DYNAMIC AND STATIC BALANCE DIFFERENCES BASED ON GENDER AND SPORT PARTICIPATION

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ABSTRACT

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Soccer possibly has the majority fans and may be the most fashionable sport in the global sporting field and at least 240 million people frequently participate in soccer (FIFA, 2000). While adolescence players are mostly not professional and have no fiscal worth for their school or probably for their clubs, but their sustained physical condition and security has a critical value. The matter of balance is considered as one of the critical issues in sports especially in soccer. On the other hand human beings are bipeds so walking, running, and standing over the ground causes a critical challenge to their balance system. The purpose of this study is to compare the static and dynamic balance performance of males and females, and of athletes and sedentary collegiate adolescents. Participants were 37 sedentary university students (M = 27.67, SD = 3.24 y) and 36 soccer players (M = 21.60, SD = 2.28 y). The tests for evaluating static and dynamic balance were One-leg Standing Balance & Star Excursion Balance Tests respectively. Results of MANOVA indicated a significant main effect for sport participation (Wilks' Lambda =

.620, *F* (4, 66) = 10.123, *p* < .01, partial η^2 = .38). However, results showed no significant main effect for gender (Wilks' Lambda = .958, *F* (4, 66) = .721, P = .580; *p* > .05, partial η^2 = .042). Similarly, no significant interaction effect was observed for gender and sport participation as independent variables with four levels of balance performance as the dependent variables (Wilks' Lambda = .941, *F* (4, 66) = 1.028, P=.400; *p* > .05, partial η^2 = .05).

Keywords: Static Balance, Dynamic Balance, Sedentary, Soccer Players, Dominant Leg

ÖZ

CİNSİYET VE SPOR KATILIM DAYALI DİNAMİK VE STATİK DENGE FARKLARI

Golshaei, Bahman

Yüksek Lisans, Beden Eğitimi ve Spor Bölümü

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Futbol muhtemelen en çok taraftarı olan ve küresel spor alanında en çok moda olan spordur ve ayrıca en az 240 milyon sporcu sık sık bu oyunu oynamaktadırlar (FIFA, 2000). Hâlbuki bu oyuncuların birçoğu genç ve profesyonel olmayan sporculardır. Bu bireylerin okulları ve kulüpleri içinde mali değerleri de yoktur ve fiziksel durumları ve güvenlikleri içinde gerekli tedbirler alınmamaktadır. Denge yeteneği ve performansı sporda özellikle futbol konusunda kritik konulardan birisi olarak kabul edilmektedir. Öte yandan biz insanların iki ayaklı olduğumuz gerçeği göz ardı edilmemelidir. Yürüme, koşma, zemin üzerinde durma bizim denge sistemimiz için kritik bir meydan okumaya neden olur. Bu gerekçelerden kaynaklı olarak, bu çalışma sporcu (futbol) olan ve olmayan bireylerin (üniversite öğrencisi) dinamik ve statik dengelerinin değerlendirmesi amacıyla yapılmıştır. 37 spor yapmayan üniversite öğrencisi (M = 27.67, SD = 3.24 y) ve 36 futbolcu oynayan öğrenci (M = 21.60, SD = 2.28 y) çalışmaya katılmıştır. Bir bacak denge testi ve “Star Excursion Denge Testi” metotları katılımcıların statik ve dinamik dengelerini

değerlendirmek için kullanılmıştır. MANOVA test sonuçları spor katılımı için dengenin önemli bir etkisinin olduğunu göstermiştir (Wilks 'Lambda = 0,620, F (4, 66) = 10.123, p <.01, kısmi η2 = .38). Ancak sonuçlar cinsiyet faktörünün (p> .05, kısmi η2 = .042 Wilks 'Lambda = .958, F (4, 66) = .721, p = 0,580) anlamlı bir etkisinin olmadığını göstermektedir. Benzer şekilde, istatistiksel olarak grup ve cinsiyet etkileşimi anlamlı bulunmamıştır (Wilks' Lambda=.941, *F* (4, 66) = 1.028, P=.400; *p* > .05, partial η^2 = .05).

Anahtar Kelimeler: Statik Denge, Dinamik Denge, Sedentar, Dominant Bacak, Futbolcular

To My Family

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CHAPTER 1

INTRODUCTION

1.1 Background of the Study

The concept of balance and keeping posture stability is essential to all individuals' locomotion. For human it is exclusively challenging by virtue of body structure (Winter, Patla, & Frank, 1990). About 2/3 of human's body mass contains some sensitive organs that are precariously balanced some distance from the earth (approximately two third of humans height) over the feet, which supply a narrow base of support (Winter et al., 1990). Drops and instability demonstrates main health problem and the fear of fall is the main issue to daily dynamism so knowledge on balance in all human beings and evaluating the individuals balance ability can be significant for their health condition and daily movements (Winter et al., 1990). On the other hand, weak balance has been identified as a knee risk injury (Plisky PJ, 2006). The keep of appropriate and usual balance of the body in daily activities and throughout work outs is really important in sport (Bakhtiari, 2012).

One of the important factors for athletic performances and activities of normal daily life is related to the postural control condition (Phillip A. Gribble & Hertel, 2003). The matter of postural stability is an essential part of prosperous sport activities and deficiencies to postural stability can make damages that can obstruct sport efficiency (Cavanaugh, Guskiewicz, & Stergiou, 2005). Balance is critical factor in the avoidance and treatment of injuries (Plisky PJ, 2006). For example in the case of soccer most injuries take place in the lower part of body (Junge et al., 2006). The most favourable balance control is an essential

requirement for all types of sport, performances and safety from injury (Kenneth & David, 2005).

A simple definition of balance can be described as the "status of a thing when the outcome force operating upon it is zero" (Pollock, Durward, Rowe, & Paul, 2000). Balance is explained as the capability to keep a posture of body for performing actions and counteract with tensions (exterior or interior). In the other word "balance is defined as the keeping body mass center in the domain of base of support" (Hrysomallis, 2011).

Because of high level of physical activities and vigorous athletic performances there is a significant rate of injury among individuals. According to the study of Powell and Barber-Foss (2000) males and females playing soccer, basketball, softball (just females), and baseball (just males) groups were encountered with injuries. This study evaluated the occurrence of injuries between males (1045 athletes) and females (998 athletes) participating in high school sports. Injuries were noted daily from 1995 to 1997. With respect to 8988 recorded injuries (4599 for males, 4429 for females) and 39.032 player seasons (20872 for males and 18160 for females) the damage amount per hundred players for female soccer players (26.7), male soccer players (23.4), males and females in basketball (28.3, 28.7) were much higher than other sports; softball (16.7) and baseball (13.2). Also there was a high rate of surgeries, especially knee injuries as lower extremity injuries for girls' basketball and soccer players than for males or females in other type of sports.

There are two types of balance. One type of balance is the static balance and the other type is related to the dynamic balance. Static balance is defined as trying to keep a body condition with slight movement or with no motion (Gribble & Hertel, 2003) and dynamic balance is the facility to retain balance while moving (Winter et al., 1990).

A variety of balance measurement devices have been developed to evaluate balance in order to discover balance deficiencies. Tools like computerized

force plates and video based postural sway system are presented. A major disadvantage is that these tools are frequently high-priced, complex and time consuming rendering them not practical in clinical setting. The simple single leg balance test is a reliable technique (r=0.96) to measure standing balance as a static balance, and it is suited for population based researches (Bohannon, Larkin, Cook, Gear, & Singer, 1984). On the other hand, Star Excursion Balance Test (SEBT) supplies a good method to measure dynamic balance (Phillip A. Gribble & Hertel, 2003). The position of one-leg standing and opposite reaching leg method provided a quantifiable test to evaluate the dynamic immovability of participants while they complete a practical activity. The (SEBT) reported as a low-priced, fast technique of measuring balance, with a fine reliability reported (Plisky PJ, 2006). The special advantage of the SEBT is that it is more challenging for healthy, athletic individuals (Phillip A. Gribble & Hertel, 2003). Intra-tester and inter-tester reliability has been established with intra-class correlation coefficients between .67 to .96, based on the reach direction (Robinson & Gribble, 2008). In order to decrease evaluation time, dynamic balance is often calculated by the modified Star Excursion Balance Test (mSEBT), a consistent and reliable version of the SEBT. It has been indicated that the modified SEBT is equally reliable compared to traditional one (Plisky PJ, 2006). The modified Star Excursion Balance Test involves a one-leg stance with a highest aimed achieve of the other feet in 3 different directions that are called anterior, postero-medial, and postero-lateral. These three directions have a reliability of .82 to .86 (B. E. Maki & W. E. Mcllroy, 1997).

Factors that effects balance are important to consider as a main issues of sport activities and normal daily activities. According to the study of Shaffer and Harrison (2007) the combination of visual system, somatosensory components, and vestibular system are contributed to keep individual in balance. Control of balance indicates a complicate interaction between the sensory systems. The visual system of an individual is the first sensory information that needs to keep postural balance. The vestibular system senses angular and liner accelerations and the somatosensory

mechanism is a plenty of sensors that perceive the location and velocity of all body parts, their impact with exterior things, and the direction of gravity (Winter, 1995). Also the study of Merla and Spaulding (1997) mentioned that vestibular system works with visual system and somatosensory system to keep balance. Moreover the somatosensory organism is concerned with keeping balance through giving information to the musculoskeletal system to be conscious about balance, movement, and position with respect to spatial and mechanical condition.

