones and run back again. All of these exercises were applied in 2 sets and they were asked to run the tempo at the return to the starting point. It took an average of 10 min.

In the second part, there were 6 exercises in total and each exercise was divided into 3 levels from easy to difficult. The exercises, designed for 6 different regions in 6 different positions, were done in 3 sets. The average duration was 10 min (figure 3.6).

There were 3 basic running exercises in the third part; 75- 80% pace in the first exercise 40m. straight running, second exercise major steps completing the run in 6-8 steps, third exercise 4-5 steps run straight at normal tempo and then make a quick exit at a maximum tempo of 85 - 90% by suddenly changing direction then running again at the same speed towards the other side by suddenly changing direction and thus completing the run. The third part of each of the running exercises were done in 2 sets and the rotation of each run was at a slow pace. It took average of 2 min.

3.2.3. Statistical Analysis

SPSS 18.0 program was used for statistical analysis. Descriptive statistics was given as numbers and percentages for categorical variables and as the average standard deviation for the numerical variables. Chi-square test was applied for categorical variables while the groups were being compared. Wilcoxon Rank Test was implemented for dependent variables while the groups were being compared within themselves. Comparison of the two groups in terms of numeric variables was made via Mann-Whitney U Test.

The Mann-Whitney U test was utilized to compare the data of the change ratio, the pre- and post-training data of the groups.

Wilcoxon Rank Test was used to compare the pre- and post-training data of the groups and to evaluate the right and left lower extremity muscle strength and balance differences.

The Wilcoxon Rank Test and Mann Whitney U tests were used as z and p values.

The mean ± standard deviation was calculated for the variables determined by measurement such as balance, vertical jump, muscle strength.

In all findings, * sign is $p < 0.05$.

The hypothesis of this research is H-0 and H-1;

H-0: F-11+ exercise program has no effect on balance and muscle strength in adolescent amateur footballers

H-1: The F-11+ exercise program is effective at the level of balance and muscle strength in adolescent amateur football players.

4. RESULTS

In our study, we examined the footballers in U-18 team of Alibeyköyspor Football Club from Turkey's Super Amateur League category for 9 straight weeks from the very beginning of the season.

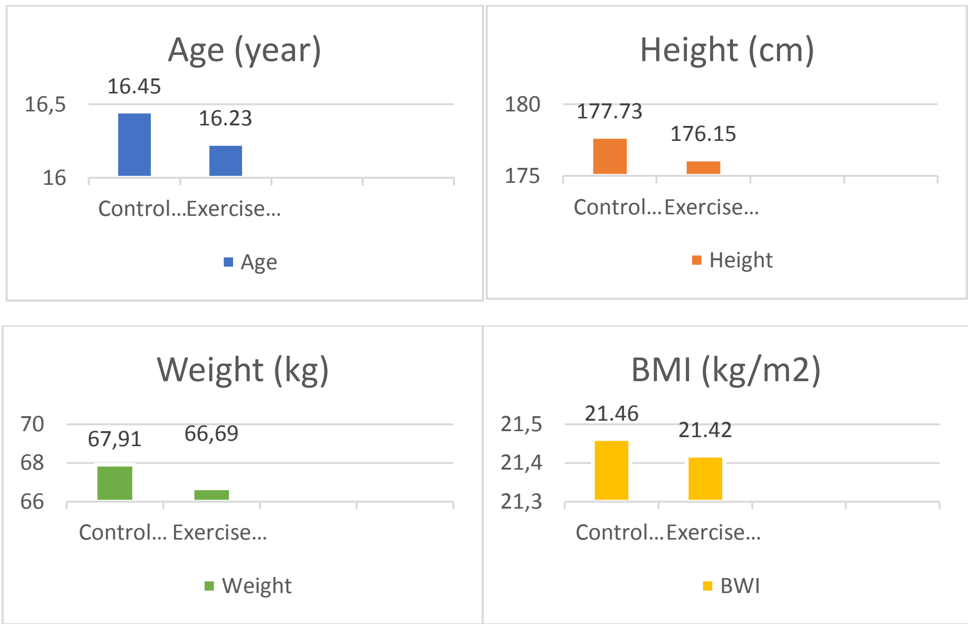
Before and after training measurements of the study group (N=13) and control group (N=11) were compared utilizing the Mann Whitney U statistical test. Accordingly, the consequences were as follows.

Comparison of demographic characteristics of groups;

The mean age of the study group football players was 16,23 ± 0,92 years, and the mean height of the players was 176,15 ± 8,69 cm. The average age of the control group was 16.45 ± 0.68 years, and the mean height of the players was 177,73 ± 5,67 cm.

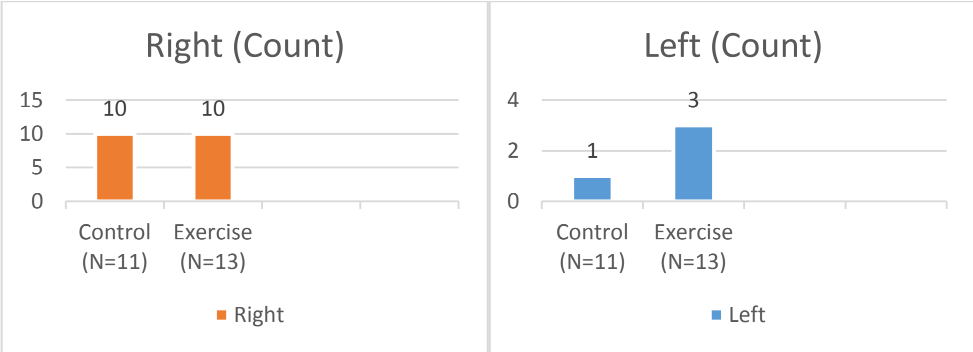
We could not find any significant difference in the body weight, height, age and BMI measurements of the two groups before the training. ($p>0,05$). The relevant consequences are given in Table 4.1.

Table 4.1. Comparison of physical characteristics and measurements of study group and control group before training



Statistically there were not any significant differences between the groups in terms of dominant foot.

Table 4.2. Dominant foot comparison between groups



Comparison of pre-training data of the groups;

The consequences obtained from both groups at the angular velocity of 60 ° / sec at the right and left lower extremity quadriceps and hamstring concentric peak torque muscle strength and H / Q ratio measurements are given in Table 4.3 below. According to these consequences, there were not any significant differences between right and left quadriceps peak torque values of both groups (p>0,05).

We could not find any significant differences in the right and left hamstring peak torque values between the groups (p>0,05). Right H / Q ratio of the control group was higher than study group (p<0,05). This difference is due to the fact that the hamstring concentric muscle strength values of the control group were higher than the values of the study group before training.

Table 4.3. Comparison of right and left lower extremity quadriceps and hamstring concentric peak torque muscle strength and H / Q ratio values at 60 ° / sec angular velocity before the training

60°/sec	Control Group (n=11) (Mean ±SD)	Study Group (n=13) (Mean ±SD)	z	P
Right Q PT (Nm)	170,36±43,59	176,54±53,29	-,290	,772
Left Q PT (Nm)	178,91±42,76	181,08±39,86	-,290	,772
Right H PT (Nm)	135,55±28,59	120,23±26,43	-1,334	,182

Left H PT (Nm)	120,73±34,48	117,00±20,11	-,058	,954
Right Q PT/BW (Nm/kg)	250,00±47,42	267,31±69,84	-1,248	,212
Left Q PT/BW (Nm/kg)	263,64±48,77	275,00±54,17	-,841	,401
Right H PT/BW (Nm/kg)	200,91±36,54	182,00±30,89	-,986	,324
Left H PT/BW (Nm/kg)	177,82±43,78	179,38±19,94	-,261	,794
Right H/Q (%)	81,64±14,49	71,15±15,37	-2,146	**,032***
Left H/Q (%)	67,27±11,46	66,85±17,19	-,609	,543

* p < 0,05, Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

The consequences obtained from quadriceps and hamstring concentric peak torque muscle strength and H / Q ratio measurements of the right and left lower extremity at 240 ° / sec angular velocity of both groups before training are given in Table 4.4 below. According to these consequences, there were not any significant differences between left and right quadriceps and hamstring peak torque and H / Q ratio measurements of both groups. (p>0,05).

Table 4.4. Comparison of right and left lower extremity quadriceps and hamstring concentric peak torque muscle strength and H / Q ratio values at 240 ° / sec angular velocity before the training.

240°/sec	**Control Group (n=11) (Mean ±SD)**	**Study Group (n=13) (Mean ±SD)**	**Z**	**P**
Right Q Peak Torque (Nm)	83,73±8,42	88,38±19,14	-,494	,621
Left Q Peak Torque (Nm)	85,36±14,32	95,08±24,93	-,841	,401
Right H Peak Torque (Nm)	71±19,4	77,38±18,02	-,784	,433
Left H Peak Torque (Nm)	67,36±14,71	73,54±16,98	-,957	,339
Right Q PT/BW (Nm/kg)	125,09±21,65	133,08±21,12	-,754	,451
Left Q PT/BW (Nm/kg)	126,09±12,10	142,23±25,18	-1,744	,081
Right H PT/BW	105,45±25,87	116,46±19,44	-,958	,338

(Nm/kg)				
Left H PT/BW (Nm/kg)	99,09±21,16	110,15±18,80	-1,594	,111
Right H/Q (%)	85,09±20,28	88,69±13,98	-,406	,685
Left H/Q (%)	79±14,43	80,23±19,98	-,116	,908

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Consequences obtained from vertical jump measurements before the training between groups given in table 4.5. Statistically we could not find any significant differences between the groups. (p>0,05).

Table 4.5. Comparison of vertical jump measurements between groups before training

	Control Group (n=11) (Mean ±SD)	**Study Group (n=13) (Mean ±SD)**	**z**	**P**
Vertical jump (cm)	36,62±5,03	38,40±5,33	-,870	,38

The right and left extremity star excursion balance test measurement comparisons of both groups before the training are shown in Table 4.6 below. According to these consequences, there were not any significant differences between the right and left anterior, anteromedial, medial, posteromedial, posterior, posterolateral, lateral and anterolateral directions of both groups. (p>0,05).

Table 4.6. Comparison of right and left star excursion balance test measurements between groups before the training

	Control Group (n=11) Mean ±SD (min-max)	**Study Group (n=13) Mean ±SD (min-max)**	**z**	**P**
Left anterior (cm)	67,84±6,14	63,93±9,44	-,899	,369
Right anterior (cm)	70,35±5,76	67,07±7,23	-,812	417
Left anteromedial (cm)	80±8,56	78,49±9,48	-,435	,663
Right anteromedial (cm)	76,99±6,35	81,83±9,51	-1,594	,111
Left medial (cm)	75,51±5,31	72,42±7,43	-1,277	,202

Right medial (cm)	72,05±9,01	73,44±9,93	-,986	,324
Left posteromedial (cm)	85,63±9,15	80,38±8,66	-1,624	,104
Right posteromedial (cm)	82,87±7,81	82,91±11,11	-,348	,728
Left posterior (cm)	75,08±8,77	77,91±5,79	-,579	,562
Right posterior (cm)	73,16±9,31	76,52±8,84	-,754	,451
Left posterolateral (cm)	72,56±12,62	75,28±12,88	-,261	,794
Right posterolateral (cm)	68,71±10,47	70±13,70	-,232	,817
Left lateral (cm)	51,50±7,09	54,05±7,88	-,348	,728
Right lateral (cm)	54,55±3,83	51,42±9,75	-,956	,339
Left anterolateral (cm)	70,08±8,63	65,80±10,64	-,986	,324
Right anterolateral (cm)	65,83±5,26	68,70±10,97	-,116	,908

Test so as to identify if there was a difference in the right or left side in terms of muscle strength and balance. Statistically there were not any significant differences between right and left extremity measurements at 60 °/ sec angular velocity before the training in study group. (p>0,05). The relevant consequences are given in Table 4.7.

Table 4.7. Comparison of right and left extremity measurements at 60˚/sec angular velocity before training in study group

Study Group				
Before training 60˚/sec	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Q PT (Nm)	176,54±53,29	181,08±39,86	-,311	,756
Q PT/BW (Nm/kg)	267,31±69,84	275±54,17	-,356	,722
H PT (Nm)	120,23±26,43	117±20,11	-,734	,463
H PT/BW (Nm/kg)	182±30,89	179,38±19,94	-,629	,529

H/Q (%)	71,15±15,37	66,85±17,19	-,934	,350

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Statistically there were not any significant differences between right and left extremity measurements at 240 °/ sec angular velocity before the training in study group. (p>0,05). The relevant consequences are given in Table 4.8.

Table 4.8. Comparison of right and left extremity measurements at 240˚/sec angular velocity before training in study group

Study group				
Before training 240˚/sec	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**p**
Q PT (Nm)	88,38±19,14	95,08±24,92	-1,609	,108
Q PT/BW (Nm/kg)	133,08±21,12	142,23±25,18	-1,533	,125
H PT (Nm)	77,38±18,02	73,54±16,98	-1,178	,239
H PT/BW (Nm/kg)	116,46±19,44	110,15±18,8	-1,156	,248
H/Q (%)	88,69±13,98	80,23±19,98	-1,783	,075

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Statistically there was one significant difference and it was only in posterolateral measurements in the comparison of right and left star excursion measurements before training in study group (p < 0,05). There were not any significant differences in other measurements (p>0,05). The relevant consequences are given in Table 4.9.

Table 4.9. Comparison of right and left star excursion balance test measurements before training in study group

Study group				
Before training	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**Z**	**P**
Anterior	63,93±9,45	67,07±7,23	-,874	,382
Anteromedial	78,49±9,48	81,83±9,51	-1,491	,136
Medial	72,42±7,43	73,44±9,93	-,623	,533

Posteromedial	80,38±8,66	82,91±11,11	-,943	,345
Posterior	77,91±5,79	76,52±8,84	-1,099	,272
Posterolateral	75,28±12,88	70±13,7	-2,353	**,019***
Lateral	53,05±7,88	51,42±9,75	-,314	,753
Anterolateral	65,8±10,64	68,7±10,97	-,945	,345

* p < 0,05

This time there were statistically significant differences in H / Q (%) values between right and left extremity measurements at 60˚/sec angular velocity before the training in control group. (p < 0,05). Statistically there were not any significant differences in other measurements (p>0,05). The consequences are given in Table 4.10.

Table 4.10. Comparison of right and left extremity measurements at 60˚/sec angular velocity before training in control group

Control Group				
Before training 60˚/sec	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**Z**	**P**
Q PT (Nm)	170,36±43,59	178,91±42,76	-,934	,350
Q PT/BW (Nm/kg)	250±47,42	263,64±48,77	-,867	,386
H PT (Nm)	135,55±28,59	120,73±34,48	-1,067	,286
H PT/BW (Nm/kg)	200,91±36,54	177,82±43,78	-1,067	,286
H/Q (%)	81,64±14,49	67,27±11,46	-2,756	**,006***

* p < 0,05, Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Statistically there were not any significant differences between right and left extremity measurements at 240 °/ sec angular velocity before the training in control group (p>0,05). The consequences are given in Table 4.11.

Table 4.11. Comparison of right and left extremity measurements at 240˚/sec angular velocity before training in control group

Control Group				
Before training 240˚/sec	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**Z**	**P**
Q PT (Nm)	83,73±8,42	85,36±14,32	-,178	,859
Q PT/BW (Nm/kg)	125,09±21,65	126,09±12,1	-,102	,919
H PT (Nm)	71±19,4	67,36±14,71	-,652	,515
H PT/BW (Nm/kg)	105,45±25,87	99,09±21,16	-,489	,624
H/Q (%)	85,09±20,28	79±14,43	-,489	,625

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Statistically there were not any significant differences in the comparison of right and left star excursion balance test measurements before the training in control group. (p>0,05). The consequences are given in Table 4.12.

Table 4.12. Comparison of right and left star excursion balance test measurements before training in control group

Control Group				
Before training	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**Z**	**P**
Anterior	67,84±6,14	70,35±5,76	-,178	,859
Anteromedial	80±8,55	76,99±6,35	-1,379	,168
Medial	75,51±5,31	72,05±9,01	-1,423	,155
Posteromedial	85,63±9,15	82,87±7,81	-1,021	,307
Posterior	75,08±8,77	73,16±9,31	-1,112	,266
Posterolateral	72,56±12,62	68,71±10,47	-1,334	,182
Lateral	51,5±7,09	54,55±3,83	-1,886	,059
Anterolateral	70,08±8,63	65,83±5,26	-1,156	,248

Comparison of post-training data of the groups;

The consequences of both groups at the angular velocity of 60 ° / sec at the right and left lower extremity quadriceps and hamstring concentric peak torque muscle strength and H / Q (%) ratio consequences after the training are given in Table 4.13. below. According to these consequences, there were not any significant differences in the right and left quadriceps and hamstring peak torque values and H / Q (%) ratio between the groups after training. (p>0,05).

Table 4.13. Comparison of right and left lower extremity quadriceps and hamstring concentric peak torque muscle strength and H / Q ratio values at 60 ° / sec angular velocity after the training.