The other issue of balance is related to the gender differences. Several studies have examined differences between males and females with respect to various forms of performance abilities of balance. Results were very different, and opposite to each other. The study of Era et al. (1997) reported that females possess better balance ability than males and the other studies claimed that males possess better balance performance (Overstall, Exton-Smith, Imms, & Johnson, 1977; Panzer, Bandinelli, & Hallett, 1995). In the study of Overstall et al. (1977), 243 elderly participants (105 males, 138 females) average 76 years old compared with 63 young participants (18 to 59 years old) to evaluate their balance. The results showed that sway (loss of balance) increased with age and was higher in females. The discrepancies in the literature relating to gender differences may refer to different balance task, measurement, different groups of participants with respect to their background of sport, and different ages and analyses procedures (Bryant, Trew, Bruce, Kuisma, & Smith, 2005).

Significant deterioration in balance control system appeared with aging (Woollacott & Shumway-Cook, 1990). According to the study of Era et al. (2006) balance changes over time and body sway increases with age. “Deterioration in balance system clearly begins at relatively young ages and further advanced from about 60 years upwards”. This study mentioned that postural control system starts to deteriorate during early years and the changes is evident among young and middle-aged individuals. While change in balance performance is progressive with

age (Bryant et al., 2005), therefore with increased life expectancy the importance of keeping balance is becoming ever more significant.

Postural control and balance are needed during daily movements (Chiang, Chiang, & Shiang, 2000). Although postural control training is essential for patient and elderly people and it is critical for athletes as well. “Balance is also a very significant factor in dynamic balance during human movement, can muscle create adequate power and strength” (Chiang et al., 2000). Factors like fast actions, changes of directions, and giving & receiving forces may contribute to the concept of balance as well. The study of Chiang et al. (2000) which investigated the balance ability between non athletes and judo players indicated a significant difference in the time of balance between groups of non athletes and judo players.

Proprioception is the other relevant factor that influences balance system of individuals. Study of Lephart, Pincivero, Giraido, and Fu (1997) defined proprioception system of body as a particular variation of the sensory system that contains the joint sensation and position of joints. This study also mentioned that the ability to recognize position and movement of joint is important to discuss while walking in ragged place, to keep us from drops or injury and also to effectively participation in activities such as sports. In order to recognize the body’s situation in space the Central Nervous System (CNC) must harmonize the incoming data from the receptors of the body joints by the proprioception (Hosseinimehr, Daneshmandi, & Norasteh, 2010). So the proprioception information is a requirement for balance, the movement coordinator, and body’s navigation structure.

1.2 Rationale of the Study

Soccer possibly has the majority fans and may be the most fashionable sport in the global sporting field (FIFA, 2000). Soccer has at least 240 million players

who frequently participate in this sport. The matter of balance is considered as one of the critical issues in sports especially in soccer. On the other hand the truth that we as human being are bipeds so walking, running, standing over the ground causes a critical challenge to our balance system. Since two-thirds of our body mass is located two-thirds of body height above the ground we are an intrinsically unbalanced system unless our control system is constantly acting (Winter, 1995). Also it should be mentioned that balance, has a functional task for vocational goals, daily movements, recreation, and injury prevention (Kenneth & David, 2005).

Deficiency of postural balance like reduction in motor reactions, decrease in sensory input, and decline in sensory integration systems are related factors that increase the possibility of drops (Liaw, Chen, Pei, Leong, & Lau, 2009; Shumway-Cook & Woollacott, 2000). Lots of studies are released focusing on postural control. Nevertheless, there are few or no sufficient studies on postural balance and balance abilities of individuals as a main issue of sports. According to the study of Tropp, Ekstrand, and Gillquist (1984) soccer players with week balance and ankle instability were at considerably greater threat of ankle re-injury. The measurement of the static and dynamic balance several times during preseason and in season could let the coach to recognize the muscle state of athletes. They can use balance program in their training programs for preventing injuries and increasing balance abilities of their athletes (Bakhtiari, 2012).

1.3 Research Questions

The research questions of this study were whether the sport participation and gender affects the balance performance of participants (dynamic and static balance). Hence, the study aimed at providing answers to the following research questions:

1. Is there a significant difference between sedentary and soccer players in their balance performance (static and dynamic)?

2 Is there a significant difference between gender (males and females) in their balance performance (static and dynamic)?

3. Is there a significant interaction effect between gender, and sport participation in their balance performance (static and dynamic)?

1.4 Purpose of the Study

The purpose of this study is to compare the static and dynamic balance performance of males and females, and of athletes and sedentary collegiate adolescents.

1.5 Research Hypothesis

The hypotheses of this study are:

1. There is no significant difference between sedentary and soccer players in their balance performance.

2. There is no significant difference between males and females in their balance performance.

3. There is no significant interaction effect between gender, sedentary and soccer players in their balance performance.

1.6 Limitations

Daily activities of the participants were not controlled.

Only soccer players participated in this study (other types of sports were not included).

Participants were selected from two universities (Gazi and METU).

1.7 Assumptions

Rest intervals between trials were sufficient so that fatigue was not an internal threat.

Participants presented their best performance during tests.

Semi-professional soccer players participated in this study (at least 3 years background of playing soccer).

Self report of the sedentary group with regard to the question on whether they participate in any regular sport activities.

1.8 Definition of the Terms

Static Balance: Is trying to keep a body condition with slight movement or with no motion (Phillip A. Gribble & Hertel, 2003).

Dynamic Balance: Is the facility to retain balance while moving (Winter et al., 1990).

Sedentary: Is a type of life style with no or irregular physical activity. For this study this is a group of collegiate students who did not participate in any regular physical activity.

Soccer Players: Are athletes who had at least three years of soccer background regularly in the past years.

Dominant Leg: Was determined by asking participant with respect to preferred leg for kicking a ball.

CHAPTER 2

REVIEW OF LITERATURE

Balance is considered as an important part of sport activities and normal daily life movements. This review of literature will explore the matter of balance, balance assessment methods, systems affecting balance, balance and sports, injuries and soccer, the role of balance in injury prevention with regarding to sport activities and finally the role of balance in prediction of injuries.

2.1 Balance

The matter of balance is an expression that applied by a health workers on a usual bases, however what precisely is balance? Some scholars implies that health workers have a sensory intellection of the expression of balance, while balance is not easy to particularly describe (Pollock et al., 2000). Once attempting to describe balance, lots of expressions applied in the literature. These applied expressions have to be argued and described. Balance is frequently applied in association with terms like postural control and stability (Pollock et al., 2000). The word balance, can be defined, as the potency to keep the body's center of gravity within the base of support with minimum sway (Nichols, Glenn, & Hutchinson, 1995). This explanation mainly concentrated on results and the situation of body that is applied to avoid falling (Winter, 1995). The center of gravity (COG) refers to the point in the human body at which entire force of gravity is considered to act and that is projected vertically onto the support surface (Nichols et al., 1995). The keep of the center of gravity within the base of support includes integration of motor control system

outputs with vestibular, visual, and somatosensory system inputs that manage muscular contractions (Nichols et al., 1995). When the base of support (BOS) shifts, these sensory systems must identify the variation and the motor system must adjust to the recent demands of the position so that balance can be kept. The sensory receptors that are located in joints, muscles, tendons, supply input to the central nervous system (CNS) regarding tissue deformation and force (Giagazoglou et al., 2009). The central nervous system must organize the incoming data from the sensory receptors in order to recognize the body's location in space by the proprioception (Giagazoglou et al., 2009). Three important components are included in Proprioception: sense of joint position (static knowledge of joint position in space), kinaesthesia (awareness of joint relocation and acceleration) and the efferent closed-loop reflex (regulation of muscular response). Proprioception can also be described as the cumulative neural input to the CNS from specialized nerve endings called mechanoreceptors. These are located in the muscles, joint capsules, tendons, ligaments and skin (Malliou et al., 2012).

The mechanical definition of Bell (1998) mentioned that balance is defined as the position of an object as the forces acting upon it is zero. Also it is mentioned that, the ability of an object to remain balance is related to the state of the center of gravity (also referred to the center of mass) and the area of the base of support of that object, the object is balanced if the line of gravity of an object falls within the base of support, otherwise the object will fall (Bell, 1998). This process was given in Figure 2-1 derived from (Pollock et al., 2000).

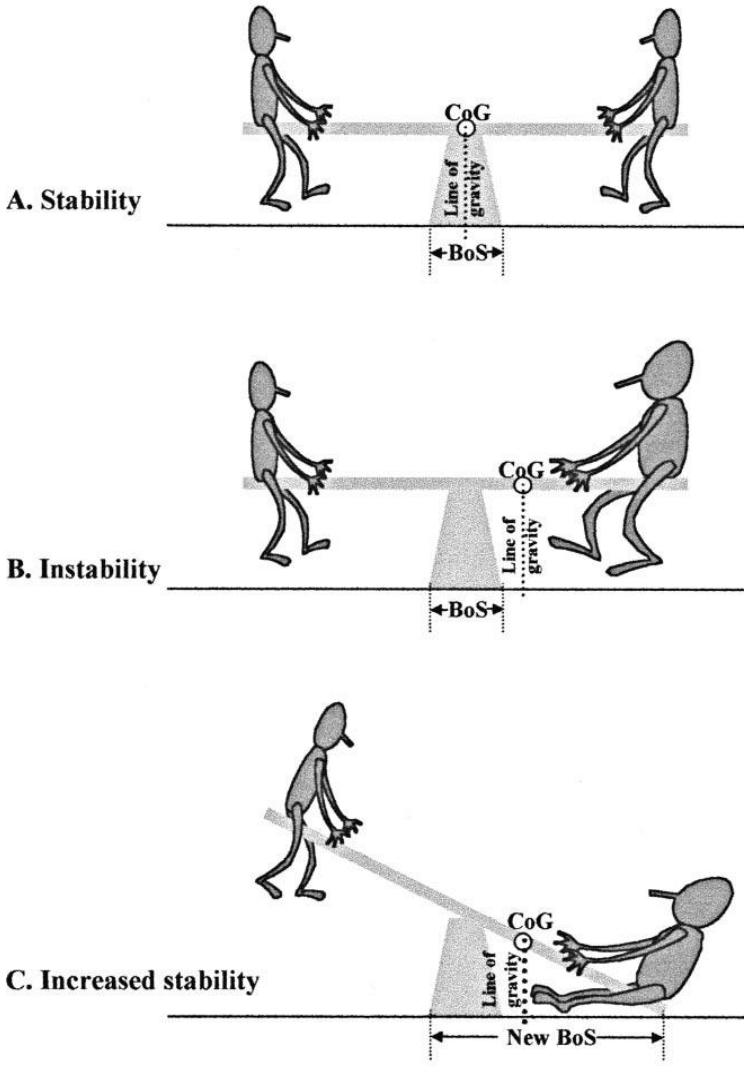

Figure 2-1 Relatioship between base of support, line of gravity, and stability

Mechanical rules stated that stability exists when the line of gravity falls within the base of support, and stability rises with a larger base of support. The rules of mechanics and the relationship between the base of support, the line of gravity, the center of gravity are suitable for the system of human balance. However, while, in an individual, the line of gravity falls out with the base of support the body has the intrinsic skill to feel the risk to the position of stability and to apply muscular movement to neutralize the force of gravity in order to remain balance and not to fall (Horak, 1987). Balance control can be defined as the ability of

individuals to regulate the relationship between the base of support and the line of gravity during daily activities movement (Brian E Maki & William E McIlroy, 1997). As a result postural control can be described as the act of keeping and gaining a position of balance during activity.

Dynamic stability defined as the ability to preserve balance and manage of the torso and distal parts of the body throughout active movement. Applying exterior forces as long as trying to keep dynamic balance figure outs the foundation of achievement in the majority of sports and in fact it is a requirement in daily functions (Kenneth & David, 2005). The matter of dynamic progress is very significant since largely musculoskeletal disorders will happen in the shape of dynamic activity. The ability to keep postural direction whether internal or external forces involved, is related to postural stability (Cavanaugh et al., 2005). During both dynamic and static condition postural stability must be kept (Cavanaugh et al., 2005). The term postural control is frequently applied when considering postural stability. Center of gravity is high in human being, vice versa base of support is small, that's the reason causes stability more complex (B. E. Maki & W. E. McIlroy, 1997). Nevertheless, in order to keep balance, individuals have the ability to solve the problem while their center of mass falls out of their base of support, as a result individuals have a power of control in the case of balance (Pollock et al., 2000). The mentioned ability to feel menace to balance and modify the trouble, to keep balance, is related to postural control.

According to the study of B. E. Maki and W. E. McIlroy (1997) postural control can be gained through predictive forces or reflexive forces. Human body can forecast there will be a danger to keep stability, and put muscles to assist conflict the outer force; or, the body can have an exterior power used to it bringing forth to center of pressure to change, to keep or return to balance.

Balance is often defined as being either static or dynamic (Phillip A. Gribble & Hertel, 2003). Static balance is the ability to keep a base of support with minimum movement, but dynamic balance considered as the ability to complete a task while

keeping or regaining a stable position (Winter et al., 1990) or the ability to keep or regain balance on an unstable surface with minimal irrelevant movement (Paillard & Noé, 2006). Static postural control is commonly measured through less complicated non-instrumented means. A researcher may measure static balance by having an individual try to keep a stationary situation while standing on either one or both leg (Phillip A. Gribble & Hertel, 2003). Standing balance is important for the performance of sports and evaluation of standing balance has been shown to be important in predicting injuries and monitoring rehabilitative achievement (Hahn, Foldspang, Vestergaard, & Ingemann-Hansen, 1999).

Dynamic balance is among the fundamental elements that underlie the performance of movement abilities, and, as a result, deficiencies in dynamic balance can hinder movement skill performance (Robinson & Gribble, 2008). The best balance control is an essential requirement for diurnal movements, sport and guarding from harm (Kenneth & David, 2005).

2.2 Balance Assessment

A variety of balance measurement devices have been developed to evaluate balance in order to discover balance deficiencies. The Berg Balance Test (ICC=.98, r=.91), The Functional Reach Test (ICC=.89, r=.98), and The Tinetti Assessment Tool (ICC=.85, r=.91) were among those measurement devices (Berg, Wood-Dauphinee, Williams, & Maki, 1992; Duncan, Weiner, Chandler, & Studenski, 1990). Although these tests have been proofed to be reliable methods but they were used in order to test elder individuals.

Many clinical assessment devices of balance exist. These tools can present information on a variety aspect of balance control (Pollock et al., 2000). For instance, the Rivermead Stroke Assessment examines patients ability to sit unsupported like keep a posture (Lincoln & Leadbitter, 1979); the Motor

Assessment Scale evaluates the ability of a sitting patient to complete a optional movement (i.e. restore a position following an expected disorder) and to shift from sitting position to standing (Carr, Shepherd, Nordholm, & Lynne, 1985); Sandin and Smith (1990) explain a test that needs a sitting patient to reply to a lateral push to the trunk (i.e. return a posture following an unpredicted disorder). Each of these tests are valid but were used for patients balance and medical condition.

Balance assessment devices also have been used for special purpose in youthful, healthy, and sportive individuals. Tools like video based system for postural sway and computerized force plates are available in the field of testing balance condition of individuals. A main problem is that these devices are mostly heavy, expensive, and complicated.

The Star Excursion Balance Test (SEBT) reported as a low-priced, fast technique of measuring balance, with fine reliability reported (Plisky PJ, 2006). The SEBT is a test of dynamic balance that offer a more precise assessment lower part function in standing position (Olmsted, Carcia, Hertel, & Shultz, 2002). Also this study mentioned that using the SEBT in athletes with chronic ankle instability had significantly reduced reach distances compared to the uninvolved leg and to the reach distances of healthy control. The special advantage of the SEBT among other dynamic balance tests is that it is more challenging for healthy, athletic individuals (Phillip A. Gribble & Hertel, 2003). Intratester and intertester reliability has been established with intraclass correlation coefficients between .67 to .96, based on the reach direction (Robinson & Gribble, 2008).

The Star excursion balance test involves 8 unidirectional balance tests that measure a one-leg position with a top aimed reach of the other leg (Fitzgerald, Trakarnratanakul, Smyth, & Caulfield, 2010). While the wanted reach distance is achieved with the free leg, the participant's postural immovability is measured. Good balance is essential to raising the extent of movement of the reach feet (Olmsted et al., 2002). This test is accomplished with the participants standing at the middle of a grid on the ground with eight tracks. The mentioned eight routes

are known as anterior, anteriomedial, anteriolateral, lateral, medial, posterior, posteromedial, and posterolateral (Olmsted et al., 2002). The participant's preferred leg defined by their desired kicking leg. The preferred leg during the test is immobile but motion about the knee, hip, and ankle happens since the other foot reaches in the tested line. The participants informed to keep a preferred foot stance when lengthened their non-preferred leg along the lines with their toes. The toe in the other word the tapping leg is not to be applied to hold up in keeping upper posture. The researcher marks the point of the participant of maximum reaches along the line and calculates the distance from the middle to reached spot with a tape. As the reach leg was applied to supply balance when the toe touching the floor or when the participant lifts the preferred leg from the middle of lines or when he/she fail to maintain his or her stability, the examiner discarded trials and repeating trials (Olmsted et al., 2002).

In order to decrease evaluation time the customized SEBT was used in this study. It has been indicated that the modified SEBT equally be reliable compared to traditional one (Plisky PJ, 2006). The modified star excursion balance test contains three directions. The directions are anterior, posteromedial, and posterolateral. The reliability of this method ranges from .82 to .86 (Brian E Maki & William E McIlroy, 1997; Robinson & Gribble, 2008).

Feet length also affects the distance of reached point so the score must be normalized. To give the normalized score the top score of the reach distance dividing by the leg length, then multiplying by 100 (Phillip A. Gribble & Hertel, 2003). The reliability of normalizing for leg length is .99.32 (McKeon & Mattacola, 2008).

One-leg standing test method is the other test that demands simple, portable, and cheap tools and suited for the matter of studies of static balance ability (Hahn et al., 1999). Single-leg balance test is more reliable technique to evaluate static balance and it is applicable for population- based researches (Bohannon et al., 1984).

2.3 Factors Affecting Balance

According to the study of Winter (1995) three main sensory systems are directly involved in balance. The initial system involved in organizing human and locomotion and in staying away from barriers along the way is vision. The vestibular system senses angular and liner accelerations and the somatosensory mechanism is a plenty of sensors that perceive the location and velocity of all body parts, their impact with exterior things, and the direction of gravity.

Giagazoglou et al. (2009) mentioned that vision is a more eminent index of performance during the postural movements compared to lower limbs length. This study examines isokinetic and isometric strength of the ankle and knee muscles and also to compare center of pressure sway between twenty sighted and blind females (10 blind and 10 with normal ability of vision). All participants accomplished three various tasks of difficulty. In spite of similar rate of strength, blind women conducted considerably worse in all balance tests regarding sighted women.