After training 60°/sec	Control Group (n=11) Mean ±SD (min-max)	Study Group (n=13) Mean ±SD (min-max)	z	p
Right Q Peak Torque (Nm)	166,36±48,51	180,23±50,15	-,608	,543
Left Q Peak Torque (Nm)	183,82±47,40	190,23±39,48	-,290	,772
Right H Peak Torque (Nm)	138,27±34,30	133,92±25,39	-,000	1,000
Left H Peak Torque (Nm)	125,64±22,23	125,38±17,23	-,203	,839
Right Q PT/BW (Nm/kg)	244,64±59,30	273,46±66,25	-1,653	,098
Left Q PT/BW (Nm/kg)	263,00±52,20	289,92±55,97	-1,044	,297
Right H PT/BW (Nm/kg)	205,18±46,39	203,54±33,82	-,145	,885
Left H PT/BW (Nm/kg)	187,36±34,35	191,31±24,44	-,203	,839
Right H/Q (%)	87,45±24,64	77,08±17,69	-1,130	,258
Left H/Q (%)	73,73±18,89	67,85±14,52	-1,044	,297

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

The consequences of both groups at the angular velocity of 240 ° / sec at the right and left lower extremity quadriceps and hamstring concentric peak torque muscle strength and H / Q (%) ratio consequences after the training are given in Table 4.14. below. According to these consequences, statistically only one significant difference was detected in the left quadriceps concentric peak torque muscle strength ($p < 0,05$). There were not any significant differences in other comparisons ($p> 0.05$).

Table 4.14. Comparison of right and left lower extremity quadriceps and hamstring concentric peak torque muscle strength and H / Q ratio values at 240 ° / sec angular velocity after the training.

After training 240°/sec	Control Group (n=11) Mean ±SD (min-max)	Study Group (n=13) Mean ±SD (min-max)	z	p
Right Q Peak Torque (Nm)	83,91±9,25	89,31±19,80	-,319	,750
Left Q Peak Torque (Nm)	85,82±10,65	101,23±21,41	-2,030	**,042**
Right H Peak Torque (Nm)	74,64±12,002	80,38±26,69	-,319	,750
Left H Peak Torque (Nm)	75,36±13,98	78,69±17,44	-,493	,622
Right Q PT/BW (Nm/kg)	123,18±17,47	135,62±25,34	-1,594	,111
Left Q PT/BW (Nm/kg)	127,09±17,77	146,77±30,67	-1,652	,099
Right H PT/BW (Nm/kg)	110,73±20,86	119,69±41,74	-1,072	,284
Left H PT/BW (Nm/kg)	113,09±28,70	118,00±22,49	-,493	,622
Right H/Q (%)	89,27±15,86	90,46±22,51	-,348	,728
Left H/Q (%)	87,45±12,60	79,31±17,41	-1,626	,104

* $p < 0,05$, Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Consequences obtained from vertical jump measurements after the training between groups given in table 4.15. Statistically there were not any significant differences between the groups. ($p>0,05$).

Table 4.15. Comparison of vertical jump measurements between groups after the training

After Training	Control Group(n=11) Mean ±SD (min-max)	Study Group (n=13) Mean ±SD (min-max)	Z	P
Vertical jump (cm)	37,49±4,32	37,59±4,09	-,319	,74

The right and left extremity star excursion balance test measurement comparisons of both groups after the training are shown in Table 4.16. below. According to these consequences, only the right anteromedial measurement was high in the study group. (p<0,05). Statistically there were no significant differences in other directions (p>0,05).

Table 4.16. Comparison of right and left star excursion balance test measurements between groups after the training

After training	Control Group (n=11) Mean ±SD (min-max)	Study Group (n=13) Mean ±SD (min-max)	z	p
Left anterior (cm)	68,43±6,15	71,26±8,63	-,754	,451
Right anterior (cm)	70,89±3,51	72,86±6,45	-1,277	,202
Left anteromedial (cm)	79,03±8,86	81,14±8,73	-,551	,582
Right anteromedial (cm)	77,95±6,65	85,39±9,88	-2,058	**,040**
Left medial (cm)	74,47±4,74	74,97±8,64	-,029	,977
Right medial (cm)	73,05±7,88	78,29±8,05	-1,883	,060
Left posteromedial (cm)	85,00±8,69	85,01±7,27	-,290	772
Right posteromedial (cm)	83,75±7,15	87,28±9,59	-1,159	,246
Left posterior (cm)	76,23±9,96	80,96±6,14	-1,101	,271
Right posterior (cm)	73,63±8,76	80,69±8,00	-1,767	,077
Left	71,60±10,86	78,66±12,36	-1,449	,147

posterolateral (cm)				
Right posterolateral (cm)	69,84±10,21	74,02±13,75	-,783	,434
Left lateral (cm)	52,45±6,18	55,04±9,03	-,899	,369
Right lateral (cm)	54,76±4,43	55,95±6,69	-,609	,542
Left anterolateral (cm)	69,04±8,11	69,75±11,08	-,261	,794
Right anterolateral (cm)	66,76±4,68	73,13±10,22	-1,914	,056

The groups were evaluated after the training with Wilcoxon Ranks Test so as to identify if there was difference in the right or left side in terms of muscle strength and balance. Statistically there were not any significant differences between right and left extremity measurements at 60 °/ sec angular velocity after the training in study group. (p>0,05). The relevant consequences are given in Table 4.17.

Table 4.17. Comparison of right and left extremity measurements at 60˚/sec angular velocity after training in study group

Study Group				
After training 60˚/sec	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Q PT (Nm)	180,23±50,15	190,23±39,48	-1,153	,249
Q PT/BW (Nm/kg)	273,46±66,25	289,92±55,97	-1,119	,263
H PT (Nm)	133,92±25,39	125,38±17,23	-1,329	,184
H PT/BW (Nm/kg)	203,54±33,82	191,31±24,44	-1,294	,196
H/Q (%)	77,08±17,68	67,85±14,52	-1,890	,059

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Statistically there were not any significant differences between right and left extremity measurements at 240 °/ sec angular velocity after the training in study group. (p>0,05). The relevant consequences are given in Table 4.18.

Table 4.18. Comparison of right and left extremity measurements at 240˚/sec angular velocity after training in study group

Study Group				
After training 240˚/sec	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Q PT (Nm)	89,31±19,8	101,23±21,41	-1,399	,162
Q PT/BW (Nm/kg)	135,62±25,34	146,77±30,67	-,874	,382
H PT (Nm)	80,38±26,69	78,69±17,44	-,315	,753
H PT/BW (Nm/kg)	119,69±41,74	118±22,49	-,559	,576
H/Q (%)	90,46±22,51	79,31±17,41	-1,188	,235

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Statistically only one significant difference was found and it was in posterolateral measurements in the comparison of right and left star excursion measurements after training in study group ($p < 0,05$). There were not any significant differences in other measurements ($p > 0,05$). The relevant consequences are given in Table 4.19.

Table 4.19. Comparison of right and left star excursion balance test measurements after training in study group

Study Group				
After training	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Anterior	71,26±8,63	72,86±6,45	-,943	,345
Anteromedial	81,14±8,73	85,39±9,88	-1,713	,087
Medial	74,97±8,64	78,29±8,05	-1,223	,221
Posteromedial	85,01±7,27	87,28±9,59	-,909	,363
Posterior	80,96±6,14	80,69±8	-,454	,650
Posterolateral	78,66±12,36	74,02±13,75	-2,353	**,019***
Lateral	55,04±9,03	55,95±6,59	-,035	,972
Anterolateral	69,75±11,08	73,13±10,22	-,874	,382

* p < 0,05

Control group, right Q and left H / Q (%) values were found to be higher in the right and left extremity comparisons at the 60˚/ sec angular velocity measurements after training (p < 0,05). Statistically there were not any significant differences in other measurements (p>0,05). The corresponding consequences are given in Table 4.20.

Table 4.20. Comparison of right and left extremity measurements at 60˚/sec angular velocity after training in control group

Control Group				
After training 60˚/sec	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Q PT (Nm)	166,36±48,51	183,82±47,4	-2,193	**,028***
Q PT/BW (Nm/kg)	244,64±59,3	263±52,2	-1,581	,114
H PT (Nm)	138,27±34,3	125,64±22,23	-1,825	,068
H PT/BW (Nm/kg)	205,18±46,39	187,36±34,35	-1,782	,075
H/Q (%)	87,45±24,64	73,73±18,89	-2,313	**,021***

* p < 0,05, Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Statistically there were not any significant differences in right and left extremity comparisons at 240˚ / sec angular velocity measurements after training in control group. (p>0,05). The corresponding consequences are also provided in table 4.21.