As mentioned before, human balance is depends on coordinated combination of sensory input from vestibular and visual systems. The sensory receptors that are found in joints, muscles, tendons, provide input to the central nervous system (CNS) regarding tissue deformation and force (Giagazoglou et al., 2009). In order to recognize the body's situation in space the (CNC) must harmonize the incoming data from the receptors of the body joints by the proprioception (Hosseinimehr et al., 2010). The proprioception information is a requirement for balance, the movement coordinator, and body's navigation structure (Hosseinimehr et al., 2010). Proprioception includes situation sensation in two segments; Static sensation (the person becomes aware of the situation and the state of different organs to each other) and dynamic sensation that these two sensations have a direct relationship with static and dynamic balance in the body (Bakhtiari, 2012).

Human muscle strength is necessary for posture and stability and Strength of muscles with kinematic adjustments, particularly about the knee and ankle are

applied to keep stability and to avoid falls (Giagazoglou et al., 2009). Ankle, knee, and hip weakness are related to weak balance and a risk for falls (Rabbins et al., 1989). Actually the finest balance score seen in people with stronger ankle and knee muscles (Jadelis, Miller, Ettinger, & Messier, 2001). In addition, research has showed that reduced lower extremity strength is connected to week balance and a greater threat for falls by some workers (Perry, Carville, Smith, Rutherford, & Newham, 2007).

Knowledge about balance with respect to ability of individuals of different ages to keep standing balance has a critical value for the purpose of injuries, prevention of injury, rehabilitation, sport activities, and normal daily life movements (Bohannon et al., 1984). Balance is an essential talent that is comprised with aging (Shaffer & Harrison, 2007). The study of Bohannon et al. (1984) was conducted to evaluate a) the relationship between performance on timed balance tests and age and b) to supply information for use in clinical diagnosis of patients from 20 to 79 ages. 184 volunteers could completed eight timed balance tests and all participants were able to keep balance with their feet together and eyes closed for 30 seconds. The ability to balance on both feet the (right and left) did not vary significantly. Participants over 60 years of age were not able to balance on one leg, especially when their eyes were not open, for as long a period as younger individuals. Also the results imply that as timed balance tests are completed as a part of a patient's neurologic examination, the findings should be explained in light of the patient's old. Liaw et al. (2009) conducted a study to evaluate characteristics of balance performance: static and dynamic balances in different ages (young, middle aged, and elderly healthy individuals). 107 healthy people 16-80 years old were tested by computerized dynamic posturography method (dynamic balance test) and Motor balance control tests (static balance test). Six subsets were included in dynamic balance test as follow: a) eyes open, fixed support platform; b) eyes closed, fixed platform ;c) eyes open, fixed platform; d) eyes open, swaying platform; e) eyes closed, swaying platform; f) swaying visual surround, swaying platform. The

results showed that in the static balance the elderly participants demonstrated a lower percentage of ankle tactics in subset (e and f). Also elderly group showed significantly lower ability and maximal stability in (e and f). In the case of static balance test, elderly people showed a significantly higher reactive time and lower directional control in the test. Finally, they concluded that elderly participants had a lower degree of postural balance and used hip tactic to keep their balance and needed a longer reaction time in balance performance.

Gender differences in balance performance are the other factor that should be considered as well. The study of Bryant et al. (2005) investigated whether any sex differences exist in balance performance among males (44 participants) and females (53 participants) in their retirement age (50-67 years). Three different assessments method; legs together eyes closed , legs together eyes open, and single limb stance eyes open were measured. The results showed that females presented smaller rang of center of pressure displacement than males. But no gender differences were seen after normalizing height of participants.

Comparison of balance ability among athletes and non athletes may give important information with respect to balance performances. Unfortunately, there is not enough study in this case. Body balance and postural control are needed through daily activities, like standing in a moving train. The study of Chiang et al. (2000) evaluated the ability of balance between judo players (10 participants) and sedentary people (10 participants). Two types of balance: Static (standing on one leg with eyes closed form) and dynamic (body sway test) balances were tested in this study. Results of dynamic balance test mentioned that there was a significant difference in the time of balance recovery between judo players and non-athletes. On the other hand, the results of static balance test mentioned that the radius of body sway of athletes was significantly smaller than sedentary group.

2.4 Balance and Sport

The matter of balance in health and performance of sports and activities has been a point of attention among researchers for many years. There is also plentiful data related to biomechanical principles of balance. Physiological systems of postural control have also been widely studied, but, most balance studies has been accomplished in clinical settings while there are rare reports related to sport-specific balance (Zemková 2011).

Postural stability is necessary not simply in normal daily-life conditions but also in all types of sports. Static balance is important in shooting and archery, on the other hand, dynamic balance has a main role in the performance of free style sports like snowboarding, skateboarding, windsurfing (Zemková 2011). In sports like tai-chi, yoga, gymnastics, the target is to manage and control balance in related sport-specific situations, and can be different in difficulty based on proficiency. The accuracy of the control of center of mass is vital in sports such as climbing, mountaineering, and ice-hockey where stability required preserving balance is restricted by the narrow area of support. Regulation of center of mass motion is also significant in ballet and dancing sport depending on rotational movements, among other type of sports. On the other hand, lack of balance through fast movements in sports games like, basketball, soccer, softball, table tennis, handball, volleyball may chip in knee injuries (Zemková 2011). The ambition is to manage balance in sports explicit situations, which can differ in complexity depending on specialization. In fact, the awareness of the center of mass control is important in sports. Failure in balance during quick activities in sports like soccer may cause knee injuries (Zemková 2011).

The cross sectional study of Hahn et al. (1999) was conducted to assess single leg standing balance to consider the relationship with type (Soccer, European team handball, Basketball, Badminton, Tennis, Competitive gymnastics, Swimming, Jogging) and amount of sport participation in athletes. 339 active (125 boys, 214

girls), aged from 14–24 years, and non-pregnant were participated in this study. One-leg standing balance was calculated as the highest time of one-legged balancing. The mean of the highest period of one-legged balancing was 29 s (interquartile range 11.25-33.5 s). The results mentioned that the period of involvement in basketball was positively associated with single leg standing balance. Sex and age was not positively associated with one leg standing balance. Also contribution in basketball may bring considerably adaptive effects on standing balance.

Bakhtiari (2012) conducted a study to evaluate the static and dynamic balance and knee proprioception in thirty six young male professional soccer players (Mean±SD; age 18.9 ±1.4 y, weight 73.6 ±6.3 kg, height 1.81 ± 5.5 m). The Flamingo and SEBT tests were used for static and dynamic balance. The results showed significantly differences between static balance with open eyes and close eyes also the relationship among static and dynamic balance with proprioception were not significance ($p > 0.05$). A significant relation was found between static balance with open eyes and dynamic balance ($p=0.01$). Finally he mentioned that the evaluations of the static and dynamic balance and proprioception several times during pre-season and in season could allow the trainer to identify the muscles condition of athletes and they can use balance program for increasing balance abilities of athletes and to prevent injuries.

2.5 Injury and Soccer

Due to the nature of athletic performances and activities there is a significant risk of injury. Many injuries happen each year caused by sport, resulting in decreased physical movement. According to the National Collegiate Athletic Association injury supervision organization, the most frequent injury parts were the knee, and lower leg among collegial soccer, hockey, and basketball players

(Association, Safeguards, & Sports, 2002). The skill of participants of sports to manage the condition of their center of gravity has gained concentration as a possible threat factor for lower extremity injury (Murphy, Connolly, & Beynnon, 2003). Studies of proprioception have mentioned that managing the condition of limbs and balance, the quantity of movement and the direction, acquiring new actions and managing those activities has an essential role in proprioception (Dover & Powers, 2003).

A cohort observational study of Powell and Barber-Foss (2000), was conducted to test the hypothesis that the occurrence of injuries for females taking part in sports is higher than males. Males and females students playing soccer, basketball, softball, and baseball were followed to reveal injury in competitions. Certified trainers reported injuries based on 39,032 players and 8989 of them reported as an exposure of injury. The injury rates for one hundred players for female soccer players (26.7) and for softball (16.7) were higher than for male soccer players (23.4) and baseball male players (13.2). The rates of knee injury for female basketball players (4.5) and female soccer players (5.2) were greater than for their male teammates. Also significant injuries happened more often in female basketball players (12.4%) and female soccer players (12.1%) than in male basketball players (9.9%) and soccer players (10.4%). The results mentioned that, there were higher surgeries, for female basketball and soccer players than for males or females in other sports. According to the given results more consideration should be focused on determining factors that cause injuries in athletes and special programs may be adjusted to decline likelihood of injuries.

Lower extremities injuries mostly occur in soccer (Junge et al., 2006). The study of Morgan and Oberlander (2001) analysed the injury data collected from the soccer players (237 players) that constituted Major League Soccer. The overall rate of injury rate was 6.2 per thousand hours of players. 2.9 per thousand hours rate of injury was reported for exercise and 35.3 per thousand hours were noted for sport competition. Around seventy seven percent of disorders (197 Out of 256) and

injuries have occurred in the lower part of body and the highest injury has taken place in knee (54 %) and ankle (46 %). The other study with respect to injuries in soccer mentioned that the most general parts of injury in football is knee (Yoon, Chai, & Shin, 2004). Also the essential cause of failure and inability to perform workouts and exercises in individuals was reported as the knee injury (Bollen, 2000). The occurrence of knee problems causes large amount of costs on teams and additionally players miss games for a long period of time (Murphy et al., 2003).

It is essential to have efficient plan to decrease the injuries and high costs of resulting injuries. The base for blocking plan for preventing injuries is the identification and evaluation of issues that known as a risk factor (Murphy et al., 2003).

2.6 Balance Ability and Injury Prevention

Balance is key point in preventing injuries. Various studies have investigated the effect of balance training on anterior cruciate ligament and have mentioned the positive consequence of balance movements and activities to prevent injury (Caraffa, Cerulli, Projetti, Aisa, & Rizzo, 1996; Lloyd, 2001). The study of Caraffa et al. (1996) tested the influence of balance exercises in prevention of anterior cruciate ligament injury in 600 hundred soccer players. The subjects were divided into distinct team (A and B); the participants of (A) trained with proprioception workouts during preseason and the others with their daily and normal program. The results of this study mentioned that the occurrence of ACL injury was 0.15 in group A and 1.15 in participants of group (B). The study of Heidt, Sweeterman, Carlonas, Traub, and Tekulve (2000) evaluated the result of a preseason training program on the incidence and intensity of soccer injuries on 300 hundred females (14-18 years old) over a year. Prior to the start of season, 42 participants of these players included in a conditioning training programme. The

severity and type of injury were recorded. The results showed that the lower occurrence of injury in participants of trained group (14 percent) experienced lower occurrence of injury than the other participants (33.7 percent).

Hewett, Lindenfeld, Riccobene, and Noyes (1999) conducted a study showing the efficacy of neuromuscular training program on the occurrence of knee injury in females. Two groups of female athletes participated in this study. One group trained with prepared 6 week program (the jumping and landing training three days per week lasted 60 minutes) before the sport activities and the other group were not. The results demonstrating that the untrained athletes had 3.6 higher occurrence of injury than trained female athletes who carrying out a special plyometric program during preseason including jumping and landing three days per week.

McGuine and Keene (2006) examined a randomized controlled clinical trial study among soccer and basketball players (765 participants) to demonstrate the decrease in the occurrence of ankle injury by balance training program. Participants (523 females, 242 males) randomly assigned to either control group that performed normal program (392 players) or to an intervention group (373 players) that taken part in balance program. All participants were followed during season and injuries were recorded. The results indicated that the balance program (single leg stance exercises program in five session weekly) proved to be effective in decreasing the number of injury when compare to participants that did not take part in intervention balance program.

Ability of balance in participants of sports also has been among the factors that studied as a predictor of lower extremity injury. Plisky PJ (2006) conducted a prospective study by using Star Excursion Balance Test (anterior, posteromedial, and posterolateral distances) to evaluate balance ability of 235 high school basketball players (130 males, 105 females) to predict lower extremity injury. The results showed that basketball players with an anterior (right/left) reach distance difference greater than 4 cm were 2.5 times more likely to sustain a lower extremity

injury (*P*<.05). Also female basketball players with a composite reach distance less than 94.0% of their leg length were 6.5 times more likely to have a lower extremity injury (*P*<.05). Finally the researcher of this study found the mechanism of the SEBT to be reliable and predictive measures of lower extremity injury in basketball players.

CHAPTER 3

MATERIALS AND METHODS

The purpose of this study was to answer following three questions: 1) is there a significant difference between sedentary and soccer players in their balance performance (static and dynamic)? 2) Is there a significant difference between gender (males and females) in their balance performance (static and dynamic)? 3) Is there a significant interaction effect between gender, and sport participation in their balance performance (static and dynamic)?

In this chapter, research design, the participants, assessment devices, protocol, and statistical analyses were presented.

3.1 Design

In this study, two types of balance were measured. In order to assess the static balance, one-leg standing balance test, and for the dynamic balance assessment, Star Excursion Balance Test (SEBT) were used. After obtaining consent from the Ethical Board comity of the Middle East Technical University and signing a letter of approval by participants and their coaches, the study was conducted. Before participation in the study all subjects were informed on the inventory, which were used during data collection.

In this study causal-comparative design were used. Participants were selected according to their background of soccer playing and their sedentary condition for tests. All the tests that were used are standardized tests. To eliminate the internal validity, the subjects were asked not to participate in any kind of sport

or exercise 24 hour before testing. All testing were performed approximately at the same time of the day around 16.00 o'clock and measurements were made at standing position.

3.2 Participants

Seventy three individuals participated in the study. 19 male soccer players, 17 female soccer players, 19 male sedentary students, and 18 female sedentary students from Middle East Technical University (METU) and Gazi University were assigned to this study. The reason of choosing these two universities is simply related to the limited number of clubs with female players in Ankara. The participants were healthy and without any injuries.

The criterion of the participants of the study were: a) no physical movement for at least 6 month (not for soccer players), b) no previous surgery on the leg part, c) lack of cardiovascular, vestibular, and neurological disorders d) lack of knee instability.

The height of participants was measured with no shoe and their weight was measured by digital scale. 36 participants participated in this study voluntarily and the soccer players were selected by purposive sampling method because only semi-professional players were included in this study and all of them had at least three years background of playing soccer in the high level competitions. Characteristics of the participants were given in Table 3-1.

Table 3-1 Characteristics of the participants

Factors	Sex	Group	N	Mean	SD	Maximum	Minimum
Age (year)	Female	Sedentary	18	28.61	2.85	33	23
		Soccer P	17	20.42	1.62	24	18
	Male	Sedentary	19	26.74	3.65	35	21
		Soccer P	19	22.74	2.94	29	19
Weight (kg)	Female	Sedentary	18	60.09	10.28	90.60	48.60
		Soccer P	17	56.85	7.18	73.00	45.60
	Male	Sedentary	19	73.42	14.47	101.40	56.80
		Soccer P	19	72.96	6.55	84.60	60.80
Height (cm)	Female	Sedentary	18	161.86	6.14	172	145
		Soccer P	17	161.23	6.02	171	150
	Male	Sedentary	19	175.47	6.87	189	165
		Soccer P	19	177.26	6.50	192	166
Sport Background(Y)	Female	Soccer P	17	6.09	2.12	9.00	3.00
	Male	Soccer P	19	9.11	3.75	15.00	3.00

Note: Soccer P = Soccer Players

3.3 Assessment Devices and Protocols

3.3.1 Dynamic Balance

To evaluate dynamic balance of participants the modified Star Excursion Balance Test was used (m SEBT). The internal consistency reliability of the original scale was .98. In this study, the internal consistency reliability, as determined by Chronbach's Alpha, is .86 which is an acceptable measure. The mSEBT contains of three tape measures on the floor. These tapes were placed at 135 degrees connecting the posterior medial and posterior lateral contrast to the anterior. In Figure 3-1 an image of the SEBT grid is presented. Then the participants were asked to extend with their free leg as far as possible in the predetermined direction. In Figure 3-2 the three positions of participant in modified SEBT grid is shown.

Participants were informed to maintain their hands on their iliac and try to maintain the heel of the test leg on the floor during the test.

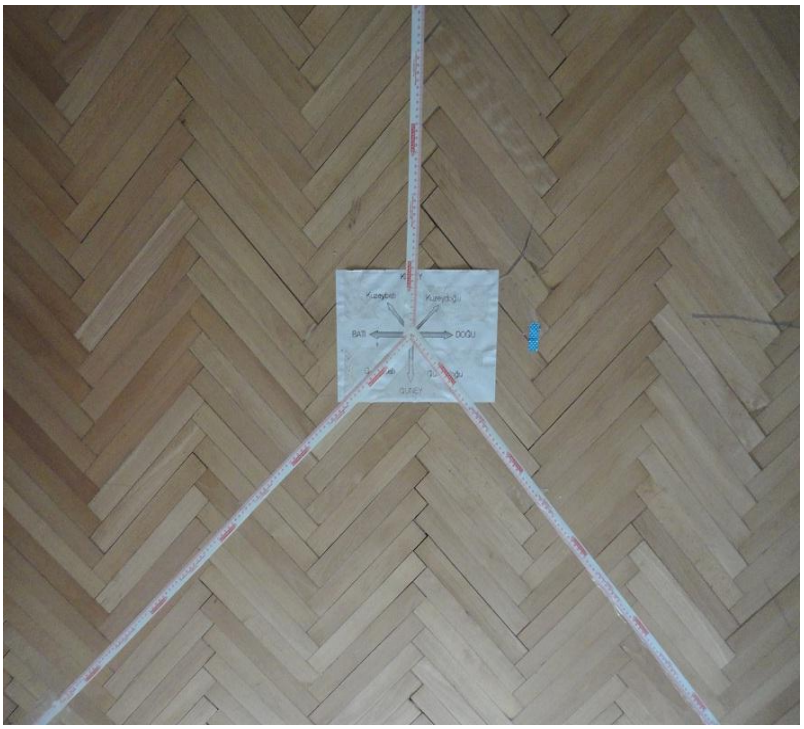

Figure 3-1 An image of modified SEBT grids

Figure 3-2 Directions of the anterior, postero medial, and postero-lateral

The participant stretched his or her free leg at the same time keeping their balance, tapping the tape measure with their toe and then they reached leg returned to the middle of grid (starting condition). All participants accomplished 4 reaches in mentioned three sides. Following a two minute break, 3 reach trials were

accomplished in directions. 30 second break between trials were given to the individuals. Necessities should be considered in the test procedures; a) Just the tip of toe touched the tape with the reached leg, b) the balance must be kept, c) and the participant again was able to re-back to the initial position otherwise the participant had to conduct the action again. Throughout the test, the distances were noted at the optimum point of the reach distance and evaluated from the middle of the tapes. Three reaches scores for each direction were averaged and was normalized by the leg length (measured from an anterior superior iliac spine (ASIS)) to normalize the highest aimed distance (P. A. Gribble & Hertel, 2004).

3.3.2 Static Balance

To evaluate the static balance of participants One-leg standing balance was used. This test was calculated while the period the participant could sit on single feet with unopened eyes, the free leg bended and both hands held on the opposed shoulder. The test was continued till the participant was able to keep the mentioned position and the test was stopped if the participant could keep the condition for more than 180 seconds (Bohannon et al., 1984). For each leg two trials were conducted, and the best period of time was recorded for each side and used for statistical analyses.