Table 4.21. Comparison of right and left extremity measurements at 240˚/sec angular velocity after training in control group

Control Group				
After training 240˚/sec	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Q PT (Nm)	83,91±9,25	85,82±10,65	-,534	,593
Q PT/BW (Nm/kg)	123,18±17,47	127,09±17,77	-,890	,374

H PT (Nm)	74,64±12	75,36±13,98	-,051	,959
H PT/BW (Nm/kg)	110,73±20,86	113,09±28,7	-,255	,798
H/Q (%)	89,27±15,86	87,45±12,6	-,400	,689

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Statistically only one significant difference was found and it was in lateral measurements in the comparison of right and left star excursion measurements after training in control group ($p < 0,05$). Statistically there were not any significant differences between other directions ($p>0,05$). The relevant consequences are given in Table 4.22.

Table 4.22. Comparison of right and left star excursion balance test measurements after training in control group

Control Group				
After training	**Left**	**Right**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**p**
Anterior	68,43±6,15	70,89±3,51	-,623	,533
Anteromedial	79,03±8,86	77,95±6,65	-,533	,594
Medial	74,47±4,74	73,05±7,88	-,622	,534
Posteromedial	85±8,69	83,75±7,15	-,711	,477
Posterior	76,23±9,96	73,63±8,76	-1,067	,286
Posterolateral	71,6±10,86	69,84±10,21	-1,275	,202
Lateral	52,45±6,18	54,76±4,43	-2,180	**,029***
Anterolateral	69,04±8,11	66,76±4,68	-,356	,722

* $p < 0,05$

Evaluation of the groups before and after the training;

Each group was evaluated with Wilcoxon Rank Test before and after the training. Isokinetic muscle strength measurements of the study group before and after the training were compared with the Wilcoxon Rank Test and the following statistical consequences were obtained.

Statistically only one significant difference was found in H PT-Right (Nm) and H PT / BW-Right (Nm / kg) comparisons in the study group at 60˚/sec angular velocity (p<0,05). Statistically there were not any significant differences in other measurements (p>0,05). The relevant consequences are given in Table 4.23.

Table 4.23. Comparison of pre and post-training values of quadriceps and hamstring concentric peak torque muscle strength and H / Q ratio values of the right and left lower extremity at 60˚/sec angular velocity of the study group

Study Group				
60˚/sec	**Before Training**	**After Training**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**p**
Q PT-Right (Nm)	176,54±53,29	180,23±50,15	-,489	,625
Q PT/BW-Right (Nm/kg)	267,31±69,84	273,46±66,25	-,455	,649
H PT-Right (Nm)	120,23±26,43	133,92±25,39	-2,727	**,006***
H PT/BW-Right (Nm/kg)	182±30,89	203,54±33,82	-2,760	**,006***
H/Q-Right (%)	71,15±15,37	77,08±17,68	-,770	,441
Q PT-Left (Nm)	181,08±39,86	190,23±39,48	-,874	,382
Q PT/BW-Left (Nm/kg)	275±54,17	289,92±55,97	-,804	,422
H PT-Left (Nm)	117±20,11	125,38±17,23	-1,434	,152
H PT/BW-Left (Nm/kg)	179,38±19,94	191,31±24,44	-,982	,326
H/Q-Left (%)	66,85±17,19	67,85±14,52	-,070	,944

* p < 0,05, Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Statistically there were not any significant differences in the measurements of the study group at an angular velocity of 240˚/sec before and after the training. (p>0,05). The relevant consequences are given in Table 4.24.

Table 4.24. Comparison of pre and post-training values of quadriceps and hamstring concentric peak torque muscle strength and H / Q ratio values of the right and left lower extremity at 240˚/sec angular velocity of the study group

Study Group

240˚/sec	Before Training	After Training		
	Mean ± SD (min-max)	Mean ± SD (min-max)	z	p
Q PT-Right (Nm)	88,38±19,14	89,31±19,8	-,525	,600
Q PT/BW-Right (Nm/kg)	133,08±21,12	135,62±25,34	-,384	,701
H PT-Right (Nm)	77,38±18,02	80,38±26,69	-,769	,442
H PT/BW-Right (Nm/kg)	11,46±19,44	119,69±41,74	-,595	,552
H/Q-Right (%)	88,69±13,98	90,46±22,51	-,629	,529
Q PT-Left (Nm)	95,08±24,92	101,23±21,41	-,979	,328
Q PT/BW-Left (Nm/kg)	142,23±25,18	146,77±30,67	-,280	,780
H PT-Left (Nm)	73,54±16,98	78,69±17,44	-1,330	,184
H PT/BW-Left (Nm/kg)	110,15±18,8	118±22,49	-1,295	,195
H/Q-Left (%)	80,23±19,98	79,31±17,41	-,315	,753

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

The consequences obtained from the vertical jump measurements of the study group before and after the training table 4.25. given. Statistically there were not any significant differences between the measurements (p>0,05).

Table 4.25. Comparison of the vertical jump measurements before and after training of the study group

Study Group				
	Before training	**After training**		
	Mean ± **SD** (**min-max**)	**Mean** ± **SD** (**min-max**)	z	**p**
Vertical jump(cm)	38,40± 5,33	37,59±4,08	-1,224	,221

Statistically only one significant difference was found in all directions except the left lateral measurement in the pre and post-training comparison of the star excursion balance test of the study group (p<0,05). The relevant consequences are shown in Table 4.26.

Table 4.26. Study group's star excursion balance test measurements before and after training.

Study Group				
	Before training	**After training**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Left Anterior	63,93±9,45	71,26±8,63	-3,182	**,001***
Right Anterior	67,07±7,23	72,86±6,45	-3,180	**,001***
Left Anteromedial	78,49±9,48	81,14±8,73	-2,697	**,007***
Right Anteromedial	81,83±9,51	85,39±9,88	-3,062	**,002***
Left Medial	72,42±7,43	74,97±8,64	-2,342	**,019***
Right Medial	73,44±9,93	78,29±8,05	-3,041	**,002***
Left Posteromedial	80,38±8,66	85,01±7,27	-2,276	**,023***
Right Posteromedial	82,91±11,11	87,28±9,59	-2,971	**,003***
Left Posterior	77,91±5,79	80,96±6,14	-2,100	**,036***
Right Posterior	76,52±8,84	80,69±8,00	-2,832	**,005***
Left Posterolateral	75,28±12,88	78,66±12,36	-2,482	**,013***
Right Posterolateral	70,00±13,70	74,02±13,75	-3,078	**,002***
Left Lateral	53,05±3,88	55,04±9,03	-1,688	,091
Right Lateral	51,42±9,75	55,95±6,59	-2,590	**,010***
Left Anterolateral	65,80±10,64	69,75±11,08	-2,825	**,005***
Right Anterolateral	68,70±10,97	73,13±10,22	-2,830	**,005***

* $p < 0,05$

The isokinetic muscle strength measurements of the control group before and after the training were compared with the Wilcoxon Rank Test and the following statistical consequences were obtained. Statistically there were not any significant differences in the measurement comparison of the control group at 60˚/sec angular velocity before and after the training. ($p>0,05$). The relevant consequences are given in Table 4.27.

Table 4.27. Measurement comparison of the control group at 60˚ / sec angular velocity before and after training

Control Group				
60˚ / sec	**Before training**	**After training**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Q PT-Right (Nm)	170,36±43,59	166,36±48,51	-,267	,790
Q PT/BW-Right (Nm/kg)	250±47,42	244,64±59,3	-,356	,722
H PT-Right (Nm)	135,55±28,59	138,27±34,3	-,802	,423
H PT/BW-Right (Nm/kg)	200,91±36,54	205,18±46,39	-,665	,506
H/Q-Right (%)	81,64±14,49	87,45±24,64	-1,636	,102
Q PT-Left (Nm)	178,91±42,76	183,82±47,4	-,816	,415
Q PT/BW-Left (Nm/kg)	263,64±48,77	263±52,2	-,153	,878
H PT-Left (Nm)	120,73±34,48	125,64±22,23	-,222	,824
H PT/BW-Left (Nm/kg)	177,82±43,78	187,36±34,35	-,267	,789
H/Q-Left (%)	67,27±11,46	73,73±18,89	-1,424	,154

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

Statistically there were not any significant differences in the measurement comparison of the control group at an angular velocity of 240˚/ sec before and after the training. (p>0,05). The relevant consequences are given in Table 4.28.