3.4 Statistical Analyses

Descriptive statistics were conducted to compare the differences between male and females with respect to their balance performances on one hand, and sedentary group and soccer players on the other. As it was difficult to maintain whether the difference between the variables measured is significant or not, the multivariate analysis of variance (MANOVA) was conducted to determine the

significance of relevance between the variables. The univariate tests or between-subjects effects were also used to establish the potential contraction between the variables under investigation.

To determine the effect of degree of significance between variables, Cohen's (1988) reliability of effect test was carried out. Cohen's (1988) reliability effect indexes for small, moderate, and strong relationships are r=0.1, 0.30, and 0.50 respectively. Additionally, the MANOVA was also conducted to disclose the interaction effect of gender and physical activity on balance performance.

Chapter 4

RESULTS

The results are offered here based on the categorical variables included in the study, where the four levels of balance performance (i.e., dynamic dominant leg, dynamic non-dominant leg, static dominant leg and static non-dominant leg) were our dependent variables, gender and group (i.e., sedentary and soccer player) were independent ones.

The two-way multivariate analysis of variance (two-way MANOVA) was conducted to assess the effects of the two-level gender variable (male & female) and the two-level sport participation (sedentary & soccer players) factor on the balance performance of the dynamic non-dominant leg, dynamic dominant leg, static dominant leg and static non-dominant leg. A significant Box's M test ($p = 0.01$) indicates that there is no homogeneity of covariance matrices of the dependent variables across the levels of groups. Moreover, the results of Leven's test of equality of error variances showed homogeneity of variances only for dynamic non-dominant leg, $F(3, 69)$, $p = 0.198$; $p > 0.05$) and static dominant leg, $F(3, 69)$, $p = .298$; $p > 0.05$) across groups. However, no equality of variances was found for dynamic dominant leg and static non-dominant leg across groups (see Table 4-1).

Table 4-1 Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
Dynamic dominant leg	4.20	3	69	.009
Dynamic non-dominant leg	1.60	3	69	.198
Static dominant leg	1.25	3	69	.298
Static non-dominant leg	2.91	3	69	.041

According to Norman (2010), in larger samples, it is not necessary for the measure to meet the assumptions of normality. He asserts that " Both theory and data converge on the conclusion that parametric methods examining differences between means, for sample sizes greater than 5, do not require the assumption of normality, and will yield nearly correct answers even for manifestly non-normal and asymmetric distributions like exponentials".(p.628). In this study, therefore, although assumptions of normality and homogeneity of variances apparently were violated due to some outliers, the findings of the study are dependable because the same results were obtained even after the outliers were excluded.

4.1 Gender and Balance Performance

The results of descriptive statistics for the effect of the participants' gender and sport participation on the balance performance demonstrated differences between males and females in all variables measured. The highest total mean scores (M= 278; SD=27.00) for dynamic dominant leg (DDL), (M=281; SD=20.34) for dynamic non-dominant leg (DNDL), (M=96; SD=68.63) for static dominant leg (SDL), and (M=100; SD=67.80) for static non-dominant leg (SNDL) were received by males while the lowest scores were ascribed to females across all dependent variables in the study (see Table4-2 and Table 4-3). Despite of the existing differences between mean scores of the participants, the results of MANOVA and follow up T-test demonstrated that this difference is not statistically significant.

4.2 Sport Participation and Balance Performance

The careful scrutiny of descriptive statistics also revealed that the soccer players performed better than sedentary group both in females and males with

respect to their dynamic balance. That is, the highest scores for all variables observed in soccer players (M=286; SD=14.69) for dynamic dominant leg (DDL) in females and (M=283; SD=11.35) in males, (M=284; SD=12.92) for dynamic non-dominant leg (DNDL) in females and (M=287; SD=13.74) in males (see Table 4-2).

Table 4-2 Sport Participation and Dynamic Balance Performance

Balance performance	Gender	Group	Mean (cm)	SD	N
Dynamic dominant leg	Female	Sedentary	265.99	24.19	18
		Soccer player	286.25	14.69	17
		Total	275.83	22.36	35
	Male	Sedentary	274.38	36.43	19
		Soccer player	283.40	11.35	19
		Total	278.89	27.00	38
	Total	Sedentary	270.30	30.95	37
		Soccer player	284.75	12.93	36
		Total	277.43	24.77	73
Dynamic non-dominant leg	Female	Sedentary	269.96	21.13	18
		Soccer player	289.08	17.54	17
		Total	279.25	21.50	35
	Male	Sedentary	274.83	24.11	19
		Soccer player	287.18	13.75	19
		Total	281.01	20.35	38
	Total	Sedentary	272.46	22.53	37
		Soccer player	288.08	15.45	36
		Total	280.16	20.78	73

In the same vein, the results disclosed a difference between sedentary group and soccer players both in females and males with regard to their static performance. The soccer players did better than sedentary group in their static performance, (M=109.94; SD=47.54) for static dominant leg (SDL) in females and (M=130.94; SD=51.07) in males, and (M=144.41; SD=37.85) for static non-dominant leg (SNDL) in females and (M=131.78; SD=60.79) in males (see Table 4-3).

Table 4-3 Sport participation and Static Balance Performance

Balance performance	Gender	Group	Mean (sec)	SD	N
Static dominant leg	Female	Sedentary	51.00	49.62	18
		Soccer player	109.94	47.54	17
		Total	79.63	56.46	35
	Male	Sedentary	61.32	67.19	19
		Soccer player	130.95	51.07	19
		Total	96.13	68.64	38
	Total	Sedentary	56.30	58.72	37
		Soccer player	121.03	49.88	36
		Total	88.22	63.21	73
Static non-dominant leg	Female	Sedentary	56.11	45.76	18
		Soccer player	144.42	37.85	17
		Total	99.00	61.04	35
	Male	Sedentary	69.21	60.72	19
		Soccer player	131.79	60.80	19
		Total	100.50	67.80	38
	Total	Sedentary	62.84	53.63	37
		Soccer player	137.75	50.96	36
		Total	99.78	64.21	73

Moreover, female soccer players performed better than male ones in three levels (M=286; SD=14.69) DDL, (M=289.08; SD=17.54) for DNDL and (M=144.41; SD=37.85) for SNDL, whereas males' performance was better than females (M=130.94; SD=51.07) in SDL (see tables 2 and 3). Besides, the analysis of profile plots for the relationship between gender and sport participation also confirms the significant differences between groups. Figure 4-1, Figure 4-2, Figure 4-3, Figure 4-4 diagrammatically illustrate mean differences for independent variables, i.e., gender, sedentary group and soccer players with respect to their balance performance.

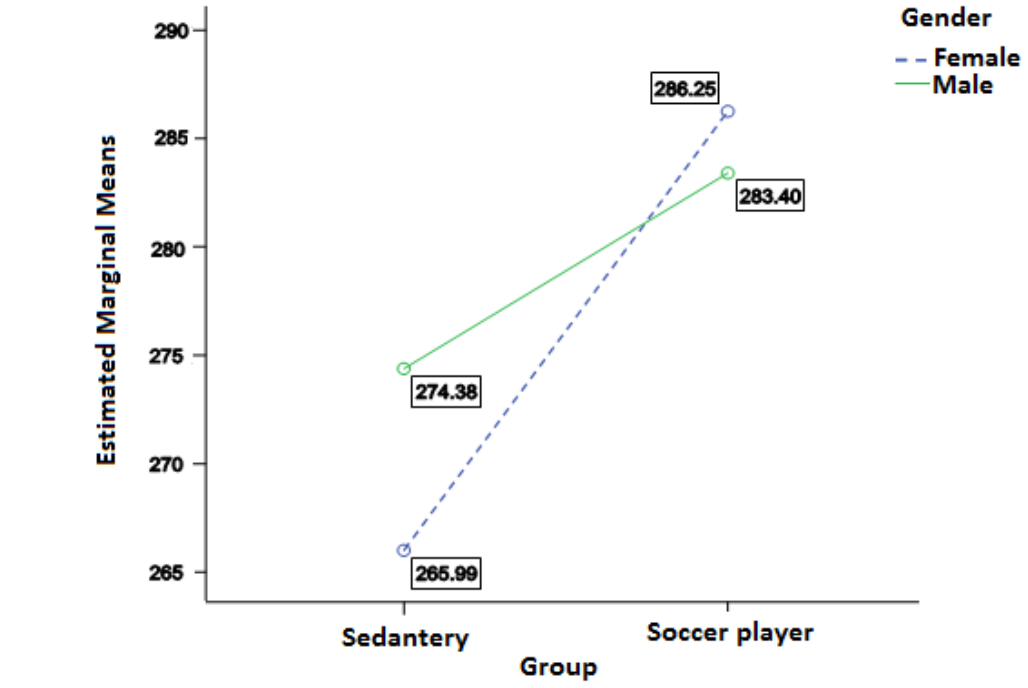

Figure 4-1 Relationship between sport participation and DDL

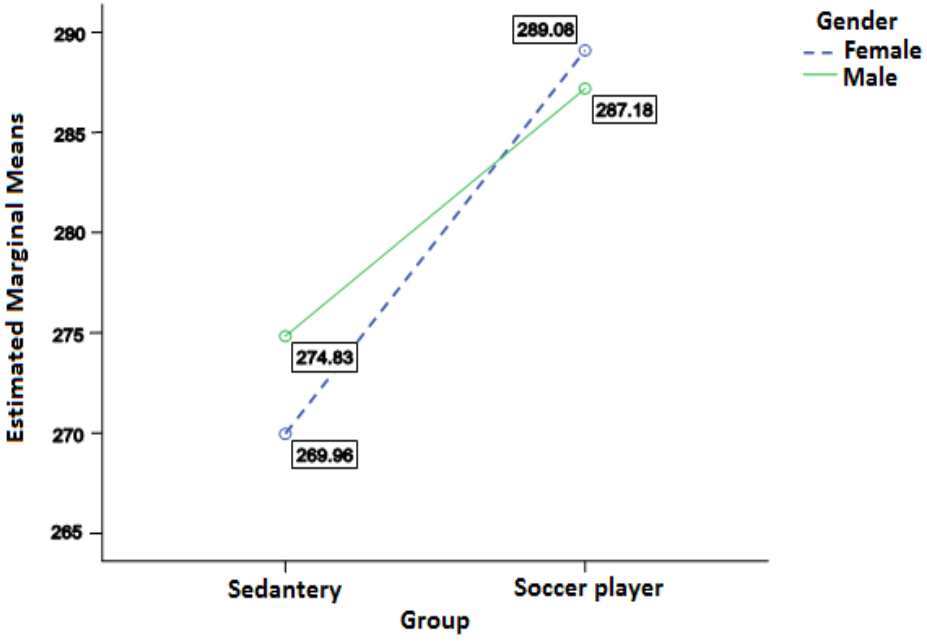

Figure 4-2 Relationship between sport participation and DNDL

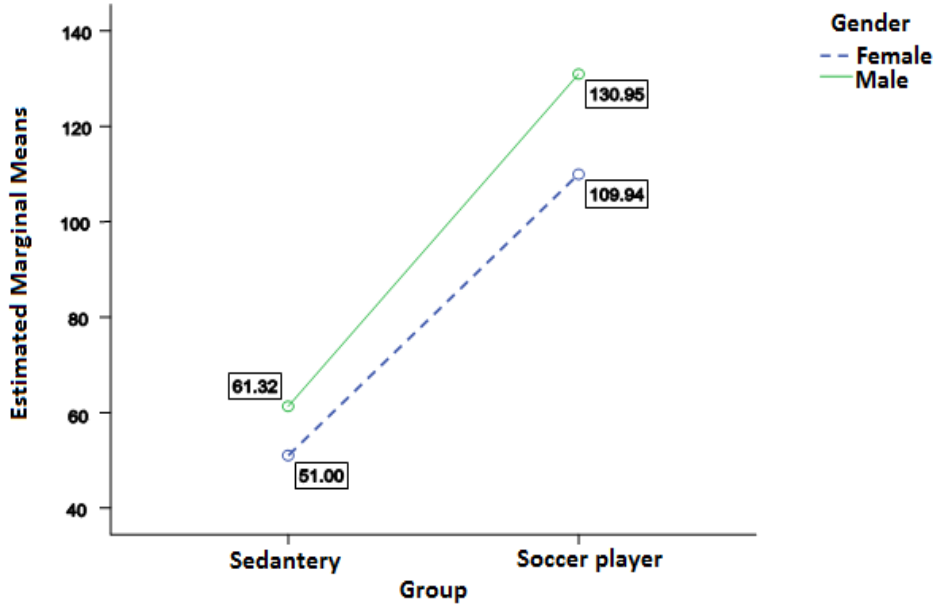

Figure 4-3 Relationship between sport participation and SDL

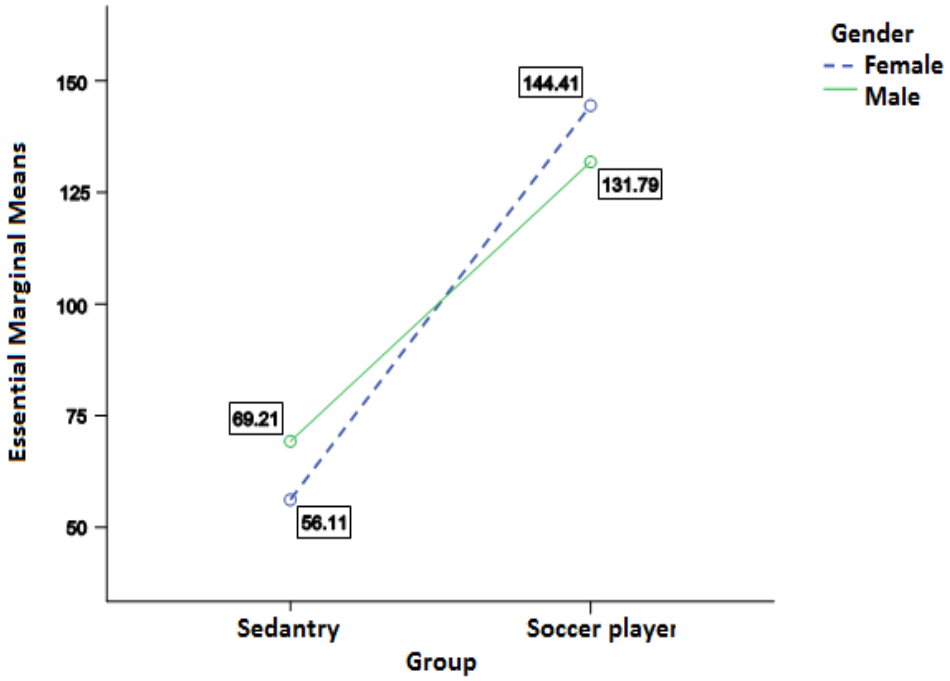

Figure 4-4 Relationship between sport participation and SNDL

Although the analysis of descriptive statistics showed differences between male and females on one hand, and sedentary group and soccer players on the other, as seen in the previous section (see tables 1 and 2), it was difficult to maintain whether the difference is significant or not. Hence, multivariate test results and test of between-subjects effects were scrutinized to establish the potential differences between the variables under investigation.

The results of multivariate tests indicated a significant main effect for participants' sport participation in both groups, i.e., sedentary group and soccer players, with respect to their balance performance (Wilks' Lambda=.620, F (4, 66) = 10.123, $p < .01$, partial $\eta^2 = .38$). However, the results showed no significant main effect between gender factor and balance performance (Wilks' Lambda=.958, F (4, 66) = .721, P=.580; $p > .05$, partial $\eta^2 = .042$). Similarly, no significant interaction effect was observed for gender and sport participation as independent variables with four levels of balance performance as the dependent variables (Wilks' Lambda=.941, F (4, 66) = 1.028, P=.400; $p > .05$, partial $\eta^2 = .05$).

The results of tests of between-subjects effects, or univariate tests, showed that there were no significant differences between females and males across the levels of balance performance. However, a significant difference was observed between participants' sport participation, i.e., sedentary and soccer player, and their balance performance, $F(1,69) = 6.796$,p=0.011; $p < .05$, partial $\eta^2 = .09$, for DDL, $F(1,69) = 11.799$, p=0.001; $p < .05$, partial $\eta^2 = .14$ for DNDL, $F(1,69) = 25.177$, p=0.000; $p < .05$, partial $\eta^2 = .26$ for SDL, and $F(1,69) = 37.360$, p=0.000; $p < .05$, partial $\eta^2 = .35$ for SNDL.

Analysis of reliability effect test, according to Cohen (1988), showed a slight significant difference for sedentary group and soccer players in the DNDL (partial $\eta^2 = .14$) and SDL (partial $\eta^2 = .25$) levels, and a moderate significant difference in SNDL (partial $\eta^2 = .35$). Cohen's (1988) reliability effect indexes for small, moderate, and strong relationships are r=0.1, 0.30, and 0.50 respectively. As for the interaction

effect of gender and sport participation on balance performance, the results of MANOVA showed no significant differences between the variables.

CHAPTER 5

DISCUSSION

The purpose of this study was to determine if a difference exists in (a) males and females collegiate students (b) sport participation of collegiate students, using one-leg standing balance test for static balance test and modified SEBT for dynamic balance assessment in their balance performances. In this section, the findings of each research question will be discussed.

5.1 Differences Between Sedentary and Soccer Players:

Is there a significant difference between sedentary and soccer players in their balance performance (static and dynamic)?

#H0: There is no significant difference between sedentary and soccer players in their balance performance.

#H1: There is a significant difference between sedentary and soccer players in their balance performance.

The first hypothesis of this study assumes that soccer players will perform better than sedentary collegiate students in balance performances (static and dynamic). The careful scrutiny of results in this study revealed that the soccer players performed better than sedentary group. Although the analysis of descriptive statistics showed differences between sedentary group and soccer players, it was difficult to maintain whether the difference is significant or not. Hence, multivariate test results and test of between-subjects effects were scrutinized to establish the potential differences between the variables under investigation. The results of

multivariate tests indicated a significant main effect for participants' sport participation in both groups, i.e., sedentary group and soccer players, with respect to their balance performance. A significant difference was observed between participants' sport participation, i.e., sedentary and soccer player, and their balance performance for Dynamic Dominant Leg (DDL), Dynamic Non Dominant Leg (DNDL), Static Dominant Leg (SDL), and Static Non Dominant Leg (SNDL). This provides answer to our first research question "*Is there a significant difference between sedentary and soccer players in their balance performance (static and dynamic)?"* Given the findings of the study, our null hypothesis, i.e., #H0 is rejected and #H1 is accepted indicating that there is a significant difference between sedentary and soccer players with respect to their balance performance.