Table 4.28. Measurement comparison of the control group at 240˚ / sec angular velocity before and after training

Control Group				
240˚ / sec	**Before training**	**After training**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Q PT-Right (Nm)	83,73±8,42	83,91±9,25	-,089	,929
Q PT/BW-Right (Nm/kg)	125,09±21,65	123,18±17,47	-,489	,625
H PT-Right (Nm)	71±19,4	74,64±12	-,845	,398
H PT/BW-Right (Nm/kg)	105,45±25,87	110,73±20,86	-,623	,533
H/Q-Right (%)	85,09±20,28	89,27±15,86	-,756	,450

Q PT-Left (Nm)	85,36±14,32	85,82±10,65	-,223	,824
Q PT/BW-Left (Nm/kg)	126,09±12,1	127,09±17,77	-,223	,824
H PT-Left (Nm)	67,36±14,71	75,36±13,98	-1,423	,155
H PT/BW-Left (Nm/kg)	99,09±21,16	113,09±28,7	-1,735	,083
H/Q-Left (%)	79±14,43	87,45±12,6	-1,646	,100

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

The consequences obtained from the vertical jump measurements before and after the training of the control group are shown in Table 4.29. also given. Statistically there were not any significant differences between the measurements ($p > 0.05$).

Table 4.29. Comparison of the vertical jump measurements before and after training of the control group

Control Group				
	Before training	**After training**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Vertical jump(cm)	36,61±5,02	37,49±4,31	-,267	,789

Statistically only one significant difference was found in the right posterolateral measurement in the control group's pre and post-training comparison of star excursion balance test ($p<0,05$). There were not any significant differences between other measurements ($p>0,05$). The relevant consequences are shown in Table 4.30.

Table 4.30. Control group's star excursion balance test measurements before and after training.

Control Group				
	Before training	**After training**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**p**
Left Anterior	67,84±6,14	68,43±6,15	-,890	,374
Right Anterior	70,35±5,76	70,89±3,51	-,445	,656
Left Anteromedial	80±8,55	79,03±8,86	-,445	,657
Right Anteromedial	76,99±6,35	77,95±6,65	-,845	,398
Left Medial	75,51±5,31	74,47±4,74	-1,112	,266
Right Medial	72,05±9,01	73,05±7,88	-,668	,504
Left Posteromedial	85,63±9,15	85±8,69	-,667	,504
Right Posteromedial	82,87±7,81	83,75±7,15	-1,246	,213
Left Posterior	75,08±8,77	76,23±9,96	-1,157	,247
Right Posterior	73,16±9,31	73,63±8,76	-,445	,656
Left Posterolateral	72,56±12,62	71,6±10,86	-,533	,594
Right Posterolateral	68,71±10,47	69,84±10,21	-2,104	**,035***
Left Lateral	51,5±7,09	52,45±6,18	-,757	,449
Right Lateral	54,55±3,83	54,76±4,43	-,534	,593
Left Anterolateral	70,08±8,63	69,04±8,11	-1,123	,262
Right Anterolateral	65,83±5,26	66,76±4,68	-,978	,328

* $p < 0,05$

There were not any significant differences in terms of the change rates of the isokinetic muscle strength which is at 60°/sec angular velocity when the change rates of some isokinetic measurements of both groups, which were found differently before and after training, were compared. The relevant consequences are shown in Table 4.31.

Table 4.31. Comparison of pre and post training measurements of both groups in terms of the change rates of the isokinetic muscle strength which is at 60°/sec angular velocity

Change Ratio				
60˚/sec	**Study group**	**Control group**		

	Mean ± SD (min-max)	Mean ± SD (min-max)	z	p
Q PT-Right (Nm)	5,11±19,51	-1,56±19,89	-1,1877	0,235
Q PT/BW-Right (Nm/kg)	5,10±19,27	-1,63±19,97	-1,1877	0,235
H PT-Right (Nm)	12,49±11,77	1,79±12,18	-1,8250	0,068
H PT/BW-Right (Nm/kg)	12,54±11,58	12,53±11,58	-1,7674	0,077
H/Q-Right (%)	10,24±26,28	6,26±16,89	-0,4925	0,622
Q PT-Left (Nm)	8,19±24,71	2,89±11,37	-0,6663	0,505
Q PT/BW-Left (Nm/kg)	8,29±24,41	0,39±13,96	-0,9560	0,339
H PT-Left (Nm)	9,20±19,53	10,89±34,06	-0,6663	0,505
H PT/BW-Left (Nm/kg)	8,01±20,59	11,16±34,94	-0,4346	0,664
H/Q-Left (%)	3,09±16,39	10,56±25,68	-0,4345	0,664

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

There were not any significant differences in terms of the change rates of the isokinetic muscle strength which is at 240°/sec angular velocity when the change rates of some isokinetic measurements of both groups, which were found differently before and after training, were compared. (p>0.05) The relevant consequences are shown in Table 4.32.

Table 4.32. Comparison of pre and post training measurements of both groups in terms of the change rates of the isokinetic muscle strength which is at 240°/sec angular velocity.

Change Ratio				
240˚/sec	**Study group**	**Control group**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Q PT-Right (Nm)	4,22±25,90	1,05±14,12	-0,5504	0,582
Q PT/BW-Right (Nm/kg)	4,70±26,85	-0,05±14,72	-0,6083	0,543
H PT-Right (Nm)	5,90±29,55	11,10±31,81	-0,0290	0,977
H PT/BW-Right (Nm/kg)	4,34±36,65	9,80±30,03	-0,0869	0,931
H/Q-Right (%)	4,32±29,56	8,61±24,15	-0,2607	0,794
Q PT-Left (Nm)	10,22±26,91	2,65±19,14	-0,5504	0,582
Q PT/BW-Left (Nm/kg)	6,21±30,98	1,88±18,94	-0,0290	0,977

H PT-Left (Nm)	8,82±20,95	15,29±26,36	-0,9560	0,339
H PT/BW-Left (Nm/kg)	8,34±21,01	15,67±24,40	-0,9560	0,339
H/Q-Left (%)	0,93±20,21	13,21±22,11	-1,4777	0,139

Q; Quadriceps, H; Hamstring, PT; Peak torque, BW; Body Weight

There were not any significant differences between the groups when the change rates of the vertical jump pre and post training measurements were compared (p>0.05). The relevant consequences are given in Table 4.33.

Table 4.33. Comparison of pre and post training measurements of both groups in terms of the change rates of vertical jump

Change Ratio				
	Study group	**Control group**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**P**
Vertical Jump	-1,36±9,49	3,6±15,97	-0,5215	0,602

Statistically only one significant difference was found in all directions excluding the right anteromedial, left posterior and left lateral direction as a consequence of the comparison of pre and post training star excursion balance test measurements of both groups in terms of the change rates (p<0,05). The relevant consequences are given in Table 4.34.

Table 4.34. Comparison of pre and post training star excursion balance test measurements of both groups in terms of the change rates.

Change Ratio				
	Study group	**Control group**		
	Mean ± SD (min-max)	**Mean ± SD (min-max)**	**z**	**p**
Left Anterior	11,93±4,25	0,91±2,83	-4,0266	**0,000***
Right Anterior	8,92±4,78	1,06±4,68	-3,0417	**0,002***
Left Anteromedial	3,57±3,82	-1,18±5,25	-2,1147	**0,034***

Right Anteromedial	4,4±2,98	1,3±4,12	-1,8829	0,060
Left Medial	3,48±4,21	-1,26±4,01	-2,4044	**0,016***
Right Medial	7,26±6,58	1,67±4,88	-2,2885	**0,022***
Left Posteromedial	6,19±7,65	-0,63±3,2	-2,1147	**0,034***
Right Posteromedial	5,68±5,08	1,18±3,34	-2,1726	**0,030***
Left Posterior	4,05±5,44	1,46±4,42	-1,2456	0,213
Right Posterior	5,7±4,3	0,84±4,12	-2,5202	**0,012***
Left Posterolateral	4,84±5,17	-0,6±8,14	-2,1147	**0,034***
Right Posterolateral	5,99±3,65	1,74±2,37	-2,7520	**0,006***
Left Lateral	3,75±7,46	2,27±6,93	-0,9560	0,339
Right Lateral	10,49±11,8	0,4±4,39	-2,1726	**0,030***
Left Anterolateral	6,13±5,26	-1,31±4,52	-2,9554	**0,003***
Right Anterolateral	6,84±5,72	1,57±4,84	-2,1441	**0,032***

* $p < 0,05$

5. DISCUSSION and CONCLUSION

Today football is the most favourite sport of many people. Consequently, football clubs have been established in many countries. Its high economic capacity has made football a sector for which millions of dollars are invested. In the football sector with such a large circulation of money, it is quite important to minimize the risk of injury of the players and to ensure that the injured players return to the games more quickly.

The development of proof-based strategies to prevent football injuries is of great significance on account of football's popularity in all over the world and high injury rates, (102). FIFA developed the F 11+, a fundamental injury prevention exercise program targeting amateur footballers (103). The consequences of randomized controlled trials (RCTs) have since supported the impact of the F 11+ in teams of amateur male (104), amateur female (52), and male footballers in college (105).

F 11+ includes FIFA 11 (F 11) program published by F-MARC in 2004 therefore, the term F 11 is used in studies before 2006.

This study covers the implementation of a sports injury prevention program for 9 weeks on an amateur football team and an evaluation of the effect of this program on physical performance.

In this research, the mean age of the footballers in the study group was determined as 16.23 ± 0.92 years and the mean age of the ones in the control group as 16.45 ± 0.68 years. The mean age of the study group and control group were similar. In this study, we evaluated the players in the adolescence age group. While examining the studies in the literature, we found many studies in which the F 11 + exercise program was applied to the same age group (106,107,108).

When we take a look at some of the physical characteristics in this research, the mean height of the footballers in the study group was 176 cm, body weight was 66 kg, BMI was 21 kg / m² while the mean height of the footballers in the control group was 177 cm, body weight was 67 kg, BMI was 21 kg / m². We observed that the groups are similar in terms of physical characteristics.

Football is a highly complicated sport which is affected by numerous, physical, psychological, tactical and technical parameters (109). The physical demands typically necessitate the majority of the game to be conducted at a low intensity. However, the most important part (scoring goals) of the match is frequently affected by explosive efforts (110). Consequently, power and strength are regarded as vital in terms of basic physical constituents (111). Therefore, evaluation of strength is commonly carried out within a football club's test battery.

Isokinetic dynamometry testing systems has been considered to be a fundamental strategy for a long time for evaluating muscle imbalances and function in clinical, study, and sports environment (112). Evaluation, which is frequently accepted as the gold standard criterion, may supply quantification of a range of muscle function indices (e.g., peak and average torque, joint angle of peak torque, work) (113). Isokinetic dynamometry system is well preferred since it has revealed to identify injury (114) together with discriminate between positional variations and playing level/training status (115, 116,117) in footballers.

The changes in motor unit working patterns among muscle groups and muscle fibril composition in any individual can be confirmed by evaluation and exercise within a spectrum of slow to fast isokinetic speeds. (118) These isokinetic rates vary between 20-400 ° / s. In this study, 60 ° / s and 240 ° / sec angular velocities were used in isokinetic evaluation. In isokinetic evaluation, as the speed of a movement increases, the amount of force generated by the muscle is also affected and the force output decreases in evaluations at high speeds. The peak torque ratios obtained at isokinetic evaluations at low speeds reflect the maximal strength of that muscle. In the isokinetic evaluation, the peak torque is formed after the joint motion used completes its degree, which leads to these problems at high angular velocities. The movements that do not reach the optimal value do not reflect the maximal peak torque values of the individuals (119).

Cotte and Chatard evaluated the relationship between isokinetic muscle strength and sprint time in their study on 14 professional footballers (6 international and 8 non-international) playing in the British Premier League. In the study they applied concentric extensor and flexor muscle tests at angular velocities of 60, 180, 240 and 300 ° / sec. In international players, both extensor peak torque values and flexor peak torque values at angular velocities of 60,180,240 and 300 ° / sec were found to be lower than in the non-international group but they stated that this difference was caused by body weight variations. Hence, no differences for both extensor and flexor peak torques were found between national and international players when expressed per kg body weight (116).

Cometti et al evaluated three skill players (elite, sub-elite, amateur) in terms of isokinetic force and anaerobic power. In the study, they applied concentric quadriceps at angular velocities of 60, 120, 240, and 300 ° / sec, eccentric quadriceps at angular velocities of 60, 120° / sec and hamstring muscle strength tests. We could not find any significant differences between elite and sub-elite players in terms of hamstring concentric peak torque at a velocity of 60°/sec (Nm) and H/Q ratio measurements yet there was a significant difference between amateur players and the the other two groups. The value of quadriceps was higher in amateur players but it didn't make a significant difference for all three groups (108). In their study, Paine et al compared skilled and non-skilled players in 49 high school footballers (30 skilled; 19 nonskilled), in terms of functional performance and isokinetic muscle strength. There were not any significant differences in terms of peak torque values between groups in the isokinetic measurements at angular velocities of 60 and 240 °/sec but the peak torque/BW and functional performance values were higher in the skilled footballers than in the non-skilled ones (106).

Football necessitates intermittent physical performance in which series of actions that necessitate a range of skills of various intensities are intermingled all together. Running is the most dominant activity, however explosive type efforts like jumps, sprints, kicking and duels are significant parameters for prosperous soccer performance. Such efforts depend on anaerobic power and maximal strength of the neuromuscular system, more specifically of the lower extremity. Quadriceps plays an important role in hitting a ball and bouncing while hamstring supplies the control of running movements (115).

Several former researches testing the impacts of the F 11+ on knee muscle strength indicated important findings at short-run, at least in several of the factors tested. Impellizzeri et al. exposed 42 amateur footballers to the F 11+, during 9 weeks 3 times per week, and showed a tiny (3-4%) but not important enhancement in the hamstring eccentric and concentric strength (120). Brito et al. twenty sub-elite footballers to a ten-week F 11+ program (three times per week), demonstrated findings in isokinetic quadriceps and hamstring concentric strength, yet no difference for eccentric strength of the hamstrings (121) Other researches revealed findings in traditional strength ratio (10), quadriceps and hamstrings isometric strength (97) and concentric hamstring strength (122) in senior professional footballers too.

In their study, Daneshjoo A. et al. enquired the impact of F 11+ and HarmoKnee injury prevention exercise programs on knee muscle strength in male footballers. Footballers under the age of 21 (n = 36) are composed of three groups as HarmoKnee, F 11+ and the control group.

They have implemented the program 24 times. Hamstring and quadriceps isokinetic muscle strength bilaterally measured at angular velocities of 60, 180 and 300 ° / s. As a result, it was suggested that the Harmo Knee program improved the quadriceps concentric peak torque value positively. Also they expressed that flexor concentric peak torque value improved positively in F 11+ and HarmoKnee groups and F 11+ programs are more advantageous than HarmoKnee program (97).

Reis et al. indicated important findings after twelve weeks of intervention in eighteen young futsal players, in the eccentric muscle strength of the hamstrings together with for the H/Q functional ratio, in the concentric strength of hamstrings and quadriceps (107).

In their study about the effect of F-11 program on the performance, Steffen et al. made a comparison between the female footballers they were training and the footballers in the control group in terms of quadriceps and hamstring concentric and eccentric peak torque values at angular velocities of 60 and 240 ° / sec. In the comparison made after a 10-week training period, the concentric quadriceps peak torque change at angular velocity of 60 ° / sec before and after the training was 3% for the footballers in the study group and was 2% for the footballers in the control group. And this reported no statistical significance. On the other hand, hamstring concentric peak torque change at angular velocity of 240 ° / sec was %1 in the study group and was %2 in the control group, which meant no statistical importance. Likewise, there were not any significant differences in concentric, eccentric and isometric values at other angular velocities (108). The consequences in this study are consistent with our study.

In their study, Lopes et al. divided 71 male futsal players into two as F 11+ (n = 37) and the control group (n = 34) F 11+ implemented the program twice a week for 10 weeks. Concentric and eccentric knee muscle strength was tested and latency time of the evertor muscles after unexpected inversion of the ankle was executed with a trapdoor mechanism following an EMG protocol of selected leg muscles (peroneus brevis and peroneus longus). It was revealed that there were not any differences in short-term isokinetic muscle strength between the groups (123).

In this research, statistically there were not any significant differences between hamstring and quadriceps peak torque values at angular velocity of 60 °/sec before and after training. Only the left quadriceps concentric PT value was statistically significant in the comparison of the study group and the control group at the angular velocity of 240 ° / sec. The values we found were consistent with some studies in the literature.

When the groups were compared after the training in terms of the rate of change in both angular velocities, the groups were reported to have advanced for 9 weeks but statistically there were not any significant differences. In this study, we observed that F 11 + exercise program singly had no effect on isokinetic muscle strength.

There are some relationships in terms of isokinetic evaluations between strength and injuries. The risks which may cause football injuries are very diverse. The most important of these is the muscle strength imbalance. In view of the nature of football, the movements usually require one-sided use. Ball hitting with the preferred leg of the footballer, or his/her movements may result in bilateral force imbalance (124).

Muscle force imbalances in the knee, as measured by H:Q ratio, are a predisposing parameter for hamstring strain lesions and are connected to joint stability. The investigation which a lower H / Q rate was connected to higher quadriceps peak torque, rather than less hamstring peak torque could be explained by the nature of the football training and game. It is usually regarded that the knee extensors are involved in all powerful actions, like sprinting and jumping, while the hamstrings chiefly act as stabilizers of the knee joint during shifts in speed and kicking and direction (125).

Former studies have indicated that level of experience and training age are important parameters for enhancing quadriceps strength. For instance, Oberg et al. (126) showed important differences in concentric isokinetic peak torque of the hamstrings and quadriceps muscles between Swedish footballers from the highest and the lowest leagues. They claimed that elite footballers might have greater leg muscle power as training intensity improved with increasing playing category (126).

In this study, right extremity H / Q ratio of study group at angular velocity of 60 ° / sec before training was 71,15 ± 15,37% and left lower extremity was 66,85 ± 17,19. The right extremity H / Q ratio of the control group was 81.64 ± 14.49 and left lower extremity was 67,27 ± 11,46. We found that the control group had higher H / Q ratio than the study group when we compared the H / Q ratio of the groups. When we took a look at the values after the training, we found out that the difference between study and control group disappeared. We do think that the reason for this is that the rate of hamstring PT change between the groups after the training increased by 12% in the study group and 1% in the control group. The right extremity H/Q ratio of the study group at an angular velocity of 240 ° / sec. was 88.69 ± 13.98, and left lower extremity was 80.23 ± 19.98. The right extremity H/Q ratio of the control group was 85.09 ± 20.28, left lower extremity was 79 ± 14.43. There was no difference between the groups in the H / Q ratio after training.

When we compared the H / Q ratio values at the angular velocity of 60 °/sec before training with the studies in the literature, we found out that the values of the study group had similarities with the study by Carvalho et al. (127) and the values of the control group had similarities with the study by Ruas et al. The data at an angular velocity of 240 ° / sec are not similar to the present studies in the literature. We could have an idea about the H / Q ratio and injuries if we had evaluated the injuries separately in our study.

Croisier et al. proposed that footballers, who were categorized as having an H / Q ratio less than 0.55, would be lower scores of H / Q more likely to maintain hamstring strain lesion (128). Orchard et al. claimed that H / Q ratio imbalance between legs was determined as a risk parameter only when measuring at a low speed (129). An intensive cohort research and meta-analysis made lately argued that high concentric quadriceps strength was a risk parameter, while H / Q ratio was not (120). These consequences conflicted with the current study.

In this study, the change in the average values of vertical jump in the study group was one percent and three percent in the control group.

Steffen et al. used 3 different types of vertical jump test for their evaluations in their study which they implemented F-11 injury prevention program for 10 weeks on women footballers. The vertical jump change of the footballers in the study group and in the control group was 6%, 4%, 4% respectively for all three tests before and after 10 weeks. However, they suggested that these changes had statistically no significance and indicated that the F-11 program did not have any effects on the vertical jump ability (108).We found out that the F-11 program did not have any effects on the vertical jump ability in a short time, which indicated that it was consistent with thus study.

We also found out that there were not any differences between the groups in terms of vertical jump, which was also consistent with some inter-league comparison researches in the literature. In their research, Cometti et al. (115) examined the difference of vertical jumping test between elite and sub-elite footballers. They did find no difference between elite and sub elite footballers (elite: 41.56 cm, sub elite: 39.71 cm).

In their study, Gauffin et al. reported that the vertical jump values of the footballers in the 1st League and 2nd League were similar; yet they were higher than the ones in the other leagues (130).

Postural control or balance may be described as the skill to sustain a support base with minimum motion and as the skill to carry out a duty while sustaining a stable position. Balance is sustained via dynamic integration of external and internal forces and parameters covering the environment. The adjustment of balance depends on the vestibular, visual, and proprioceptive stimuli.

Static balance can be evaluated by getting a person to sustain a immobile position while he is standing on his legs. On the other hand, dynamic balance may be evaluated with SEBT, this test has a bigger demand on the neuromuscular-control systems and balance (96).

The Star Excursion Balance Test (SEBT), originally intended for lower limb rehabilitation, is intensively used in clinical and sport (131).

Leavey et al. suggested that during six week combined exercise covering strength and balance programs can enhance dynamic control in posture (assessed by SEBT) in healthy female and male (132). McKeon et al. revealed that 4 weeks of balance exercises enhanced dynamic control in posture as evaluated via the SEBT. They underlined that this improvement perhaps refers to the decline in constraints located on the sensorimotor system as a consequence of balance training (133).

In this study, we observed improvement in favor of F 11 + study group in all aspects when we examined the rates of change of the study group. The greatest improvement was in the left anterior direction with a rate of 11%. We noticed that the outcomes we found out were similar to the some studies when we compared our data with the studies in the literature.

In their study, Daneshjoo A. et al. enquired the impact of F 11+ and HarmoKnee injury prevention programs on static and dynamic equilibrium in male footballers. Footballers under the age of 21 (n = 36) were composed of three groups as HarmoKnee, F 11+ and control group. They implemented the program 24 times. Static balance was assessed using stork stand test; whereas dynamic equilibrium was evaluated through SEBT. Static balance increased with a rate of 10.9% in F 11+group whose eyes are open and with a rate of 6.1% in HarmoKnee group. They reported that static balance increased with a rate of 12.4% in F 11+ group and with a rate of 17.6% in HarmoKnee group in the test done with closed eyes. According to the consequences of SEBT, they stated that F 11+ group had an increased with a rate of 12.4% and the HarmoKnee group with a rate of 17.6% (97).

In their study, Steffen et al. implemented performance test on 226 young female footballers before and after the season and compared them with the unsupervised group. They reported that the anterior direction of SEBT importantly improved whereas two leg jumping performance reduced in the supervised group. In SEBT, a significant difference was found in 5 aspects out of 6 in favor of 11+ group. We found out that SEBT data in our study were consistent with the data in this study and that the most improved aspects were similar (134).

In their study with 41 youth male amateur footballers, Ayala et al. indicated important improvements after 4 weeks (3 times per a week) in the posteromedial and anterior reach measurement of the Y-balance test in the F 11+ group (2).

Impellizzeri et al. examined 81 footballers for their study in which throughout 9 weeks, the working group (42 players) were subjected to the F 11+ 3 times per week. They observed no changes in the composite score of the SEBT (120).

Daneshjoo et al. demonstrated important improvements in the static balance testing, as stated above, the dynamic balance testing with the star excursion balance test, they did not find statistical importance with the composite scoring (96).

Lopes et al. implemented the F 11 + warm-up program twice per week for ten weeks in their study in which they included 71 male futsal players from 6 amateur clubs. They applied static and dynamic balance proprioception and active joint position sense test. They could not find any significant difference between the groups in terms of center of pressure (Cop P) measures, y-balance and proprioception in the short and long run (135).

Conclusion and Suggestions

This study was carried out for 9 weeks in an amateur football team to prevent sports injuries and to evaluate the effect of this program on physical performance.

1. Study group and control group were similar in terms of mean age, height, body weight and BMI parameters
2. There were not any differences between the groups in terms of vertical jump and balance parameters.
3. When we examined the isokinetic tests, we noticed that the H / Q ratio of the control group at the angular velocity of 60 ° / sec was higher than the study group before the training. After training there was no difference comparison of the groups.
4. Since quadriceps concentric peak torque values between the groups were observed after the training, it was found out that only 240 ° / sec angular left Q peak torque value at was statistically different in favor of the study group.
5. The players were evaluated at 60 and 240 ° / sec angular velocities in terms of strength. If at different angular velocities and, in particular, eccentric muscle strength could have been evaluated, better information would have been provided about the the effect of F 11 + on strength.
6. In the study group, there was improvement in all directions in terms of balance parameters yet there was only one significant difference in right anteromedial direction between groups after training.
7. If the psychological conditions of the players could have been evaluated together with their performance evaluations, better information on this aspect would have been provided.
8. The exercise program was implemented on the players for 9 weeks. If the F 11+ program could have been implemented during the whole season, we could have had more detailed information.

9. When we took a look at the physical compatibility parameters, it was noticed that there is a need for prevention program studies to be done with the larger scale, homogenous groups to investigate the performance levels and injuries of the footballers

Football is a very popular sport both in Turkey and in the world and it attracts a wide range of population. Factors leading to injuries should be identified to maintain this sport in a more healthy way, performance test should be made in the teams regularly and training programs should be updated.

In this study, which was conducted in the amateur league, the fact that the players had not experienced performance tests before made it difficult to adapt to performance tests. In addition, we could have had the opportunity to analyze the F11 + program better if the communication deficiencies and economic barriers we encountered could have been overcome.

Most of the football clubs in Turkey cannot keep their squad because of various reasons. Therefore, if we had been able to maintain our research with the footballers removed from our study, the number of players participated in the study would be more and our consequences could be statistically more significant. However, the fact that the follow-up and the evaluation of the players in the working groups with low numbers can be made better should also be taken into consideration.

In our country, there are very few studies focusing on the effectiveness of preventive exercise programs in the amateur league. Therefore, we do believe that the importance of our study has increased in terms of its potential to be a resource for further research.

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7.APPENDIXES

Appendix 1: Ethical Approval

T.C. YEDİTEPE ÜNİVERSİTESİ

Sayı : 37068608-6100-15-1546
Konu: Klinik Araştırmalar
Etik kurul Başvurusu hk.

27/09/2018

İlgili Makama (Büşra Aydın Erkılıç)

Yeditepe Üniversitesi Fizyoterapi ve Rehabilitasyon Bölümü Dr. Öğr. Üyesi Feyza Şule Badıllı Demirbaş'ın sorumlu olduğu **"Adölesan Amatör Futbolcularda F-11+ Egzersizi Programının İzokinetik Kas Kuvveti ve Dengeye Etkisi"** isimli araştırma projesine ait Klinik Araştırmalar Etik Kurulu (KAEK) Başvuru Dosyası (**1522** kayıt Numaralı KAEK Başvuru Dosyası), Yeditepe Üniversitesi Klinik Araştırmalar Etik Kurulu tarafından **26.09.2018** tarihli toplantıda incelenmiştir.

Kurul tarafından yapılan inceleme sonucu, yukarıdaki isimi belirtilen çalışmanın yapılmasının etik ve bilimsel açıdan uygun olduğuna karar verilmiştir (**KAEK Karar No: 902**).

Prof. Dr. Turgay ÇELİK
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Appendix 2: Informed Consent and Evaluation Form

ARAŞTIRMA AMAÇLI ÇALIŞMA İÇİN ÇOCUK RIZA FORMU

Sevgili Kardeşim,

Benim adım Yrd.Doç.Dr. Feyza Şule Badilli Demirbaş Yüksek lisans öğrencim Büşra Aydın Erkılıç ile beraber bu araştırmayı planladık. Bir futbol yaralanmaları önleyici egzersiz programının dengeye ve kas kuvvetine etkisi konusuyla İlgileniyoruz ve bu araştırmanın çocuk sporuna ve yaralanmaları önleyici egzersiz programlarının önemini vurgulamaya önemli katkı sağlayacağını düşünüyoruz. Bu araştırmaya katılmam öneriyoruz. Bu araştırmaya katılacak olursan senden İzokinetik kas testine ve Star Excursion Balance testine girmeni isteyeceğiz. Test sonunda kısa süreli yorgunluk hissedeceksin ancak bu geçici bir durumdur ve yorgunluk kendiliğinden geçici bir durum olacak. Bu araştırmanın sonuçlan ileriye dönük olarak bir yaralanmaları önleyici egzersiz programının fiziksel parametreler üzerine etkisi olup olmadığı konusunda bilgi sağlayacaktır.

Bu araştırmanın sonuçlarını başka araştırmacılarla da paylaşacağız ama senin adını söylemeyeceğiz. Bu araştırmaya katılıp katılmamak için karar vermeden önce anne, baban ve antrenörün ile konuşup onlara danışmalısın. Onlara da bu araştırmadan bahsedip onaylarını/ izinlerini alacağız. Anne, baban ve antrenörün tamam deseler bile sen kabul etmeyebilirsin. Bu araştırmaya katılmak senin isteğine bağlı ve istemezsen katılmazsın. Bu nedenle hiç kimse sana kızmaz ya da küsmez. Önce katılmayı kabul etsen bile sonradan vazgeçebilirsin, bu tamamen sana bağlı. Aklına şimdi gelen veya daha sonra gelecek olan soruları istediğin zaman bana sorabilirsin. Telefon numaram ve adresim bu kağıtta yazıyor. Telefon numaramdan bana günün herhangi bir saatinde ulaşabilirsin. Bu araştırmaya katılmayı kabul ediyorsan aşağıya lütfen adını ve soyadım yaz ve imzam at. İmzaladıktan sonra sana ve ailene bu formun bir kopyası verilecektir.

Çocuğun Adı Soyadı:

Çocuğun İmzası:

Velisinin Adı Soyadı:

Velisinin İmzası:

Araştırıcının

Adı Soyadı: Büşra Aydın Erkılıç

Adres: Yeditepe Üniversitesi, Sağlık Bilimleri Enstitüsü, Spor Fizyoterapistliği Ataşehir- İstanbul

Tel:

(Araştırmanın açıklanması)

AYDINLATILMIŞ (BİLGİLENDİRİLMİŞ) ONAM FORMU

Sayın Katılımcı,

Bu Araştırma, Yeditepe Üniversitesi, Sağlık Bilimleri Fakültesi, Fizyoterapi ve Rehabilitasyon Bölümünde öğretim üyesi olarak görev yapan, Yrd.Doç.Dr. Feyza Şule Badilli Demirbaş sorumluluğunda gerçekleştirilmektedir. Araştırmanın amacı, bir futbol yaralanmalarını önleme egzersiz programının denge ve izokinetik kas kuvveti üzerine olan etkisini saptamak için planlanmıştır. Bu çalışma iki aşamalı ve iki ölçüm seansından oluşmaktadır. Bunun için 9 hafta arayla aynı ölçümler tekrar yapılacaktır. Birinci ölçüm seansında fazla uzun sürmeyecek izokinetik kas testi ölçümleri ve Star Excursion Balance testi uygulanacaktır. Testler öncesinde gerekli bilgilendirmeleri sağlayıp antrenman geçmişlerinizi ve sizler hakkında kısa bilgi almak için form dağıtacağız. Araştırmaya katılmanız halinde sizden elde edilen tüm bilgileri araştırmacı ve sizin dışınızda kimse bilmeyecek, bu bilgilerin gizliliğini, büyük bir özen ve saygı ile yaklaşılacaktır. Araştırma sonuçlarının eğitim ve bilimsel amaçlarla kullanımı sırasında kişisel bilgileriniz ihtimamla korunacaktır. Daha öncesinde sonuçların bilinmesinin bir yaran olmadığından sonuçlar hemen rapor edilmeyecektir. Çalışmanın bitiminde isterseniz sonuçlarınız hakkında size bilgi verilecektir. Bu çalışmaya katılmanız için sizden herhangi bir ücret istenmeyecektir. Çalışmaya katıldığınız için size ek bir ödeme de yapılmayacaktır.

Muhtemel risk ve rahatsızlıklar

İzokinetik kas testi kısa süreli fakat maksimal bir test olduğundan kısa süreli yorgunluk hissedebilirsiniz.Star Excursion Balance Test: Herhangi bir risk taşımamaktadır.Yukarıda sayılanlar böyle bir çalışmada yaşanabilecek potansiyel risklerdir. Ancak bunlardan en az oranda zarar görmenizi sağlamak için elimizden geleni yapacağız Çalışmanın devamı su^{s}asında ortaya çıkacak sorun ve riskler size iletilecektir.Bu çalışmaya katılmayı reddedebilirsiniz. Bu araştırmaya katılmak tamamen isteğe bağlıdır. Katıldığınız taktirde çalışmanın herhangi bir aşamasında onayınızı çekmek hakkına da sahipsiniz.Çalışma hakkında daha fazla bilgi almak istediğiniz veya herhangi bir sorunla karşılaştığınız taktirde araştırma sorumlusu Yrd.Doç.Dr. Feyza Şule Badilli Demirbaş'ı   no' lu telefondan arayabilirsiniz.

Appendix 3: FIFA 11+ Exercise Program

Appendix 4: Curriculum Vitae

Personal information

Name	Büşra	**Surname**	Aydın Erkılıç
Place of Birth	Akşehir	**Date of Birth**	26.05.1991
Nationality	Turkish	**ID Number**	58015123566
E-mail	bsrr.aydinn@gmail.com	**Gsm**	05062214052

Education

Degree	Department	Name of the institution	Date of graduation
Postgraduate	Sports physiotherapy	Yeditepe University	….
University	Physical Therapy and Rehabilitation	Muğla Sıtkı Koçman University	2014
High School	Science	Karaman Fen Lisesi	2009

Language	Examination Grade
ENGLİSH	86,25 (YDS)

Work Experience

Duty	Institution	Duration (Year- year)
PHYSİOTHERAPİST	Okmeydanı Education and Research Hospital	2015-..-
PHYSİOTHERAPİST	EMCARE home care services	2014-2015-

institution	
Aytunç Benturk Dance Academy	Flamenco dancer (2017-2018)
Swing İstanbul	Lindy Hop and Solo jazz dancer (2018-..)

Dance