As it was mentioned in this study, soccer players gained higher scores rather than sedentary ones in balance performance. It can be concluded, therefore, that sport participation increases balance ability of individuals. The findings of the present study are in line with Chiang et al. (2000) who investigated the ability of balance between judo players and sedentary ones by using static and dynamic balance tests (Kistler Force Plate System & Tensiometer). Interesting insight is gained by examining static balance tests, one with eyes closed and another with eyes open. Judo players had better static balance ability than non-athletes. Their findings and the results of the present research suggested that regular sport training can significantly enhance the static balance ability. There is also an agreement between current work and Lord's (1996) study. Lord suggested that regular exercise is essential for both healthy non-athletic persons and patients with disease. In clinical application, measuring body sway Center of Pressure (COP) by using force platform is an effective and reliable way to assess balance ability which is in agreement with other studies (Andres, 1980; Nashner, 1979, Odenrick, 1987). Also with respect to dynamic balance test, significant difference was revealed in the time of balance recovery between the judo players and non athletes ($p<.05$). These results related to the activities of judo players such as Nage-waza (special technique

that judo players used) which frequently involved in competitions. Techniques that involved in judo are targeted at unbalancing the competitor devoid of losing balance themselves which needs high postural control ability in dynamic positions.

In the same vein, the study of Tsang and Hui-Chan (2010) conducted to find out whether older golfers have better static and dynamic balance control than older but non athletes healthy adults. The results of this study revealed that golf players kept significantly longer duration in static balance and gained less body sway than non golfers did. This significant results exhibited by golfers probably shows the effect of walking on rough fairways and weight transfers from repeated golf swings during weight shift from two-leg to one-leg stance. The improvements in static and dynamic balance imply that golfing may improve balance control in participants so it is suggested that sport activities can be included in normal daily life and in trainers' program to increase abilities of players and avoid fallings and injuries.

According to the results of this present study, it is offered that sport participation would significantly develop balance ability of individuals. This result would relate to the muscle strength of soccer players whom regularly participated in soccer trainings and competitions. With respect to this point of view Giagazoglou et al., (2009) mentioned that human muscle strength is necessary for postural stability and it is applied to keeping balance and avoiding falls. Ankle, knee, and hip weakness significantly affect balance condition and cause a weak balance among people. So it can be concluded that sport participation increases muscle strength of participants and at the same time this factor also increases balance performances of sport participants. Actually the finest balance score was seen in people with stronger ankle and knee muscles (Jadelis et al., 2001) If physical activities and exercises could be performed among sedentary individuals, it would positively develop balance and health condition. Moreover, developed ability of balance would reduce the occurrence of falling among individuals. Future studies should focus on evaluating the effect of different sport activities on balance performance.

5.2 Difference between Males and Females:

Is there a significant difference between gender (males and females) in their balance performance (static and dynamic)?

H0: There is no significant difference between males and females in their balance performance.

#H1: There is a significant difference between males and females in their balance performance.

In the second hypothesis, we assumed that males would perform better than females collegiate students in balance performances (static and dynamic). The results of this study showed that there is no significant main effect between gender factor and balance performances. The results of descriptive statistics for the effect of the participants' gender on the balance performance demonstrated differences between males and females in all variables where the highest total mean scores for dynamic dominant leg (DDL), dynamic non-dominant leg (DND), static dominant leg (SDL), and static non-dominant leg (SNDL) were received by males while the lowest scores were ascribed to females across all dependent variables in the study. However, the results of MANOVA showed no significant differences between males and females. This means that gender does not affect participants' scores in their balance performance. This provides answer to our second research question "*Is there a significant difference between gender (males and females) in their balance performance (static and dynamic)?"* Therefore based on the results, our null hypothesis, i.e., #H0 is accepted indicating that there is no significant relationship between gender and balance performance.

The findings of this present study are in line with the study of Bryant et al. (2005) who tested balance performance in female and male at the time of retirement. In the aforementioned study Balance was measured under different situations; feet together eyes closed, feet together eyes open, and one leg stance

eyes open. The results showed that males performed a statistically better center of pressure than females, but, after normalizing the data for participant's height, the outcomes changed and no gender differences were seen. In general the articles that have reported gender differences (Overstall, 1977 & Panzer 1995) in balance performance did not normalise their data for differences in body size (Bryant et al., 2005). On the other hand, the study of Phillip A Gribble, Robinson, Hertel, and Denegar (2009) investigated the effects of gender on performance of individuals by using Star Excursion Balance Test (SEBT) and the outcomes revealed that female exhibited greater reach distances than males. The explanation of this difference related to the increased knee flexion performed by the female at the point of highest reach distance. Phillip A Gribble et al. (2009) also mentioned that biomechanical difference between males and females was amplified under fatiguing situations to the lower extremity as reach distances and knee flexion decreased in both males and females with the matter of fatigue, but the decline was higher among the males. Farenc, Rougier, and Berger (2003) investigated the effect of sex during postural stability. The outcomes of this study reveal that males have larger sway amplitude for center of gravity motion comparing to females. This outcome can be described by the moment of body inertia and the natural body frequency and physiological characteristics, indicating the need to differentiate between males and females postural behaviours. The study of Nolan, Grigorenko, and Thorstensson (2005) evaluated gender and age differences in standing balance of children (age ranges from 9 to 15). The outcome implies that boys presented greater center of pressure movement comparing to the girls indicating that boys may lag behind somewhat in terms of developing postural control, so investigating balance in children should be studied separately with respect to the sex.

Drawing upon the results of the present study, it is offered that gender differences would not significantly affects balance ability of participants. By reviewing the literature different outcomes were seen. These results may be attributed to the different tests, different participants and background of sport,

healthy condition, and different ages. Future studies should focus on evaluating the effect of different sport activities, different ages, on balance ability, with different sport athletes (both previously injured athletes and healthy athletes) who are trained in regular activities being involved to be the subjects.

5.3 Interaction between Gender and Sport Participation:

Is there a significant interaction effect between gender, sedentary and soccer players in their balance performance?

#H0: There is no significant interaction effect between gender, sedentary and soccer players in their balance performance.

#H1: There is a significant interaction effect between gender, sedentary and soccer players in their balance performance.

In the third hypothesis, we assumed that there would be a significant interaction effect of gender and sport participation on collegiate students' balance performances (static and dynamic). The results of this study showed that there is no significant interaction effect between gender and sport participation with respect to balance performance. This provides answer to our last research question, "*Is there a significant interaction effect between gender, sedentary and soccer players in their balance performance?"* Therefore based on the results, our null hypothesis, i.e., #H0 is accepted indicating that there is no significant interaction between gender and sport participation in relation to balance performance. As it mentioned before sport participation has a significant effect on balance performances, on the other hand, no significant main effect between gender factor and balance performances was seen in the present study. Unfortunately, no substantial evidence was found in the literature to either sport or reject the findings of the present study regarding the interaction between gender and sport participation. In the Other word, there is

no strong body of evidence in the literature that support the findings of this research study.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

The purpose of this study was to determine if a difference exists in males and females collegiate students and sport participation of collegiate students, using one-leg standing balance test for static balance test and modified SEBT for dynamic balance assessment in their balance performances. The results of multivariate tests indicated a significant main effect for participants' sport participation in both groups, i.e., sedentary group and soccer players, with respect to their balance performance (Wilks' Lambda=.620, F (4, 66) = 10.123, $p < .01$, partial $\eta^2 = .38$). Also the results of MANOVA demonstrated that the effect of the participants' gender on the balance performance is not statistically significant. Similarly, no significant interaction effect was observed for gender and physical behaviour as independent variables with four levels of balance performance as the dependent variables.

Due to the popularity of soccer and the huge amount of participants of this sport in one hand, and the essential role of balance in sports specially in soccer, and the truth that we as human being are bipeds and walking, running, standing over the ground which causes a critical challenge to our balance system on the other hand, this study offered that sport participation would significantly develop balance ability of individuals. If physical activities and exercises could be performed among sedentary individuals, it would positively develop balance and health condition. Moreover, developed ability of balance would reduce the occurrence of falling among individuals. Weak balance is among the main factors that caused injuries and unfavoured performance among soccer players so the measurement of the static and dynamic balance several times during preseason and in season could let the

coach to recognize the muscle state of athletes. They can use balance program in their training programs for preventing injuries and increasing balance abilities of their athletes. Future studies should focus on different sport activities; different balance tests and special population (person with previous injuries, Childs, elder people) for evaluating balance performance among individuals.

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APPENDIX A: ETHICAL APPROVAL

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

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12 Şubat 2013

Gönderilen: Yrd.Doç.Dr.Sadettin Kirazcı
Beden Eğitimi ve Spor Bölümü

Gönderen : Prof. Dr. Canan Özgen
IAK Başkan Yardımcısı

İlgi : Etik Onayı

Danışmanlığını yapmış olduğunuz Beden Eğitimi ve Spor Bölümü Yüksek Lisans öğrencisi Bahman Golshaei'nin "Futbolcular ve Sedanter Öğrencilerde Dinamik ve Statik Denge ve Diz Proprioseptif Karşılaştırması" isimli araştırması "İnsan Araştırmaları Komitesi" tarafından uygun görülerek gerekli onay verilmiştir.

Bilgilerinize saygılarımla sunarım.

Etik Komite Onayı

Uygundur

12/02/2013

Prof.Dr. Canan ÖZGEN
Uygulamalı Etik Araştırma Merkezi
(UEAM) Başkanı
ODTÜ 06531 ANKARA

APPENDIX B: TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ■

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı: GOLSHAEI

Adı : BAHMAN

Bölümü: Beden Eğitimi ve Spor - Physical Education and Sports

TEZİN ADI (İngilizce): EVALUATION OF DYNAMIC AND STATIC BALANCE BETWEEN SOCCER PLAYERS AND SEDENTARY STUDENTS

TEZİN TÜRÜ: Yüksek Lisans ■ Doktora ☐

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir ☐

2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir. ☐

3. Tezimden bir (1) yıl süreyle fotokopi alınamaz. ☐

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: