DETERMINE THE EFFECTS OF LONG TERM PLAYING SOCCER ON THE DEGENERATION OF LUMBAR SPINE

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ABSTRACT

DETERMINE THE EFFECTS OF LONG TERM PLAYING SOCCER ON THE DEGENERATION OF LUMBAR SPINE

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The main purpose of this study was to determine whether playing soccer at high intensity training for a long period causes degeneration of the lumbar spine or not. This degeneration may occur without any symptoms or low back pain. Results of the present study were discussed in the framework of lumbar disc degeneration, trunk strength, lumbar and hip bone mineral density, trunk flexibility, activity MET scores for active and veteran soccer groups. There have been four subject groups in this study (15 active soccer players, 15 sedentary participants, 14 veteran soccer players, 13 sedentary participants). The BMD was measured in anterior-posterior view with a second-generation dual energy X-ray absorptiometry (DEXA) device. Isokinetic trunk strength data were recorded with the Biodex System Dynamometer (Biobex Medical Inc, Shirly, NY) at the 60º/sec and 120º/sec. Plain lateral radiographs were taken. The presence of degenerative changes of each lumbar vertebra was determined by using the Kellgren and Lowrence Score. A modified Schober test was used to measure lumbar flexion. Findings of the study demonstrated that veteran soccer players displayed greater lumbar disc degeneration than other groups. Moreover, active soccer group had more BMD than other groups, but the veteran group's BMD results were not different while comparing the control participants. Isokinetic test findings of the current study, trunk extension strength at 60/sec◦ was significantly higher in active 1st group players than 2nd group participants, but there were no significant differences between the 1st group and 2nd group in terms of trunk flexion strength and agonist/antagonist ratio at 60/sec◦. In conclusion, Findings of the study support the main hypothesis that playing soccer at high intensity training at a long period of time may cause lumbar spine degeneration. Degeneration may occur without low back symptoms. Moreover, results supported the idea that Soccer can be accepted an impact loading sport that are to keep or accelerate bone mineral density. At last, having abnormal trunk extension strength while playing actively may cause lumbar disc degeneration on the spine at later years. A similar study should be carried out with a larger number of subjects, and longitudinal studies should be designed to examine the factors that effect the degeneration on the lumbar spine.

Keywords: Lumbar Disc Degeneration, Bone Mineral Density, Trunk muscle Strength, Veteran and Active Soccer Player

ÖZ

UZUN SÜRE FUTBOL OYNAMANIN BEL OMURLARINDAKİ DEJENERASYONA ETKİSİ

Altunsöz, Ömür Serdal

Yüksek Lisans, Beden Eğitimi ve Spor Bölümü

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Bu çalışmanın asıl amacı, uzun süre yoğun antrenmanlara katılarak futbol oynamanın bel omurları üzerinde dejenerasyona sebep olup olmadığını belirlemektir. Bu dejenerasyon herhangi bir belirti veya belde ağrı olmadan da gerçekleşebilir. Çalışmadaki sonuçlar, veteran ve aktif futbol oyuncularının bel omurlarındaki dejenerasyon, gövde kuvveti, bel ve kalça kemik yoğunluğu ve egzersiz geçmişleri ölçülerek değerlendirilmiştir. Bu çalışmada dört adet denek gurubu vardır (15 aktif futbol oyuncusu, 15 spor yapmayan katılımcı, 14 veteran futbol oyuncusu, 13 spor yapmayan katılımcı). Bel omurları ve sağ ve sol femur başı kemik yoğunluk ölçümleri için DEXA aleti kullanılmıştır. Gövde kas kuvveti ölçümleri Biodex Sistem izokinetik dinamometresi ile 60 derece/sn. ve 120 derece/sn. açısal hızla ölçülmüştür. Yan yüzey röntgenleri çekilmiş ve Kellgren ve Lowrence puanlaması kullanılarak bel omurlarındaki dejenerasyon değerlendirilmiştir. Bel esneklik ölçümü modifiye edilmiş Schober test aracılığıyla yapılmıştır. Sonuçlar doğrultusunda veteran futbolcularda bel omurlarında diğer gruplardan daha fazla dejenerasyona rastlanmıştır. Buna ek olarak, aktif futbolcularda kemik yoğunluğunun diğer gruplara oranla daha fazla olduğu belirlenmiş, fakat veteran oyuncuların kemik yoğunluğuna bakıldığında kontrol gurubunun sonuçlarından farklı olmadığı gözlenmiştir. Bu çalışmadaki izokinetik gövde kuvveti sonuçlarına göre aktif sporcuların 60 derece/sn. ekstansiyon kuvvetleri kontrol gurubundan daha fazlayken 60 derece/sn. deki fleksiyon kuvvetinde ve agonist/antagonist oranında farklılık bulunmamıştır. Sonuç olarak, bu çalışmadaki bulgular, uzun süre yoğun antrenmanlara katılarak futbol oynamanın bel omurları üzerinde dejenerasyona etkisi olabileceği hipotezini doğrular. Bu dejenerasyon herhangi bir belirti veya ağrı olmadan meydana gelebilir. Bu çalışmada ulaşılan sonuçlar futbolun yüksek yüklenmeler gerektirdiği ve bu yüklenmeler sonucunda kemik yoğunluğunun korunduğu ve arttırıldığı görüşünü destekler niteliktedir. Son olarak, veteran gurubunda diğer gruplardan daha fazla oluşan bel omurlarındaki dejenerasyonun nedeni aktif gruptaki 60 derece/sn. deki ekstansiyon kuvvetinin diğer gruplardan fazla olması olabilir. Bel dejenerasyonunu etkileyen faktörleri belirlemek için denek sayısını arttırarak aynı denekler üzerinde uzun süreli çalışmalar planlanmasında yarar vardır.

Anahtar Kelimeler: Bel Omurlarında Dejenerasyon, Kemik Mineral Yoğunluğu, Gövde Kas Kuvveti, Veteran ve Aktif Futbol Oyuncuları.

To My Family

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CHAPTER I

INTRODUCTION

Soccer is a popular, complex strategically game of physical and mental challenges. At least 200 million licensed players participate in soccer and 20 million soccer games are arranged each year in the world (Witvrouw, 2003). Skilled movement must be executed under the situation of match related conditions of restricted space, limited time, physical and mental fatigue and opposing players. Soccer players have to possess moderate to high aerobic and anaerobic power, have good agility and joint flexibility, and be capable of generating high torques during fast movements (Reilly, Bangsbo, Franks, 2000).

Due to the nature of the game, acute injuries are common. According to the reports of epidemiologic investigations (Giza, Fuller, Junge and Dvorak 2003; Dvorak & Junge, 2000), the incidence of injuries during male's elite soccer matches is between 13 and 35 injuries per 1000 player/hours of competition. Furthermore, another study (Chomiak, Junge, Peterson, 2000) shows that the estimation of incidence of injury per 1000 playing hours is 10 to 15 injuries. The highest rate of soccer injury (68% to 88%) occurs in the lower extremities (Heidt, Sweetermen, Carlonas, Traub & Tekulve, 2000); beside this, approximately 25% of soccer injuries are musculoskeletal lesions mainly located in the thigh and the groin (Tyler, Nicholas, Campbell, & McHugh 2001).

Although acute soccer injuries are closely investigated; chronic injuries are rarely studied. Furthermore, little is known on lumbar spine degeneration (LSD) resulting from playing soccer. One study (Hellström, Jacobsson, Sward & Peterson, 1990) focused on radiological abnormalities of spine in sports including soccer. Raty et al., (1997) mentioned that team sports, such as soccer, may cause LSD; however, players do not suffer of back pain in general. Moreover, many asymptomatic individuals also demonstrate degenerative disc disease on radiological image (Boden, 1990). According to Buschbacher (1995), deterioration on vertebral column naturally occurs with aging. However, Christopher and Bono (2004) have also indicated that radiological findings of broad disc degeneration are at higher level in athletes than in nonathletes. It is assumed that heavy physical activity may lead to degenerative changes in the lumbar spine.

The physiological definition of soccer is high- intensity movements (Lees & Nolan, 1998; Hoy, Lindblad & Terkelsen, 1992) that necessitate maximum speed and the functional activities include accelerations, decelerations, jumping, cutting, pivoting, turning and kicking the ball while playing (Lees & Nolan, 1998). Soccer is characterized by high intensity, intermittent, noncontinuous exercise (Reilly, Bangsbo, & Franks 2000), and peak physical condition is required. To gain peak physical capacity high intensity training including weight lifting and running for a long periods is essential. Such high intensity and long duration training can cause LSD. Moreover, the result of sharp and forceful back movements which are necessity for soccer can cause acute and chronic injuries at the lumbar spine. Videman et al., (1995) presented a higher rate of degenerative changes in the upper lumbar spine due to training. However, soccer players suffer from their lower lumbar discs. Christopher & Bono, (2004) stated that participate the sports which requires high intensity and long duration training can cause LSD.

Weight training for muscular development and running that multidirectionally load the spine are used for general fitness purposes (Leatt, Reilly, Troup, 1986). Weight training is often arranged as a circuit with wait lifting exercises and this type of activity has been shown to cause degenerative findings at the lumbar spine (Christopher & Bono, 2004). Tyrell, Reilly and Troup (1985), declared that reductions in spine stature of 6.9 mm and 14.5 mm which causes lumbar spine degeneration were reported while a dead lift of 10 kg and 40 kg lifted repeatedly for 20 min. When compare dynamic and static loading, greater losses in stature were found during the dynamic loading (Leatt et al., 1986) which is common in soccer.

Other factor that causes LSD is running for a long duration. Woolf and Glaser (2004) mentioned that back problems are more often chronic or episodic instead of acute injuries among runners. While running the force produced at the point of hill strike is usually in excess of 2000 N (Lees and McCullagh, 1984), and as the force indirectly load the spine, suggestive spinal injuries may be implicated. The quantity of intra-abdominal pressure changes increasing the speed of running bear out this (Grillner, Nilsson, & Thorstensson, 1978) intra-abdominal loading pressure is related to lumbosacral loading. There are a lot of factors that influence the intensity of these effects, such as the total distance covered and the experience of the runner. Soccer players are in the order of 11 km for the field players (Calbet, Dorado, Dıaz-Herrera, & Rodrıguez, 2001) that may create a pressure on the spine causing LSD. Videman et al. (1995) found that the degree of disc degeneration and bulging in the L4-S1 region could be seen at the soccer players.

The spinal column provides the main support for your body, allowing you to stand upright, bend and twist, while protecting the spinal cord from injury. There is an intervening soft tissue disc that connects the main bodies of the adjacent vertebrae located between the vertebrae except the first two. Vertebral bodies are formed as a ring that spinous process protects posteriorly and the transverse processes protect it from the each side. Muscle and the ligamentous attach the ring form these processes. Within the ring, or the spinal canal takes place spinal cord and facet joint is a small stabilizing joint located between and behind adjacent vertebrae (Buschbacher, 1995).

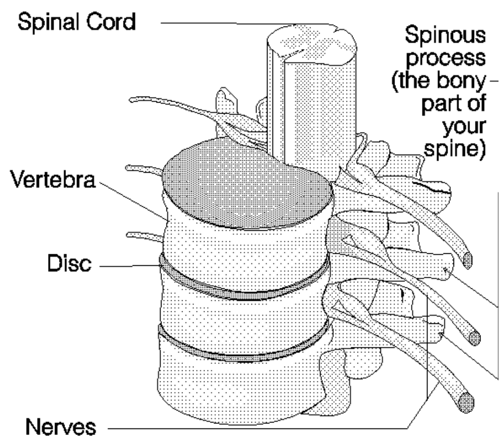

Figure 1.1. Cross Section of Spinal Cord

To support the upper body by transmitting compressive and shearing forces to the lower body is one of the crucial mechanical functions of the lumbar spine during the performance of everyday activities (Cholewicki & McGill, 1996). Niosi and Oxland (2004) emphasized that first; the spine must support the weight and resulting bending moments of the head and upper torso and transfer the load to the pelvis. The spine must allow motion between the torso and pelvis. Second, the spine must protect the spinal cord and nerve roots from damage. Disc degeneration directly affects the first two roles of the spine. Because these fundamental roles are intertwined, LSD also indirectly affects the capability of the spine to protect the neural elements.

Low back pain (LBP) is most commonly caused by muscle strain associated with heavy physical work, lifting or forceful movement, bending or twisting, awkward positions, or standing in one position too long. Any of these movements can exacerbate a prior or existing back disorder (Fessler, 2002). LBP is either acute or chronic. Acute LBP may begin suddenly with intense pain usually lasting less than 3 months. Chronic pain is persistent long-term pain, sometimes lasting throughout life. Even chronic pain may present episodes of acute pain. Lumbar spine degeneration cause chronic pain (Fessler, 2002). Mechanism of the disc degenerative changes may enclose disc degeneration, facet joint osteoarthritis, vertebral body degeneration, and ligament degeneration (Atsushi, Tae-Hong, Howard, Nobuhiro, Chang-Hoon, Gunnar, Victor, 2000). The most common lumbar degeneration occur within the intervertebral disc and, more specifically, within the nucleus pulposus (Buckwalter, 1995). Disc space narrowing, formation of ostephytes and end plate sclerosis which are the result of the disc degeneration are determined by the help of the radiological definition (Niosi et al. 2004).

Generally, the risk factors of LSD can be categorized as two groups; the first one is intrinsic (person-related), and the later one is extrinsic (environment-related) risk factors (Chomiak et al., 2000). In this study, intrinsic risk factors of LSD; lack of spinal flexibility (SF), TMS and the bone mineral density (BMD) are examined.

SF has been conjectured to be a crucial part of spinal health. SF measures have been offered for use in preplacement physical examinations (Michele et al., 1987). It is found that while comparing the adults who had been engaged in leisure physical activity for more than five years with sedentary individuals, they slightly had less lumbar mobility which is dependent on spine abnormalities. (Stokes, Wilder, & Frymoyer, 1981; Burton & Tillotson, 1991) Beside, the relations between spinal range of motion and LSD have been investigated widely. Raty et al. (1997) mentioned that soccer or weight lifting imposed greater compression or torsional forces on the spine that reduced spinal mobility. This was directly related with heavy work and disc height narrowing. Furthermore, it would seem that exercise, such as in soccer or weight lifting lead to a decline in lumbar mobility. In the study by Niosi and Oxland (2004), SF is changed with the effects of the geometry consisting of the disc height and end plate cross-sectional area. The alterations in spine geometry that result from degeneration should decrease the flexion - extension spinal mobility; and the material property changes should increase the spinal axial rotation.

Not only SF but decrease in trunk muscle strength (TMS) is the other intrinsic factor that can cause the LSD. Insufficient TMS and endurance combined with decrease of mobility of the spine are among that can lead to low back pain risk factors that can cause low back trouble (Hodges & Richardson 1996). Pope et al. (1985) have shown that in the males with low-back complaints a decrease in flexor and extensor isometric strength was determined. TMS, balance between agonist and antagonist muscles and coordination are proposed to present low back pain (Hodges & Richardson, 1996). Choleric and McGill (1996) reported that muscle co-activation is essential to equalize the healthy spine around a neutral spine position.

The last intrinsic factors of LSD are BMD. It is widely believed that keeping and developing BMD can be possible by physical activity (Uzunca, Birtane, Durmus-Altun, and Ustun 2005). A lifetime of increased physical activity causes rising in BMD (Andrea et al., 1988). Activity MET score measurement is an important key to understand the effects of doing physical activity at a long duration on BMD. In spite of not having sufficient data on males, high intensity physical activity and sufficient calcium intake have been shown to improve BMD in females (Molgard, Thomsen, Michaelsen, 2001). On the other hand, the type of sport is determinant in developing and keeping BMD (Woolf & Glaser, 2004). Ruffing et al., (2006) found that higher level of physical activity were directly associated with higher BMD. Alfredson et al. (1996) mentioned that the muscle strain producing impact bone loading instead of muscle strength is the dominant factor that increases BMD. Uzunca et al. (2005) revealed that athletes participating impact loading sports have higher BMD in loaded skeletal regions. According to Södermen, et al., (2000), soccer is an impact loading sport affecting BMD positively and taking the role on rising weight in specific skeletal regions. Harada et al. (1997) reported that there was a negative correlation between BMD and LSD; but, a positive correlation between BMD disc bulging. This correlation is thought to be independent of age, considering that percentage lumbar BMD and percentage total-body BMD also showed similar results.

Acute injuries to the lumbar spine in soccer have been closely investigated since they immediately intensely draw attention. However, chronic injuries of the lumbar spine and their relation to SF, TMS, BMD, activity MET score and LSD are investigated sparsely their affects are experienced at long term. In this study, LSD resulting from chronic injuries will playing soccer for long duration is examined and relations between LSD and SF, TMS, BMD, activity MET score were investigated.

1.1 Hypotheses

1. There will be significant differences between active soccer players at the age of 20-25 with at least five years of active carrier and age matched sedentary controls in respect to a) lumbar spine degeneration, b) spinal flexibility, c) trunk muscle strength, d) bone mineral density and e) activity MET scores.

2. There will be significant differences between veteran soccer players at the age of 30-35 with at least ten years of active carrier and age matched sedentary controls in respect to a) lumbar spine degeneration, b) spinal flexibility, c) trunk muscle strength, d) bone mineral density and e) activity MET scores.

3. There will be significant differences between active soccer players at the age of 20-25 with at least five years of active carrier; and veteran soccer players at the age of 30-35 and at least ten years of active carrier in respect to a) lumbar

spine degeneration, b) spinal flexibility, c) trunk muscle strength, d) bone mineral density and e) activity MET scores.

4. a) There will be negative relationship between lumbar spine degeneration and spinal flexibility & trunk muscle strength within groups.

b) There will be positive relationship between lumbar spine degeneration and activity MET scores & bone mineral density within groups.

1.2 Purposes of the Study

1. Compare active soccer players at the age of 20-25 with at least five years of active carrier and age matched control subjects in respect to a) lumbar spine degeneration, b) spinal flexibility, c) trunk muscle strength, d) bone mineral density and e) activity MET scores.

2. Compare veteran soccer players at the age of 30-35 with at least ten years of active carrier and age matched control subjects in respect to a) lumbar spine degeneration, b) spinal flexibility, c) trunk muscle strength, d) bone mineral density and e) activity MET scores.

3. Compare active soccer players at the age of 20-25 with at least five years of active carrier; and veteran soccer players at the age of 30-35 and at least ten years of active carrier in respect to a) lumbar spine degeneration, b) spinal flexibility, c) trunk muscle strength, d) bone mineral density and e) activity MET scores.

4. a) To establish a negative relationship between lumbar spine degeneration and spinal flexibility & trunk muscle strength within groups.

b) To establish a positive relationship between lumbar spine degeneration and activity MET scores & bone mineral density within groups.

1.3 Limitations of the study

Level of disc degeneration may differ between individuals. The number of subjects studied was limited to decide a cut off value describing clearly the causes of degeneration.

In this study, only male soccer players were investigated. Furthermore; since there were limited number of subjects, a sub set of evaluation based on their playing position in the field was not conducted.

Should this study be carried out with the same subjects in a long period of time, the results may have been more explicit.

1.4 Delimitations of the study

The study is delimited to soccer player's voluntarily participating in this study that played at the first and the second amateur league in Ankara. The generalizability of the study of these results is impacted by the delimitation that the study only focuses on amateur but not professional soccer players.

1.5. Significance of the Study

Soccer players are subjected to considerable mechanical forces due to rapid and forceful movements when performing their sports. They have to participate in regular extensive and complex training programs containing weight lifting, long runs, sprint and competitions that needs jumping, quick movement and changing directions. This continuous training and competition programs may cause LSD.

Active and veteran soccer players LSD was compared to age matched controls. Radiological degenerative changes were evaluated and used relations with trunk strength, BMD, spinal flexibility and anthropometric characteristics were evaluated.

CHAPTER II

REVIEW OF LITERATURE

Soccer players must have moderate to high aerobic and anaerobic power, have good agility, joint flexibility and muscular development, and be capable of generating high torques during fast movements (Reilly et al., 2000) to meet the sophisticated physical needs of soccer high intensity, intermittent, noncontinuos exercise (Lees & Nolan, 1998) causes lumbar disc degeneration. Christopher & Bono (2004) mentioned that to participate any sports appears to be a risk factor for the development of disc degeneration that seems to be affected by the type and intensity of the sport.

In this study the aim of the Kartal and his colleagues (2004) were to assess the early degenerative changes in amateur active and veteran soccer players in a cross-sectional descriptive study using biomechanical, radiological, and magnetic resonance measures. Radiological changes and degeneration of the cervical spine have been previously described in soccer players. The onset of such changes was 10-20 years earlier than that of the normal population. The subjects were active (<30 years; *n*=15) and veteran (>30 years; *n*=15) male amateur soccer players, and their age-matched controls (*n*=13 and *n*=15). Biomechanical measurements were made on a cervical dynamometer. Dynamic radiological and magnetic resonance findings were also obtained and evaluated. The normalized mean extension moment was higher in the active soccer players, but the mean range of motion was lower. Degenerative changes were prominent in veteran players, and the sagittal diameter of their spinal canal at C2 to C6 was lower when compared to active players and controls. Magnetic resonance findings of degeneration were more prominent in soccer players when compared to their age-matched controls. A tendency towards early degenerative changes exists in soccer players most probably due to high- and/or low-impact recurrent trauma to the cervical spine caused by heading the ball.

Stokes, Wilder, Frymoyer, and Pope, (1981) stated that abnormalities of intervertebral joint motion including hypermobility, reduced mobility, torsional abnormality, and displacement of the center of rotation have been associated with degenerative change. However, measurement of these signs in plane X-ray films is handicapped by the three-dimensional motion and geometry of the spine. This study aimed to relate three-dimensional motion of the joints to their pathological state. We have used biplanar radiography to measure intervertebral motion during voluntary movements by patients with low back pain. Primary (or intentional) and coupled motions were measured by a refined technique, along with disc shear and facet joint motion. Abnormalities were found, especially in the "coupled" motions which were related to narrowed disc space, and to proximity to previous fusions. There was asymmetry of motion specific to joints with herniated nucleus pulposus.

Videman, Sarna, Battie, Koskinen, Gill, Paananen, and Gibbons L (1995) studied that the long-term effects of exercise on back-related outcomes, back pain, sciatica, back-related hospitalizations, pensions, and magnetic resonance imaging findings were studied among former elite athletes. Exercise and sports participation have become increasingly popular, as have recommendations of exercises for back problems, but little is known about their long-term effects. Questionnaires were returned by 937 former elite athletes and 620 control subjects (83% response rate). Identification codes allowed record linkage to hospital discharge and pension registers. Magnetic resonance images were obtained of selected subgroups with contrasting physical loading patterns. Odds ratios for back pain were lower among athletes than among control subjects, with significant differences in endurance, sprinting and game sports, and wrestling and boxing. No differences in the occurrence of sciatica or in back-related pensions and hospitalizations were seen. When comparing lumbar magnetic resonance images of 24 runners, 26 soccer players, 19 weight lifters, and 25 shooters, disc degeneration and bulging were most common among weight lifters; soccer players had similar changes in the L4-S1 discs. No significant differences were seen in the magnetic resonance images of runners and shooters. Maximal weight lifting was associated with greater degeneration throughout the entire lumbar spine, and soccer with degeneration in the lower lumbar region. No signs of accelerated disc degeneration were found in competitive runners. However, back pain was less common among athletes than control subjects and there were no significant differences in hospitalizations or pensions. No benefits were shown for vigorous exercise compared with lighter exercise with respect to back findings.

In this long-term follow-up study, Lundin et al., (2000) investigated the previous radiological study of the spine with clinical correlation. From 1996 to 1999, back pain and radiological changes in the thoraco-lumbar spine were investigated in 134 former top athletes, representing wrestling, gymnastics, soccer and tennis (age 27–39 years) and a group of 28 non-athletes of comparable age. Despite significantly more radiological abnormalities among the athletes, they did not report higher frequency of back pain than the non-athletes. A decrease in disc height or new disc height reduction in one or more of the intervertebral discs between the two examinations correlated significantly with back pain at follow-up.

Schmitt and his friends (2005) investigated the bone mineral density (BMD) and degenerative changes in the lumbar spine in male former elite athletes participating in different track and field disciplines and to determine the influence of body composition and degenerative changes on BMD. One hundred and fifty-nine former male elite athletes (40 throwers, 97 jumpers, 22 endurance athletes) were studied. Anthropometric (age, body mass index [BMI]) and sport-specific data (personal best, intensity, duration, and time since termination of competitive sports career as well as current sporting activity) were collected. Degenerative changes of the lumbar spine in lateral view were evaluated by using the Kellgren and Lawrence Score. Bone mineral density of the lumbar spine was measured in an anterior-posterior view with dual energy X-ray absorptiometry (DEXA, T-score). Throwers had a higher body mass index than jumpers and endurance athletes. Throwers and jumpers had higher BMD (T-LWS) than endurance athletes. Bivariate analysis revealed a negative correlation of BMD (T-score) with age and a positive correlation with BMD and Kellgren score ($p<0.05$). Even after multiple adjustment for confounders lumbar spine BMD is significantly higher in throwers, pole vaulters, and long- and triple jumpers than in marathon athletes. Different types of mechanical loading caused by sporting activities seem to influence the BMD of the lumbar spine, even if different body constitutions (i.e. BMI) and age, training history, and degenerative changes in the lumbar spine of former throwers, jumpers, and endurance athletes are taken into consideration.

Hellström and his co-workers (1990) investigated the occurrence of radiological abnormalities of the lower thoracic and the lumbar spine in top athletes in four different sports, as a compared with a reference group of non-athletes. A radiological study of the thoraco-lumbar spine was performed in 143 (117 male and 26 female) athletes (wrestlers, gymnasts, soccer players and tennis players), aged 14 to 25 years and 30 male non-athletes, aged 19 to 25 years. Film interpretation was made after mixing the films from all groups and without knowledge of the individual's identity. Various types of radiological abnormalities occurred in both athletes and non-athletes but were more common among athletes, especially male gymnasts and wrestlers. Abnormalities of the vertebral ring apophysis occurred exclusively in athletes. Combinations of different types of abnormalities were most common in male gymnasts and wrestlers.

The purpose of Boden et al. (1990) was to determine the prevalence of positive findings on magnetic resonance images of the lumbar spine in asymptomatic subjects. Magnetic resonance imaging was performed on sixty-seven individuals who had never had low-back pain, sciatica, or neurogenic claudication. The scans were interpreted independently by three neuro-radiologists who had no knowledge about the presence or absence of clinical symptoms in the subjects. About one-third of the subjects were found to have a substantial abnormality. Of those who were less than sixty years old, 20 per cent had a herniated nucleus pulposus and one had spinal stenosis. In the group that was sixty years old or older, the findings were abnormal on about 57 per cent of the scans: 36 per cent of the subjects had a herniated nucleus pulposus and 21 per cent had spinal stenosis. There was degeneration or bulging of a disc at at least one lumbar level in 35 per cent of the subjects between twenty and thirty-nine years old and in all but one of the sixty to eighty-year-old subjects. In view of these findings in asymptomatic subjects, we concluded that abnormalities on magnetic resonance images must be strictly correlated with age and any clinical signs and symptoms before operative treatment is contemplated.

Leatt et al. (1986) have reported that spinal shrinkage was used as an indicant of loading on the spine in circuit weight-training and running regimes. The loss of stature during two sets of a circuit of weight-training (n = 10), a 6 km run by novices (n = 9) and a 25 km run by trained runners (n = 7) was assessed in male subjects. Shrinkage was not significantly different between the weight-training regime and the 6 km run by novices, mean losses being 5.4 and 3.25 mm respectively. The rate of height loss in the experienced runners was 2.35 mm over 6 km run at 12.2 km.h-1, representing 0.4 mm.km-1 over the 6 km run, this shrinkage rate being continued over the last 19 km run at 14.7 km.h-1. The loss of height could not be predicted from a set of covariates. The magnitude of the circadian variation, mean 14.4 mm, exceeded the change in height during the 25 km run. The diurnal variation conformed to a cosine function, though a better fit was obtained with a power function equation. A marked diurnal pattern was also observed in lumbar extension. Though reversal of spinal shrinkage was observed during a night's sleep, no significant recovery occurred during a 20 min resting period immediately following the exercise regimes. These results have implications for the warm-up and timing of exercise regimes that impose significant loading on the spine.

In the year 1996, Hodges et al. investigated the temporal sequence of trunk muscle activity associated with arm movement, and to determine if dysfunction of this parameter was present in patients with low back pain. The contribution of transversus abdominis to spinal stabilization was evaluated indirectly in people with and without low back pain using an experimental model identifying the coordination of trunk muscles in response to disturbances to the spine produced by arm movement. Few studies have evaluated the motor control of trunk muscles or the potential for dysfunction of this system in patients with low back pain. Evaluation of the response of trunk muscles to limb movement provides a suitable model to evaluate this system. Recent evidence indicates that this evaluation should include transversus abdominis. While standing, 15 patients with low back pain and 15 matched control subjects performed rapid shoulder flexion, abduction, and extension in response to a visual stimulus. Electromyographic activity of the abdominal muscles, lumbar multifidus, and the surface electrodes. Movement in each direction resulted in contraction of trunk muscles before or shortly after the deltoid in control subjects. The transversus abdominis was invariably the first muscle active and was not influenced by movement direction, supporting the hypothesized role of this muscle in spinal stiffness generation. Contraction of transversus abdominis was significantly delayed in patients with low back pain with all movements. Isolated differences were noted in the other muscles. The delayed onset of contraction of transversus abdominis indicates a deficit of motor control and is hypothesized to result in inefficient muscular stabilization of the spine.

Batti'e et al. (1987) conducted an investigation to examine the spinal flexibility of a large, adult population and to study the effects of other individual physical characteristics on spinal range of motion. The study group consisted of 3,020 blue collar employees (2,350 men and 670 women) who underwent a physical examination that included assessments of standing and sitting height, weight, shoulder flexibility, and spinal flexibility in the sagittal and frontal planes. Flexibility measures were correlated positively to one another; however, lumbosacral flexion measurements assessed by the modified Schober method correlated to the other flexibility measurements to a much lesser degree. Age, sex, and height affected ROM, as did obesity and the ratio of standing height to sitting height. The study findings indicate that spinal ROM covers a wide spectrum of values and is affected by many individual factors. Any attempts to determine what is normal, excessive, or diminished must take into account variations caused by age, sex, and other physical attributes.

Harada and his colleagues (1997) examined quantitatively the correlation between intervertebral disc degeneration and bone mass. In results of previous studies, an inverse correlation between osteoporosis and spondylosis has been reported. In these studies, only radiographic findings were used to evaluate spondylosis; changes in the intervertebral disc itself were not investigated. To determine bone mass, total-body bone mineral density, lumbar bone mineral density, and age-matched control values of bone mineral density were measured by dual-energy X-ray absorptiometry in all cases. To evaluate intervertebral disc degeneration, disc area and disc bulge ratio (calculated by measuring the areas protruding from lines connecting the middle points of the anterior and posterior borders of the vertebral bodies) were obtained from four discs, using magnetic resonance images of the lumbar spine. The correlation between bone mass data and disc area data was analyzed. Bone mineral density showed a significant decrease with increasing age. Disc area and disc bulge ratio had no relation to age. There was a negative correlation between total-body bone mineral density, lumbar bone mineral density, and age-matched control values versus disc area, and a positive correlation between all bone mineral density data and the disc bulge ratio. According to the results of the analysis by disc morphology and bone mass, especially total body bone mineral density, bone mass has an inverse correlation to intervertebral disc degeneration i.e., reduction and disc bulge which is important when considering degenerative spinal diseases and osteoporosis.

In this cross-sectional study, Alfredson et al. (1996) investigated bone mass in female athletes participating in an impact-loading sport (soccer), and evaluated whether any changes in bone mass could be related to the type of weight-bearing loading and muscle strength. The group of soccer players consisted of 16 second-division female players (age 20.9 +/- 2.2 years) training for about 6 hours/week. The reference group consisted of 13 nonactive females (age 25.0 +/- 2.4 years) not participating in any kind of regular or organized sport activity. The groups were matched according to weight and height. Areal bone mineral density (BMD) was measured in total body, head, lumbar spine, femoral neck, Ward's triangle, trochanter, the whole femur and humerus, and in specific sites in femur diaphysis, distal femur, proximal tibia, and tibia diaphysis using dual X-ray absorptiometry. Isokinetic concentric peak torque of the quadriceps and hamstring muscles was measured using an isokinetic dynamometer. The soccer players had significantly ($P < 0.05$-0.01) higher BMD in the lumbar spine (10.7%), femoral neck (13.7%), and Ward’s triangle (19.6%), nondominant femur and humerus (8.2 and 8.0%, respectively), distal femur (12.6%), and proximal tibia (12.0%) compared with the nonactive women. There was no significant difference in muscle strength of the thigh between the two groups. In the nonactive group, muscle strength in the quadriceps and especially hamstrings, was correlated to BMD of the adjacent bones (whole femur, hip sites) and also to distant sites (humerus). In the soccer group, there were no correlations between muscle strength and BMD of the adjacent and distant bones. Soccer playing and training appears to have a beneficial effect on bone mass in young females, and it seems that there is a site-specific skeletal response to the type of loading subjected to each BMD site. Muscle strength in the thigh is not related to bone mass in female soccer players.

In another cross-sectional study, bone mass and muscle strength of the thigh were investigated in 51 female soccer players, age 16.3 +/- 0. 3 years, who had been playing soccer for 8.1 +/- 2.1 years and were at the time of the study in soccer training for 5.0 +/- 1.7 hours/week by Söderman et al. (2000). They were compared with 41 nonactive females, age 16.2 +/- 1.3 years. The groups were matched according to age, weight, and height. Areal bone mineral density (BMD) was measured of the total body, head, lumbar spine, femoral neck, Ward's triangle, and the greater trochanter using dual energy X-ray absorptiometry (DXA). Isokinetic muscle strength of the quadriceps and hamstrings muscles was measured using an isokinetic dynamometer. Compared with the nonactives, the soccer players had significantly higher BMD of the total body (2.7%), lumbar spine (6.1%), the dominant and nondominant hip (all sites). The largest differences were found in the greater trochanter on both sides (dominant, 16.5%, nondominant, 14.8%). The soccer players had significantly higher concentric and eccentric peak torque of the thigh muscles. In the soccer group, there was only a positive association between thigh muscle strength and BMD of the adjacent hip, and in the nonactive group there were several positive associations between muscle strength and BMD. However, when adjusting for the variation in weight and height all these associations became nonsignificant. Using multiple linear regression, the type of activity (soccer player, nonactive) independently predicted BMD of all dominant hip sites (beta = 0.32-0.48, $P < 0.01$). No other variable was found to independently predict BMD of any site. In the younger subjects (</=16 years) only BMD of the greater trochanter was significantly higher in the soccer players. In the older subjects (>16 years) the soccer players had significantly higher BMD in all measured sites except for the nonweight-bearing head. The differences in muscle strength between soccer players and nonactives were already seen in the young age group. In conclusion, girls who train and play soccer in adolescence have a higher bone mass in the hip and lumbar spine, and a higher muscle strength of the thigh compared with nonactive controls, indicating a site-specific skeletal response of weight-bearing and impact-loadng acting on the skeleton. The differences in bone mass were already apparent in early adolescence, but became more pronounced in late adolescence, probably explained by a longer exposure to soccer training with time. Results also indicated that muscle strength in itself might not be of decisive importance for bone mass in the hip of adolescent females.

Uzunca et al. (2005) in their study compared bone mineral density at different skeletal regions in a group of former professional football players and in normal control subjects and evaluated the effect of demographic factors and time after active career on BMD. Physical exercise is an important factor in the acceleration and maintenance of bone mineral density (BMD). Football is an impact loading sport and some studies demonstrate its site specific, bone mass increasing effect. Twenty four former football players <70 years old who had retired from professional football at least 10 years previously and 25 non-athletic controls were recruited. The demographic characteristics, activity levels, and dietary habits of all subjects and the chronological history of the footballers' professional careers were noted. BMD was measured by DEXA at the calcaneus and distal tibia and at the lumbar spine, proximal femur, and distal and proximal radius, and compared between groups. Stepwise multiple linear regression analysis was used to determine the probable predictors of BMD in former football players. In former players BMD values were found to be significantly higher at the lumbar spine, femur neck, femur trochanter, distal tibia, and calcaneus, but not at Ward's triangle (femur) or the distal and proximal radius regions compared with controls. Time after active career was the only independent predictor of BMD at the lumbar spine, proximal femur (neck, trochanter, and Ward's triangle), and distal tibia. Former footballers had higher BMD at weight loaded sites and time after active career seemed to be an important factor in determining BMD.

CHAPTER III

MATERIALS AND METHODS

The design of the study is crosssectional descriptive study. Measurement of the Isokinetic (TMS), BMD (Lumbar and Dual Femur), and LSD (Plain Lateral Radiographs) parameters were performed at the Medical Center of the Middle East Technical University.

3.1 Participants

The group of soccer players consists of 15 subjects between the age of 20-25 who were active players at least for 5 years in the first and second division amateur soccer teams. To be the control group of first group, 15 ages matched sedentary controls who have never participated in any kind of sport actively in general were selected. The group of veterans consists of 14 players between the age of 30-35 who played soccer at the first and second division amateur soccer teams for at least 10 years. To be the control group of veterans, 13 ages matched sedentary controls who have never participated in any kind of sport actively in general were selected. The subjects were all healthy males who had no history of back pain and any other serious injuries that caused them stop playing for a period of time. The control groups also didn't have a history of low back disorder or display any symptoms as the soccer groups, and they were selected on the basis of their age and physical activity history. Only those participants who had not taken part in any kind of regular physical activity, physically demanding work activity, or sport during their life were chosen. The exact nature of the studies' aim was explained to each voluntary subject and written consent was obtained.

Body height was measured standing to the nearest 0.5 cm using a measuring rod fixed to a wall. Body weight was taken with the subject dressed only underpants with the sensitive balance. The body mass index (BMI) defined as the ratio of body weight in kilograms to the square of the standing body height in meters (kg/sq m), was calculated. All the measurements and observations in this study were made by the author. All the examinations were performed in the afternoon.

Before the measurements of physical performance, the subjects warmed up on a bicycle ergometer for 5 minutes. They then performed 2 to 3 warm up contractions, and finally participated in the test. In all the physical performance tests, a neutral verbal command was given to each subject.

3.2 Activity Met Scores

Historical Leisure Activity Questionnaire, the participants' activity MET scores calculated. This questionnaire consisted of 39 different sports activity and provided the chooser to add other activities that did not have in. Each activity identified, quantifying the amount of time spent in that activity for each age/time period and intensity in which the individual performed the activity. Specifically for each age /time period in which the activity was performed: a) the number of years that the activity was performed in that age/time period is estimated b) the average number of months per year that the activity was performed during those years is determined and finally; c) the average numbers of hour per week (rounded to the nearest half hour) that the activity was performed during that age /time period was estimated.

3.3 Spinal flexibility measurement:

A modified Schober test was used to measure lumbar flexion. The test method required only a plastic tape measure and pen to make three markings on the skin overlaying the lumbosacral spine. With the subject standing erect, the first mark was placed at the lumbosacral junction as indicated by the dimples of Venus. A second mark was placed 5 cm below the lumbosacral junction; and the third, 10 cm above the junction. The subject then was asked to bend forward as far as possible. As through to touch the toes and the new distance between the marks two and three was measured. Lumbar flexion was expressed as the difference between this measurement and the initial distance of 15 cm.

3.4 Bone mineral density measurement:

The BMD was measured in anterior-posterior view with a second-generation dual energy X-ray absorptiometry (DEXA) device. Measurements of the proximal femur and the lumbar spine were performed with high-resolution array scans. Informed consent for the DEXA examination in addition to a routine conventional X-rays was obtained.

Figure 3.1. DEXA examination for “Lumbar Spine”

Figure 3.2. DEXA examination for “Proximal Femurs”

3.5 Trunk Muscle Strength

Isokinetic strength data were recorded with the Biodex System Dynomometer (Biobex Medical Inc, Shirly, NY) to examined parameters of peak torque, work, average torque, and average power. For torso flexion and extension testing, participants were positioned semi-standing on the seat in down position approximately 15° and 15° flexion in knee joint. The axis of rotation of the dynamometer resistance adaptor was adjusted with the ASIS. Torso straps, the clavicle pads on the torso straps, and lumbar pad were formed and applied firmly for maximum patient restraint and comfort. The participants’ pelvis and thighs were steadied with straps designed to minimize extraneous body movements and momentum (Figure 2). Subjects performed torso flexion and extension for 5repetitions at 60°/s. and 10 repetitions at 120°/s. with a ten-second rest between the testing speeds. The reliability of trunk flexion and extension isokinetic strength testing had been previously established with intraclass correlation coefficients (ICC) reported to be 0.89-0.95 ICC for the peak torque of trunk flexion and 0.80-0.92 ICC for the peak torque of trunk extension at the speed of and 90º/s.

Figure 3.3. The Biodex System Dynamometer

3.6 Radiological Measurement:

Plain lateral radiographs were taken. The presence of degenerative changes of each lumbar vertebra was determined by using the Kellgren and Lowrence Score.

Kellgren and Lowrence Score.

- Grade I: Minimal osteophytosis only
- Grade II: Definite osteophytosis with some sclerosis of anterior part of vertebral plates
- Grade III: Marked osteophytosis and sclerosis of vertebral plates with slight narrowing of disk space
- Grade IV: Large osteophytosis, marked sclerosis of vertebral plates and marked narrowing of disk space

All radiographs were independently assessed by three raters at two different times. The intra and inter-rater reliability were determined by the intra class coefficient (ICC). For the further statistical analysis, the mode (most frequent value) of the three rating was used. If there were three different values, the median value would be used.

3.7 Data Collection Procedures

Data were collected in the season of 2005-2006 years between September and June, in first and second division amateur team of Ankara. Before the data collections, necessary permission was obtained from team managers and the couches.

3.8 Data Analysis Procedures

Statistical Package for Social Sciences (SPSS) was used for statistical analyses. In a first step, one-way variance analysis (MANOVA) was performed to compare the results of the soccer players and controls, whereas the post-hoc test was used to define the variations between the groups.

The second step was to test the correlation between lumbar spine degeneration and spinal flexibility, bone mineral density, activity MET scores and trunk strength in amateur soccer players. Pearson coefficients were used for the correlation calculations.

CHAPTER IV

RESULTS

4.1 Subject Characteristics

In this study, there were four groups at two different age that were active and veteran soccer groups and also age match sedentary control groups. 15 of the subjects were active soccer players whose mean age were 2.5 ± 1.6 years and 15 of the subjects were sedentary control participants whose mean age were 22.6 ± 1.5 years (ranging from 20 to 25 years). 14 of the subjects were veteran soccer players whose mean age were 31.9 ± 2.4 years (ranging from 30 to 36 years) and 13 of the subjects were sedentary control participants whose mean age were 31 ± 1.7 years (ranging from 30 to 35 years). The mean body weight for active soccer players and sedentary participants were 73.3 ± 6.1 kg (ranging from 64 to 83 kg) and 70.5 ± 11.7 kg (ranging from 56 to 99 kg). The mean body weight for veteran soccer players and sedentary participants were 76 ± 12.3 kg (ranging from 58 to 102 kg) and 77.3 ± 13.2 kg (ranging from 58 to 105 kg), respectively. The mean height of the active soccer players was 175.7 ± 5.2 m (ranging from 1.67 to 1.87 m) and 175 ± 7.8 m (ranging from 1.62 to 1.91 m) for control participants of actives. The mean height of the veteran soccer players was 174.4 ± 4.1 m (ranging from 1.66 to 1.80 m) and 176.6 ± 5.8 m (ranging from 1.68 to 1.86 m) for control participants of veterans. The mean BMI of the active soccer players was 23.8 ± 1.5 (ranging from 21.5 to 26.7) and 23 ± 2.9 (ranging from 17.5 to 27.3) for control participants of actives. . The mean BMI of the veteran soccer players was 24.9 ± 3.6 (ranging from 20.8 to 33.2) and 24.7 ± 3.4 (ranging from 20.1 to 30.7) for control participants of veterans. The mean year of experience for active soccer players and veteran soccer players were 7.7 ± 1.9 years (ranging from 5 to 11 years) and 15.2 ± 3.7 years (ranging from 10 to 22 years). The data are presented in Table 4.1.

Table 4.1 Selected Physiological Parameters of the Subject

	N	Age	Weight	Height	BMI	Experience
Active Soccer Players	15	21,5 ± 1.6	73.3 ± 6.1	175.7 ± 5.2	23.8 ± 1.5	7.7 ± 1.9
Sedentary Participants	15	22.6 ± 1.5	70.5 ± 11.7	175 ± 7.8	23 ± 2.9	
Veteran Soccer Players	14	31.9 ± 2.4	76 ± 12.3	174.4 ± 4.1	24.9 ± 3.6	15.2 ± 3.7
Sedentary Participants	13	31 ± 1.7	77.3 ± 13.2	176.6 ± 5.8	24,7 ± 3,4	

Multivariate analysis of variance (MANOVA) was conducted to determine the effect of the four types of soccer and control groups (between the age of 20-25 soccer and control groups and 30-35 soccer and control groups) on eleven dependent variables. Significant differences were found among the four study groups on the dependent measures, Wilks' Λ= .045, F (36,125) = 6.47, p < .000.

Table 4.2.1 Multivariate Analysis Of Variance Tests Results

Effect	Value	F	Hypothesis df	Error df	Sig.	Eta Squared	Observed Power
GROUPS	1,638	4,407	36,000	132,000	,000	,546	1,000
	,045	6,468	36,000	124,821	,000	,645	1,000
	7,676	8,672	36,000	122,000	,000	,719	1,000
	5,513	20,213	12,000	44,000	,000	,846	1,000

[#] All values in the MANOVA above were given according to Pillai's Trace, Wilks' Lambda, Hotelling's Trace, Roy's Largest Root.

[a] Computed using alpha = .05

According to the result of the MANOVA, Table 4.2 displays the results of MANOVA. As Table 4.2.1. indicates, there was a significant difference between active, veteran soccer groups and control groups. According to the Table 4.2.2 there was significant difference intra- group members.

Table 4.2.2 Test of Between Subjects Effects

Source	Dependent Variable	df	F	Sig.	Observed Power
GROUPS	EXT60	3	7,332	,000	,978
	FLEX60	3	5,414	,003	,919
	RATIO60	3	,919	,438	,238
	EXT120	3	2,683	,056	,621
	FLEX120	3	4,764	,005	,878
	RATIO120	3	,579	,631	,162
	FEMURR	3	7,785	,000	,984
	FEMURL	3	7,731	,000	,983
	LUMBAR	3	3,040	,037	,682
	MODI	3	,329	,804	,110
	METTOTAL	3	42,016	,000	1,000

4.2 Lumbar Spine Degeneration Differences between Soccer and Control Groups

Analyses of variance (ANOVA) on each dependent variable were conducted as follow up tests to the MANOVA in order to test hypotheses 1a, 2a and 3a and that there will be significant difference between active soccer players (at the age of 20-25 and at least five years active carrier) and the control group and between veteran soccer players (at the age of 30-35 and at least ten years active carrier) and the control group between active soccer players (at the age of 20-25) and veteran soccer players (at the age of 30-35 and at least ten years active carrier) in terms LSD. Table 4.3 presented the results of the comparison analyses. Using the Bonferroni method, each ANOVA was tested at the .05 level. The ANOVA on the LSD was significant, F (3, 53) = 4,181 p>.010, $\eta^2 = .191$.

Chi-square test was conducted to assess the consistency of three medical doctor evaluations of X-ray results. The results of the test were not significant, x^2 (2, N = 171) =7.000, p = 0.537. Over all these results suggest that the X-ray evaluation of three medical doctors were consistent.

Table 4.3 Multivariate Analyses of Variance for Soccer and Control Groups for Lumbar Disc Degeneration

	Lumbar Disc Degeneration	
Groups	Mean Difference (I-J)	Sig.
Active Soccer G.(age 20-25) Control Groups (age 20-25)	1,33	1,000
Veteran Soccer G.(age 30-35) Control Groups (age 30-35)	7,36	1.000
Active Soccer G.(age 20-25) Veteran Soccer G.(age 30-35)	-,16*	,036

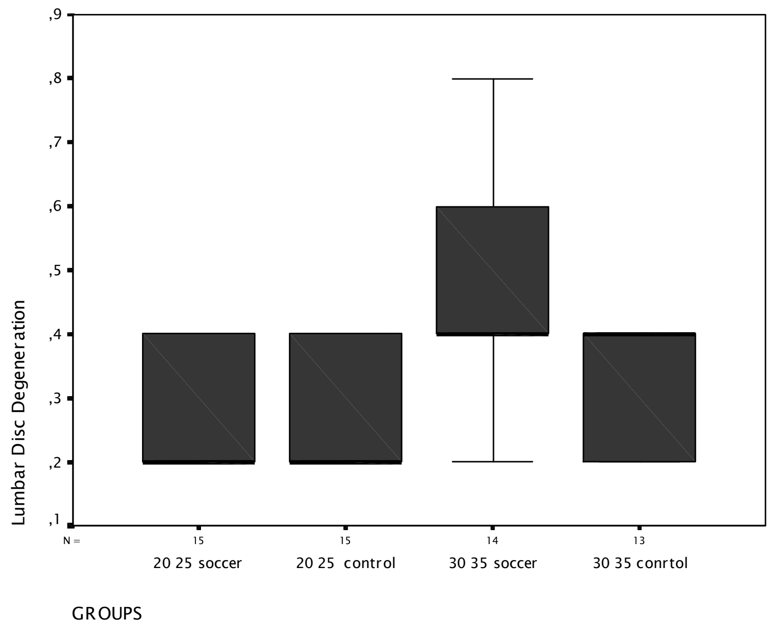

Figure 4.1. Mean Lumbar Disc Degeneration in Soccer and Control Groups

4.3 Spinal flexibility and Met Total Scores Differences between Soccer and Control Groups.

Analyses of variance (ANOVA) on each dependent variable were conducted as follow up tests to the MANOVA in order to test hypotheses 1b, 2b, 3b and 1e, 2e, 3e that there will be significant difference between active soccer players (at the age of 20-25 and at least five years active carrier) and the control group and between veteran soccer players (at the age of 30-35 and at least ten years active carrier) and the control group between active soccer players (at the age of 20-25) and veteran soccer players (at the age of 30-35 and at least ten years active carrier) in terms of SF and MET total scores (Table 4.4). Using the Bonferroni method, each ANOVA was tested at the .05 level. The ANOVA on the SF was nonsignificant, $F(3.53) = .329$ $p> .804$, $\eta^2= .018$, while the ANOVA on the MET total scores was significant, $F(3.53) = 42.016$ $p>.000$, $\eta^2 = .70$.

Table 4.4 Multivariate Analyses of Variance for Soccer and Control Groups for Spinal flexibility and Met Total Scores

	Spinal flexibility		Met Total Scores	
Groups	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.
Active Soccer G.(age 20-25) / Control Groups (age 20-25)	,40	1,000	11,28*	,000
Veteran Soccer G.(age 30-35) / Control Groups (age 30-35)	-,22	1,000	16,43*	,000
Active Soccer G.(age 20-25) / Veteran Soccer G.(age 30-35)	,21	1,000	-6,43*	,005

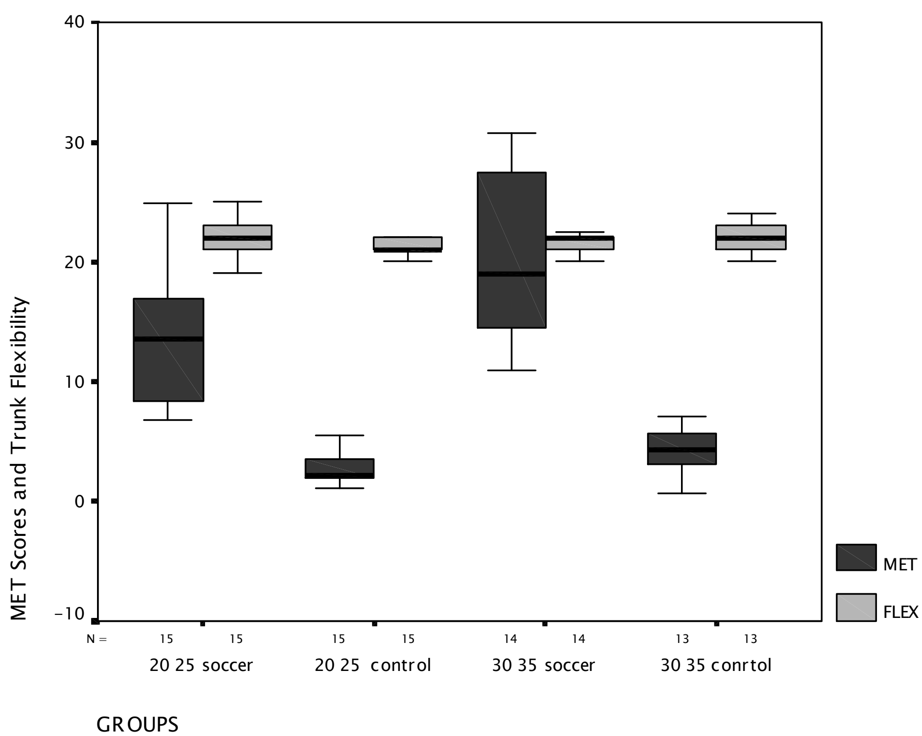

Figure 4.2. Mean Spinal flexibility and Met Total Scores in Soccer and Control Groups

4.4 Trunk Muscle Strength

4.4.1 Trunk Flexion and Extension Strength Differences between Soccer and Control Groups at 60º/s.

Analyses of variance (ANOVA) on each dependent variable were conducted as follow up tests to the MANOVA in order to test hypotheses 1c, 2c and 3c that there will be significant difference between active soccer players (at the age of 20-25 and at least five years active carrier) and the control group and between veteran soccer players (at the age of 30-35 and at least ten years active carrier) and the control group between active soccer players (at the age of 20-25) and veteran soccer players (at the age of 30-35 and at least ten years active carrier) in terms of trunk flexion and extension strength at 60º/s. (Table 4.5). Using the Bonferroni method, each ANOVA was tested at the .05 level. The ANOVA on the trunk flexion strength at 60º/s. was significant, F (3.53) = 5.414 p> .003, η^2 = .24. The ANOVA on the trunk extension strength at 60º/s. was also significant, F (3.53) = 7.33 p> .000, η^2 = .29.

Table 4.5 Multivariate Analyses of Variance for Soccer and Control Groups for Trunk Flexion and Extension Strength at 60º/s.

	Trunk Flexion@60ºs.		Trunk Extension@60ºs.	
Groups	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.
Active Soccer G.(age 20-25) / Control Groups (age 20-25)	27,60	.398	81,77*	0,005
Veteran Soccer G.(age 30-35) / Control Groups (age 30-35)	11,85	1.000	36.60	0,852
Active Soccer G.(age 20-25) / Veteran Soccer G.(age 30-35)	45,37*	.023	69,38*	0,030

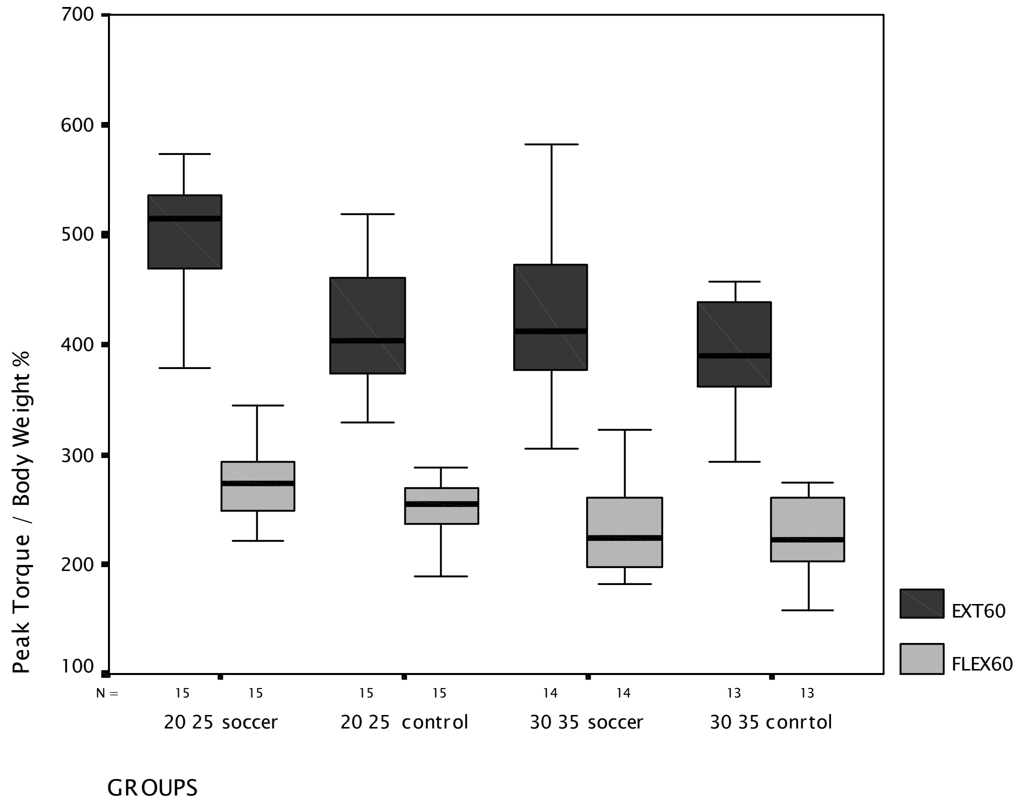

Figure 4.3. Mean Trunk Flexion and Extension Strength at 60º/s. in Soccer and Control Groups

4.4.2 Trunk Flexion and Extension Strength Differences between Soccer and Control Groups at 120º/s.

Analyses of variance (ANOVA) on each dependent variable were conducted as follow up tests to the MANOVA in order to test hypotheses 1c, 2c and 3c that there will be significant difference between active soccer players (at the age of 20-25 and at least five years active carrier) and the control group and between veteran soccer players (at the age of 30-35 and at least ten years active carrier) and the control group between active soccer players (at the age of 20-25) and veteran soccer players (at the age of 30-35 and at least ten years active carrier) in terms of trunk flexion and extension strength at 120º/s. (Table 4.6). Using the Bonferroni method, each ANOVA was tested at the .05 level. The ANOVA on the trunk flexion strength at

120º/s. was significant, F (3.53) = 4,764 p> .005, η^2 = .21, while the ANOVA on the trunk extension strength at 120º/s. was nonsignificant, F (3.53) = 2,683 p> .056, η^2 = .13.

Table 4.6 Multivariate Analyses of Variance for Soccer and Control Groups for Trunk Flexion and Extension Strength at 120º/s.

	Trunk Flexion@120ºs.		Trunk Extension120@ºs.	
Groups	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.
Active Soccer G.(age 20-25) Control Groups (age 20-25)	34.42	.095	50,71	,320
Veteran Soccer G.(age 30-35) Control Groups (age 30-35)	-8,61	1,000	28,70	1.000
Active Soccer G.(age 20-25) Veteran Soccer G.(age 30-35)	49,25*	,006	43,92	,591

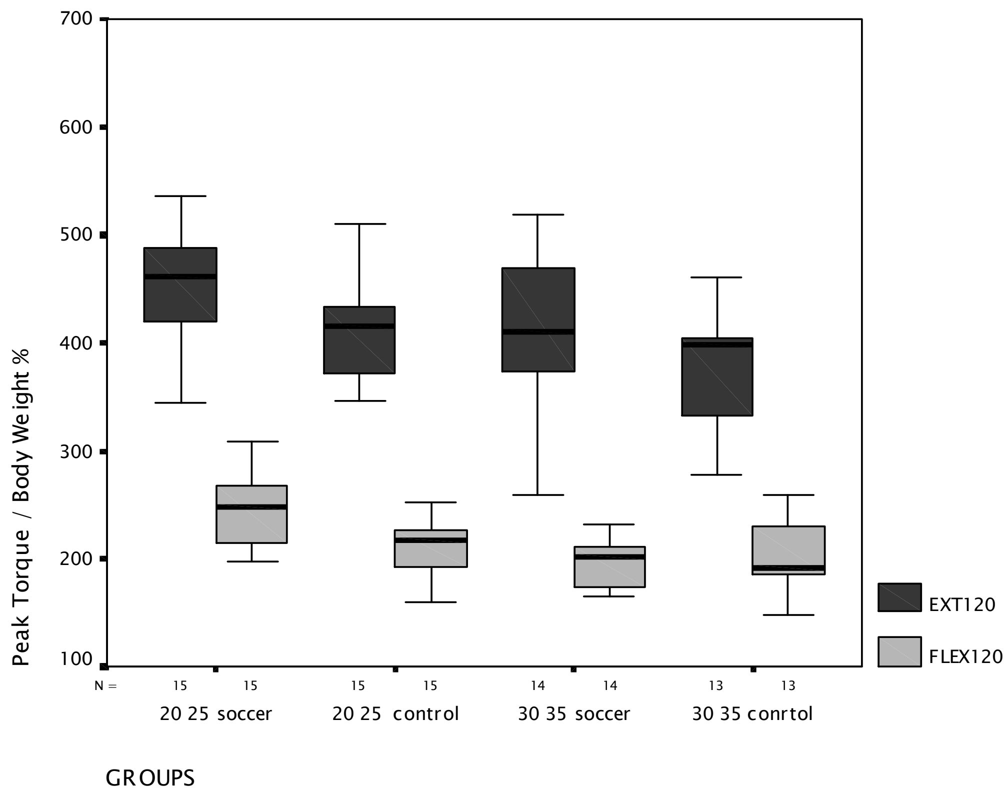

Figure 4.4. Mean Trunk Flexion and Extension Strength at 60º/s. in Soccer and Control Groups

4.4.3 Trunk Flexion and Extension Strength Ratio at 60º/s. and 120º/s. Differences between Soccer and Control Groups

Analyses of variance (ANOVA) on each dependent variable were conducted as follow up tests to the MANOVA in order to test hypotheses 1c, 2c and 3c that there will be significant difference between active soccer players (at the age of 20-25 and at least five years active carrier) and the control group and between veteran soccer players (at the age of 30-35 and at least ten years active carrier) and the control group between active soccer players (at the age of 20-25) and veteran soccer players (at the age of 30-35 and at least ten years active carrier) in terms of trunk flexion and extension strength ratio at 60º/s. and 120º/s. (Table 4.7)**.**. Using the Bonferroni method, each ANOVA was tested at the .05 level. The ANOVA on the trunk flexion/extension ratio 60º/s. was nonsignificant, $F(3.53) = .919$ $p > .438$, $\eta^2 = .05$.

The ANOVA on the trunk flexion/extension ratio120º/s. was nonsignificant, F (3.53) = .579 p> .631, $\eta^2 = .03$.

Table 4.7 Multivariate Analyses of Variance for Soccer and Control Groups for Trunk Flexion and Extension Strength Ratio at 60º/s. and 120º/s.

	TrunkRatio@60ºs.		TrunkRatio@120ºs.	
Groups	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.
Active Soccer G.(age 20-25) Control Groups (age 20-25)	-4,9067	1,000	2,09	1,000
Veteran Soccer G.(age 30-35) Control Groups (age 30-35)	-1,86	1,000	-4,44	1,000
Active Soccer G.(age 20-25) Veteran Soccer G.(age 30-35)	,64	1,000	5,10	1,000

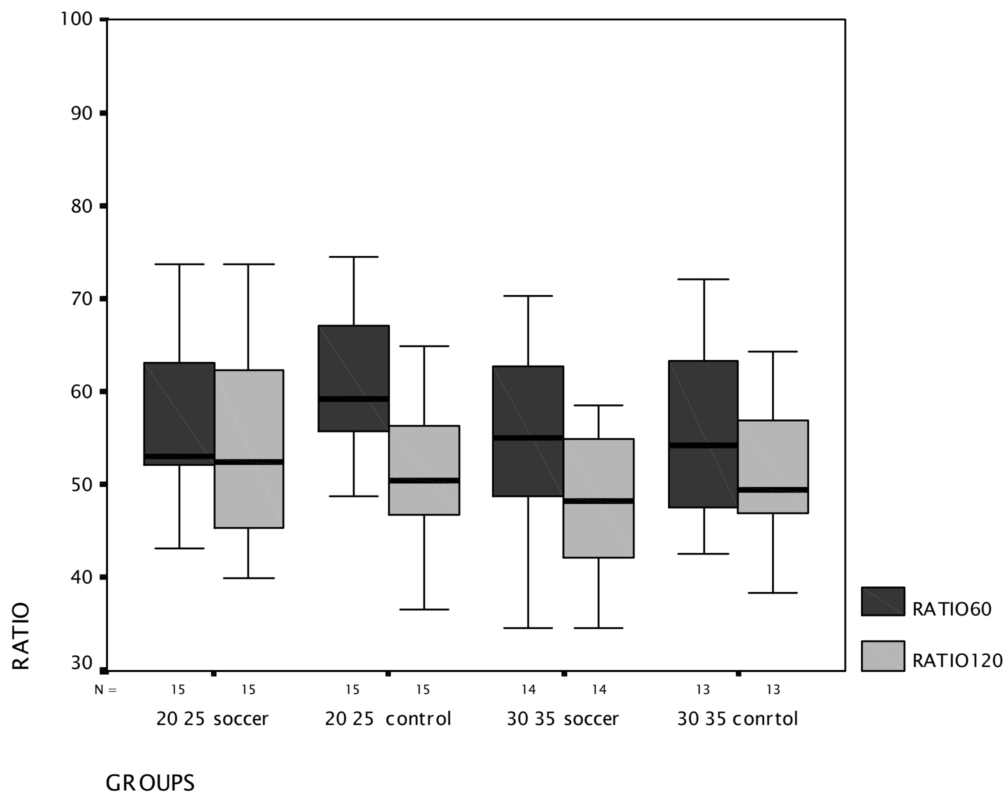

Figure 4.5. Mean Trunk Flexion / Extension Strength Ratio at 60º/s. and 120º/s. in Soccer and Control Groups

4.5 Right and Left Femur and Lumbar Bone Mineral Density Differences between Soccer and Control Groups

Analyses of variance (ANOVA) on each dependent variable were conducted as follow up tests to the MANOVA in order to test hypotheses 1d, 2d and 3d that there will be significant difference between active soccer players (at the age of 20-25 and at least five years active carrier) and the control group and between veteran soccer players (at the age of 30-35 and at least ten years active carrier) and the control group between active soccer players (at the age of 20-25) and veteran soccer players (at the age of 30-35 and at least ten years active carrier) in terms of right and left femur and lumbar BMD (Table 4.8, Table 4.9). Using the Bonferroni method, each ANOVA was tested at the .05 level. The ANOVA on the right femur BMD was significant, F

(3.53) = 7,785 p> .000, η^2 = .31. The ANOVA on the left femur BMD was significant, F (3.53) = 7,731 p> .000, η^2 = .30. The ANOVA on the lumbar BMD was significant, F (3.53) = 3,040 p> .037, η^2 = .15.

Table 4.8 Multivariate Analyses of Variance for Soccer and Control Groups for Right and Left Femur Mineral Density

	Right Femur BMD		Left Femur BMD	
Groups	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.
Active Soccer G.(age 20-25) Control Groups (age 20-25)	,17*	,007	,18*	,004
Veteran Soccer G.(age 30-35) Control Groups (age 30-35)	3,42	1,000	4,24	1,000
Active Soccer G.(age 20-25) Veteran Soccer G.(age 30-35)	,19*	,003	,18*	,005

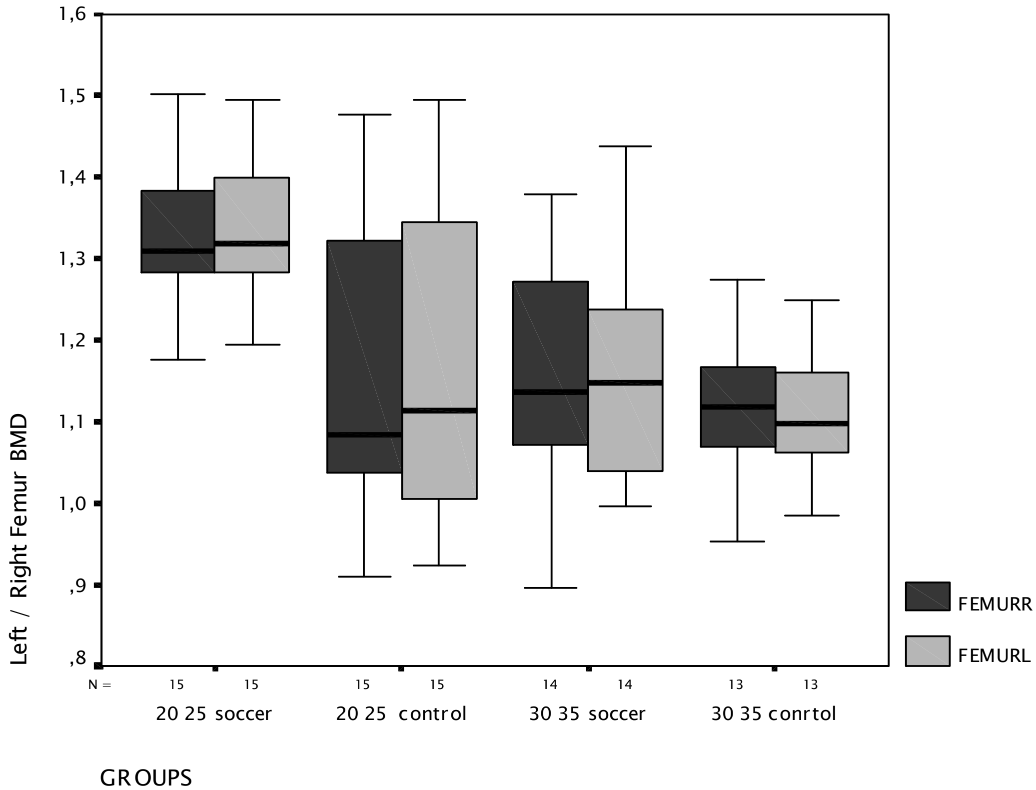

Figure 4.6. Mean Right and Left Femur Bone Mineral Density in Soccer and Control Groups

Table 4.9 Multivariate Analyses of Variance for Soccer and Control Groups for Lumbar Bone Mineral Density

	Lumbar BMD	
Groups	Mean Difference (I-J)	Sig.
Active Soccer G.(age 20-25) Control Groups (age 20-25)	,12	.136
Veteran Soccer G.(age 30-35) Control Groups (age 30-35)	3,42	.462
Active Soccer G.(age 20-25) Veteran Soccer G.(age 30-35)	9.42	1.000

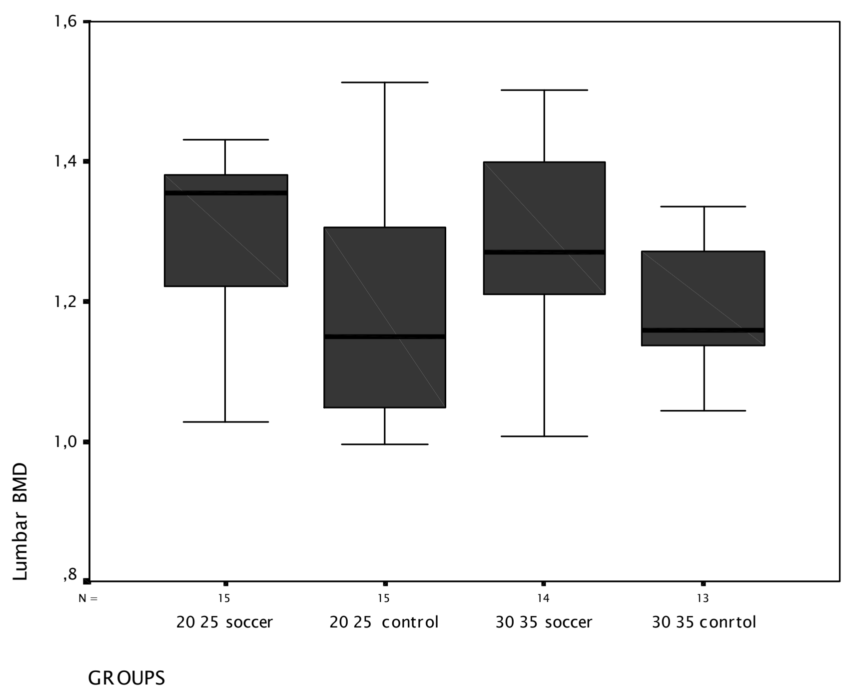

Figure 4.7. Mean Lumbar Bone Mineral Density in Soccer and Control Groups

4.6 Relationship between Physical Parameters for Active Soccer Players

Correlation coefficients were computed among the seven physical parameters. Using the Bonferroni approach to control for Type I error across 21 correlations, a p- value of less than .005 (05 / 10 = .005) was required for significance. The result of the correlational analyses presented in Table 10 show that three out of the 21 correlations were statistically significant and were greater than or equal to .35. In general, the correlations between physical parameters measures for active soccer players tended to be lower and not significant.

Table 4.10. Intercorreletions between Physical Parameters for Active Soccer Players

Physical Parameters	1	2	3	4	5	6	7	8
				Active Soccer Players (n = 15)				
1.Extension60˚/s.	-	,466	-,236	-,017	,067	-,214	-,234	,073
2.Flexion60˚/s.		-	,746*	-,263	,260	,153	-,533*	,307
3.Ratio60˚/s.			-	-,279	,260	,322	-,433	,250
4.Lumbar BMD				-	,123	-,607*	-,031	,238
5.Flexibility					-	,110	-,411	-,002
6.Met						-	,324	-,024
7.Degeneration							-	,000
8.Left Femur BMD								-

* p<.05

4.7 Relationship between Physical Parameters for Veteran Soccer Players

Correlation coefficients were computed among the seven physical parameters. Using the Bonferroni approach to control for Type I error across 21 correlations, a p- value of less than .005 (05 / 10 = .005) was required for significance. The result of the correlational analyses presented in Table 11 show that two out of the 21 correlations were statistically significant and were greater than or equal to .35. In general, the correlations between physical parameters measures for veteran soccer players tended to be lower and not significant.

Table 4.11. Intercorreletions between Physical Parameters for Veteran Soccer Players

Physical Parameters	1	2	3	4	5	6	7	8
				Veteran Soccer Players (n = 14)				
1.Extension60˚/s.	-	,350	-,580*	,455	,032	,159	-,211	-,501
2.Flexion60˚/s.		-	,547*	,080	,240	,010	-,066	-,087
3.Ratio60˚/s.			-	-,305	,165	-,147	,136	,421
4.Lumbar BMD				-	,030	,066	-,179	,240
5.Flexibility					-	,322	,107	,143
6.Met						-	-,353	,059
7.Degeneration							-	,340
8.Left Femur BMD								-

* p<.05

4.8 Relationship between Physical Parameters for Age 20-25 Control Group

Correlation coefficients were computed among the seven physical parameters. Using the Bonferroni approach to control for Type I error across 21 correlations, a p- value of less than .005 (05 / 10 = .005) was required for significance. The result of the correlational analyses presented in Table 12 show that three out of the 21 correlations were statistically significant and were greater than or equal to .35. In general, the correlations between physical parameters measures for active soccer players tended to be lower and not significant.

Table 4.12. Intercorreletions between Physical Parameters for Age 20-25 Control Group

Physical Parameters	1	2	3	4	5	6	7	8
				Age 20-25 Control Group (n = 15)				
1.Extension60˚/s.	-	,631*	-,658*	,190	-,322	-,223	-,066	,114
2.Flexion60˚/s.		-	,166	,379	-,131	-,063	,235	,284
3.Ratio60˚/s.			-	,102	,286	,257	,349	,136
4.Lumbar BMD				-	,293	-,058	,043	,529*
5.Flexibility					-	,199	,203	,180
6.Met						-	,631*	,089
7.Degeneration							-	,200
8.Left Femur BMD								-

* p<.05

4.9 Relationship between Physical Parameters for Age 30-35 Control Group

Correlation coefficients were computed among the seven physical parameters. Using the Bonferroni approach to control for Type I error across 21 correlations, a p- value of less than .005 (05 / 10 = .005) was required for significance. The result of the correlational analyses presented in Table 13 show that three out of the 21 correlations were statistically significant and were greater than or equal to .35. In general, the correlations between physical parameters measures for active soccer players tended to be lower and not significant.

Table 4.13. Intercorreletions between Physical Parameters for Age 30-35 Control Group

Physical Parameters	1	2	3	4	5	6	7	8
Age 30-35 Control Group (n = 13)								
1.Extension60˚/s.	-	,249	-,470	-,067	-,013	,786*	,209	,347
2.Flexion60˚/s.		-	,728*	,148	,106	,182	,494	-,006
3.Ratio60˚/s.			-	,168	,015	-,397	,268	-,238
4.Lumbar BMD				-	,256	,103	,252	,367
5.Flexibility					-	,276	,253	,071
6.Met						-	,455	,414
7.Degeneration							-	,350
8.Left Femur BMD								-

* p<.05

4.10 Relationship among Lumbar BMD (L2-L4), Right Femur BMD, Left femur BMD.

Correlation coefficients were computed among Lumbar BMD (L2-L4), Right Femur BMD, Left femur BMD in order to test hypotheses 8 that there were no relationships among Lumbar BMD (L2-L4), Right Femur BMD, Left femur BMD. The results of the correlation analyses were presented in Table 14. The results indicated that right femur BMD values were highly correlated with the left femur BMD (r = .917*). In spite of being high correlation between the femurs BMD, there has been moderate correlation between lumbar BMD and right femur BMD (r =. 563*) & left femur BMD (r = .547*).

Table 4.14. Intercorreletions among Lumbar BMD (L2-L4), Right Femur BMD, Left femur BMD.

Physical Parameters	1	2	3
1. Lumbar BMD	-	,563*	,547*
2. Right Femur BMD		-	,917*
3. Left femur BMD			-

* p<.05

CHAPTER V

DISCUSSION

Playing soccer for long duration can cause acute and chronic injuries that lead to LSD. Because of insufficient literature with this subject, we are investigating systematically in order to determine the risk factors for soccer which cause LSD. Thus, to prevent LSD can only be accomplished by this way. The main purpose of this study was to determine whether playing soccer at high intensity training for a long period causes degeneration of the lumbar spine or not. This degeneration may occur without any symptoms or low back pain. Results of the present study were discussed in the framework of lumbar disc degeneration, trunk strength, lumbar and hip BMD, trunk flexibility activity MET scores for active and veteran soccer groups.

There have been four subject groups in this study. First group has been 15 soccer players who are in the amateur soccer league at least for five years. Second group – again 15 subjects - has been selected from people who have never participated in sports in their lives. The age of first and second group is between 20 and 25; also, the physical characteristics of these two groups have been the same. Our third group has been 14 former soccer players who were in the amateur soccer league at least for ten years. The last group has been selected people who have never participated in sports in their lives. In the last group, there have been 13 people; the age of third and fourth group is between 30 and 35. Also physical characteristics of these two groups have been the same. The groups didn't have a history of low back disorder or display any symptoms and they were selected on the basis of their age and physical activity history.

The results of the present study demonstrated that there was a significant difference between soccer groups and sedentary groups. Hypotheses about lumbar disc degeneration that there was no significant difference among veteran soccer players, active soccer players and sedentary groups in terms of lumbar disc degeneration were rejected (Table 4.3.). Among these groups, veteran soccer players displayed greater lumbar disc degeneration. However, a significant difference in lumbar spine degeneration between groups could not be established. Findings of the study support the main hypothesis that playing soccer at high intensity training at a long period of time may cause LSD. Degeneration may occur without low back symptoms. The results were consistent with other studies conducted by the various researchers on similar variables (Videman et al. 1995, Sohal, & Allen, 1978).

Videman et al. (1995) in their study demonstrated similar findings to the present study in terms of those former elite athletes, unlike control groups, overall reported less back pain or no symptoms in later adulthood. However, they revealed an increase in the lumbar disc degeneration throughout the entire spine in former weight lifters and in the lower lumbar levels in soccer players when compared to controls. Although the former weight lifters and soccer players had high degenerative findings, they still had no symptoms or less back pain than those in the control groups. This study provides some evidence that certain forceful athletic activities may accelerate the degenerative process, but that the degenerative changes seen on imaging studies do not correlate well with clinical symptoms. It might be resulted from high intensity training programs. Similarly, Sohal, & Allen, (1978) discovered in their study that there were some lower lumbar disc degeneration when a high or repeated load exceeds the strength of a structure, and free radical formation in connection with strenuous exercise could increase disc degeneration. Although the rehabilitation and back pain prevention programs, which are commonly recommended, strengthen muscles and increase aerobic capacity and range of motion; few studies have showed a positive effect on back problems (Leino, 1993). In spite of other sports, jogging doesn’t seem to cause the risk for developing lumbar disc disease (Woolf & Glaser, 2004). In fact, the type of exercises that needs high physiological performance -such as soccer- has no positive effects on back problems; on the other hand, it may cause degeneration on the lumbar spine because of its complex physiological necessities.

The aerobic requirements and muscle strength are the physiological demands of soccer players explained by Reilly, Bangsbo and Franks (2000). They also declared that many activities in soccer were forceful and explosive. The power output during such activities is related to the strength of the muscles. Leatt et al. (1986) investigated in their study that reductions in height in the spine which could be measured sensitively and reliably with appropriate methodology were caused by circuit training with weights and distance running. Moreover, they assumed that the loss of height increase loading on spinal. Troup (1979) also mentioned that the nucleus of the disc and epiphyseal plates were especially vulnerable as they had no innervations and could be injured without pain. In general, the results of the studies may clarify why veteran soccer players had more lumbar spine degeneration than other groups without any low back pain and symptoms.

One of the findings of the current study presented no significant difference between soccer groups and sedentary groups in terms of lumbar flexibility (Table 4.4.). It supported the hypotheses about SF that there were no significant differences among veteran soccer players, active soccer players and sedentary groups. The result of the current study was not consistent with the study of Raty et al. (1997). They investigated the long-term effects of different loading conditions in sports and worked on SF. The study stated that exercise such as weight-lifting or soccer, which impose greater compression or torsional forces on the spine, do not lead to a decline in SF.

Although in Raty and his colleagues' study (1997), it revealed that soccer and weight lifting had no negative effect on SF; Troup, Foreman, Baxter and Brown (1987) stated visa versa in their study. Troup et al. (1987) mentioned that the weight lifters and soccer players complained about the first back pain episode at a younger age than the athletes who are being trained lighter. The decline in lumbar mobility could have been resulted for this reason.

Battie et al. (1987) declared that longitudinal studies have to be designed to define directly the relationship between SF and back problems. There were some researches about a general decrease in spinal mobility associated with low back pain complaints (Biering-Sorensen, 1984, Mayer, Tencer, Kristoferson, & Money, 1984) whereas another study results showed the decrease in the spinal mobility (Howes, & Isdale, 1972).

Being different from previous studies; in this research, that there was no significant difference between active soccer players and age matched sedentary controls is a considerable finding. This result showed that the necessary time for flexion exercise which should be done during warm-up and cool-down in trainings was not assigned.

In this current study, although there was a high correlation between the right femur BMD and left femur BMD, there was a moderate correlation between right & left femur BMD and lumbar BMD (Table 14.). That there were no difference between the dominant leg BMD and non dominant leg BMD was briefly explained in the study having similar results. A recent study by Jose et al. (1999) found that right and left femur BMD could be in correlation because of the fact that the nondominant leg is also used to kick. The additional strain created by kicking actions does not apparently contribute to further enhance bone mass or density, beyond the effect produced by the rest of football-related physical activities. In fact, while kicking, the forces and torques exerted on the nonkicking leg to keep balance could contribute to the symmetrical leg bone improvement.

In this investigation, other findings related with BMD was that although there were significant differences between first and second group & first and third group rejecting the hypotheses of in terms of their right & left femur BMD, there were no significant differences between the third group and fourth group that was supported by the hypotheses of BMD in terms of their right & left femur BMD. Other findings exposed that the result supported the hypotheses of BMD in terms of their lumbar BMD that there were no significant differences between the 1st & 3rd and 2nd & 4th group (Table 4.8., Table 4.9.).

Veteran soccer players participated in the study has not been active approximately for five years. To not find any difference between their controls in terms of their BMD scores may relate with doing any exercise periodically after their active carrier.

Normally, participating exercise for long duration improves BMD. Active soccer players' BMD test results verify the positive effects of exercise on BMD bluntly. Therefore, after finishing active carrier, soccer players should participate regular activity in order to keep BMD values.

The common acceptance is that the positive effects of physical activity and impact loading sports are to keep or accelerate BMD. Soccer can be accepted an impact loading sport that redounded the BMD on specific skeletal regions (Alfredson 1996). In deed, the athletes participating high impact loading sports had high bone mass in the loaded skeletal regions (Uzunca et al., 2004). A recent study by Magnusson, Linden, Karlsson, Obrant, and Karlsson, (2001) investigated that exercise may induce changeable low bone mass in unloaded and high bone mass in weight loaded skeletal regions. They measured BMD in one unloaded (skull), one partly loaded (arms) and one highly loaded skeletal region (femoral neck) in active soccer player mean age 22.7 years (17-35). Active soccer players had 10.3 ± 10.4% lower BMD in the skull, 1.4 ± 6.3% higher BMD in the arms and 12.7 ± 9.8% higher BMD in the femoral neck compared with sedentary controls. The findings of the femur neck BMD results are consistent with the present study. Magnusson (2001) stated that active soccer players had high BMD in the weight-loaded region such as femoral neck compared with controls, but they had lower BMD in the skull and no difference in the arms.

Jose et al. (2001) searched that the long term soccer participation may have effects on regional BMD and bone mineral content (BMC) in male soccer players. Although the results of the study were consistent with the present study in terms of high femoral BMD; in the present study, the largest difference was observed at lumbar spine BMD. Unlike present study, Jose et al. (2001) found significant difference in the lumbar spine BMD 10% higher in the soccer players than in the control subjects. Beside this, there are some studies discovering the high BMD at the region of femoral neck in female soccer players (Alfredson et al, 1996, Duppe, Gardsell, Johnell, & Ornstein, 1996), but opposite results have been reached at lumbar spine same as the present studies' results (Duppe et al., 1996, Lee, Long, Rissner, Poindexter, Gibbons, Goldzieher, 1995). The studies mentioned above and the present study's results show that there were significant differences between the 1st & 3rd groups and 2nd & 4th groups in terms of their femoral neck region BMD. However, unlike Jose et al. (2001), there was no significant difference between the groups in terms of lumbar BMD. At most of the game and almost the whole portion of the training, soccer players spend most of their time by walking or low speed running. This kind of exercises produces not so much grand reaction force which was necessary to keep BMD at the lumbar spine. This may be the reason of the different findings.

Isokinetic strength has been tested for torso flexion and extension at 60°/s. and at 120°/s. The first isokinetic test findings of the current study, trunk extension strength at 60/s. was significantly higher in active 1st group players than 2nd group participants, but there were no significant differences between the 1st group and 2nd group in terms of trunk flexion strength and agonist/antagonist ratio at 60/s. The other test findings at velocity of 120/s. revealed that there were no significant differences between 1st group and 2nd group. These results, except trunk extension strength at 60°/s. supported the hypotheses of trunk strength like 3rd group and 4th group scores that there were no significant differences for extension, flexion, and agonist/antagonist trunk strength ratio at the speed of 60°/s. and 120/s. (Table 4.5, Table4.6., Table 4.7).

Most of the researchers declared that trunk extension strength is stronger than the trunk flexion strength, and this finding is also accepted with in the current study for similar model of isokinetic measurement (Davies, & Gould, 1982, Hasue, Fujiwara, & Kikuchi, 1990, Mayer, Gatchel, Kishino, Keeley, Capra, Mayer, Barnett, & Mooney, 1985). However, some of them did not agree that they have invented flexion strength higher than extension strength (Langrana, & Stover, 1977, Pope, Bevins, Wilder, & Frymoyer, 1985). There were various results in the trunk agonist/antagonist ratio. This may result of the different methods of measurement technique and the parameters used in analysis (Beimborn, & Morrissey, 1987). In fact, in the findings of the study, agonist/antagonist ratio has been between 1.65 and 1.85; Addison and Shults (1980), Nicolaisen and Jorgensen (1985) discovered similar results that the peak torque extension/flexion ratio is between the range of 1.0

and 2.0. However, some of the researchers found some various results in extension/flexion ratios between the healthy and having low back problem participants. Mayer et al. (1985) and Langrana, Lee, Alexander, & Mayott, (1984) pointed out that the ratios of 1.36 and 1.6 were discovered for healthy participators, 0.91 and 1.0 were found for participators with low-back pain. On a count of inseparable outcomes of the two studies, the extensor muscle strength was affected more than the flexor in participants with low back problems. However, there is controversy about the contribution of trunk muscle weakness to the incidence of low back problem. The test subjects with low-back pain had lower trunk flexion strength (Pope et al., 1985). Nonetheless, in the current study, results concluded that higher lumbar disc degeneration was observed in the 3rd group; but there were not significant differences between the groups in terms of their trunk strength ratios. This deduced that trunk strength ratio was not a determinative symptom on the lumbar disc degeneration in this study. In actual fact, while selecting participants, the most major characteristic is that not having any complaint or any symptoms on their back caused any considerable differentiation between the groups trunk strength ratios'.

In the present study, findings of degeneration on the lumbar spine at the 3rd group players different from other groups may be explained by 1st group players' greater trunk extension strength at 60º/s. than the other groups in the study, but not flexion strength; therefore, having abnormal trunk extension strength while playing actively may cause lumbar disc degeneration on the spine at later years. Furthermore, a negative correlation was found between trunk flexion muscle strength at 120º/s. And LSD. This result exhibited that possessing high trunk flexion muscle strength prevented degeneration on the lumbar spine. In fact, Coaches should take trunk flexion strength and SF into consideration in their training programs in order to prevent lumbar disc degeneration.

The result of the current study was consistent with the study of Andersson, Sward, & Thorstensson, (1988). This study recruited 57 male athletes (soccer players, wrestlers, tennis players, gymnasts), and in normal group of 87 participants. They also revealed that the discriminating enhancement of the strength of trunk and hip muscles in the athletes resulted in extension/flexion ratios which were at controversy with those of the normal. These kinds of imbalances in the trunk strength were brought forward as probable factors of low-back problem (Mcneill, Warwick, Andersson and Schultz, 1980).

In summary, results of these investigations provided support for the main hypothesis that playing soccer at high intensity training at a long period of time may cause degeneration at the lumbar spine that may occur without any symptoms or low back pain. Disc degeneration of the lumbar spine may be observed in 1st group in later years since this degeneration has been observed in 3rd group. This degeneration of the lumbar spine in 1st group players may be the result of possessing greater trunk extension strength than other groups. To prevent this kind of low-back problem, soccer players may attach importance to getting around trunk extension and flexion muscle strength improvement in well-balanced training program.

> McGill (1998) gives some advice to decrease the effects of high loaded exercise on the lumbar spine that exercises involving spinal loading has to be performed in a natural spine position. The researcher takes attention to those who suggest posterior pelvic tilts during spinal loading, which may cause preloading of the annulus (of the intervetebral disc) and the posterior ligaments. Investigator of the study also suggests performing unloaded SF training as it is done with the well-known "cat stretch." The stress of the flexibility training have to be in establishing mobility, with less focus on achieving end range of motion improvements in the spine. McGill (1998) defends a sort of abdominal exercises since no single spinal flexion motion fully and effectively engages all of the abdominals. The researcher also suggests exercises same as to a side lying support (hips off floor with body weight supported by a bent elbow with side of body toward floor) to strengthen the quadratus lumborum, which have a part in spinal stabilization.

CHAPTER VI

CONCLUSIONS

6.1 Conclusions

1. Veteran soccer players' lumbar disc degeneration was higher than active soccer players and its age matched sedentary groups. These results showed that playing soccer more than ten years may cause degeneration at the lumbar spine.

2. Trunk extension strength at 60/s. was significantly higher in active soccer players than age-matched sedentary controls. Other trunk strength of extension, flexion and agonist/antagonist ratio measurements at the 60º/s. and 120º/s. did not demonstrate any differences between groups.

3. Between MET scores and lumbar BMD correlated negatively. However, MET scores and left & right femur BMD had no correlation.

4. Lumbar BMD values had moderate correlation with right & left femur BMD moreover, there was a high correlation between the right femur BMD and left femur BMD.

5. **I**n terms of lumbar BMD, there were significant differences between active soccer group and age matched sedentary group & veteran soccer group. No significant differences were found between the soccer groups and sedentary groups in terms of their lumbar BMD.

6. Trunk flexibility was not different between groups.

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APPENDICES

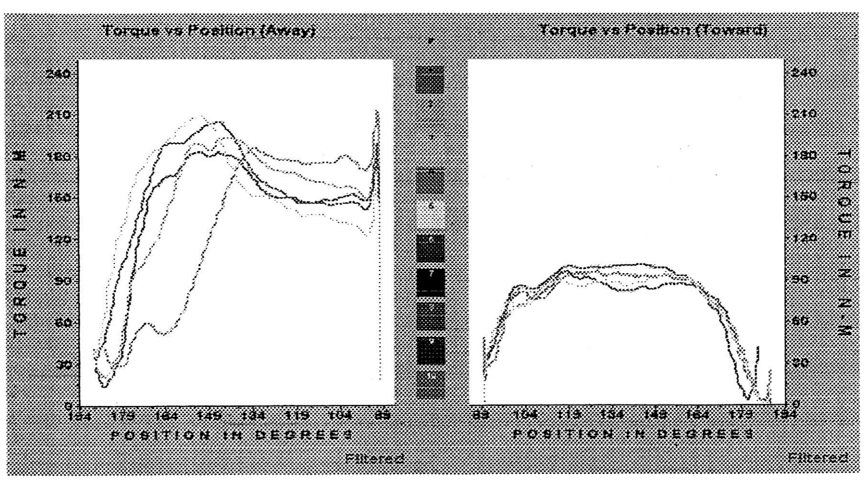
APPENDIX A

ISOKINETIC STRENGTH ASSESSMENT SHEET

Comprehensive Evaluation

Name:		Session:		Windowing:	**None**
ID:		Involved:		Protocol:	**Isokinetic Unilateral**
Birth Date:	(dd.MM.yyyy)	Clinician:		Pattern:	**Ext/Flex Semi-Standing**
Ht:		Referral:		Mode:	**Isokinetic**
Wt:		Joint:		Contraction:	**CON/CON**
Gender:		Diagnosis:		GET:	**No Gravity Correction**

		EXTENSION 60 DEG/SEC	FLEXION 60 DEG/SEC
Side: None			
# OF REPS: 5			
PEAK TORQUE	N-M	213.4	101.5
PEAK TQ/BW	%	333.4	158.5
TIME TO PK TQ	MSEC	1600.0	1080.0
ANGLE OF PK TQ	DEG	91.0	144.0
TORQ @ 30.0 DEG	N-M	0.0	0.0
TORQ @ 0.18 SEC	N-M	48.0	26.3
COEFF. OF VAR.	%	5.7	2.1
MAX REP TOT WORK	J	266.6	132.7
MAX WORK REP #	#	4	1
WRK/BODYWEIGHT	%	416.5	207.3
TOTAL WORK	J	1245.0	644.7
WORK FIRST THIRD	J	389.6	234.2
WORK LAST THIRD	J	427.3	206.4
WORK FATIGUE	%	-9.7	11.9
AVG. POWER	WATTS	133.3	67.9
ACCELERATION TIME	MSEC	40.0	220.0
DECELERATION TIME	MSEC	260.0	60.0
ROM	DEG	99.0	
AVG PEAK TQ	N-M	202.1	97.2
AGON/ANTAG RATIO	%	47.5	G: 49.0



APPENDIX B

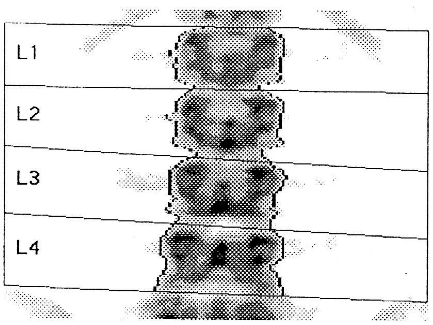
LUMBAR BONE MINERAL DENSITY ASSESSMENT SHEET

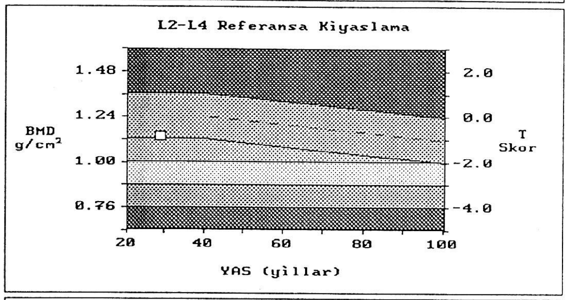
ORTA DOGU TEKNIK UNIVERSITESI
SAGLIK VE REHBERLIK MERKEZI
DENSITOMETRE UNITESI

HASTA ID:
ISIM:

ÖLÇÜM:4.8 20.01.2006
ANALIZ:4.8 13.02.2006

ID: ÖLÇÜM TARIH20.01.2006





L2-L4 BMD (g/cm²)1	1.138 ± 0.01
L2-L4 T-Skor2	-0.85 ± 0.1
L2-L4 Z-Skor3	-0.85 ± 0.1
L2-L4 sBMD (mg/cm²)7	1083 ± 10

LUNAR®

IMAJ DIAGNOZ IÇIN DEGILDIR

Yas (yillar)........	29	Büyük Standart......	273.95	Ölçüm Modu..........	Orta
Cinsiyet...........	Erkek	Orta Standart.......	203.47	Ölçüm Tipi..........	DPX
Kilo (Kg)..........	64	Küçük Standart......	144.12	Kolimasyon (mm).....	1.68
Boy (cm)...........	172	Low keV Air (cps)...	714386	Örnek Boyut (mm)....	1.2x 1.2
Etnik..............	Beyaz	High keV Air (cps)..	415234	Akim (µA)...........	750
Sistem.............	5742	R-degeri (%Yag).....	1.376(8.0)		

Bölge	BMD[1] g/cm²	Genç Eriskin[2] %	T	Yas Grubu[3] %	Z
L1	1.053	91	-0.9	91	-0.9
L2	1.125	91	-1.0	91	-1.0
L3	1.139	92	-0.8	92	-0.8
L4	1.148	93	-0.8	93	-0.8
L1-L2	1.091	91	-0.9	91	-0.9
L1-L3	1.108	92	-0.9	92	-0.9
L1-L4	1.119	92	-0.8	92	-0.8
L2-L3	1.132	91	-0.9	91	-0.9
L2-L4	1.138	92	-0.9	92	-0.9
L3-L4	1.144	92	-0.8	92	-0.8

1 - Presizyon ve kesinlik için appendix'e bakiniz.
Istatistiksel olarak tekrarlanmis ölçümlerin 68%'i 1 SD içinde olur. (±0.01 g/cm²)
2 - AMERIKAN REFERANSI KULLANILMISTIR / T-SKOR YAS ARALIGI 20-40 PEAK BONE DEGERLERIDIR.
3 - Yasa ve Etnik'e göre.
7 - Lunar BMD L2-L4 için 1.138 g/cm². J Bone Miner Res 1994'e bakiniz; 9:1503-1514

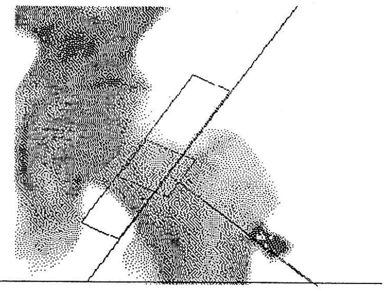
APPENDIX C

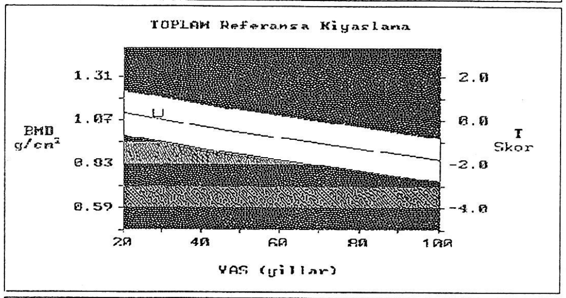
PROXIMAL FEMUR BONE MINERAL DENSITY ASSESSMENT SHEET

ORTA DOGU TEKNIK UNIVERSITESI
SAGLIK VE REHBERLIK MERKEZI
DENSITOMETRI UNITESI

HASTA ID:	ÖLÇÜM:	4.8	20.01.2006
ISIM:	ANALIZ:	4.8	20.01.2006

ID: ÖLÇÜM TARIH 20.01.2006





TOPLAM BMD (g/cm²)[1]	1.109 ± 0.02
TOPLAM % Genç Eriskin[2]	104 ± 2
TOPLAM % Yas Grubu[3]	103 ± 2
TOPLAM sBMD (mg/cm²)[7]	1055 ± 20

Yas (yillar).........	29	Büyük Standart......	273.95	Ölçüm Modu...........	Hi-Res Orta
Cinsiyet.............	Erkek	Orta Standart.......	203.47	Ölçüm Tipi...........	DPXIQ
Kilo (Kg)............	64	Küçük Standart......	144.12	Kolimasyon (mm)......	1.68
Boy (cm).............	172	Low keV Air (cps)...	714386	Örnek Boyut (mm).....	0.6x 1.2
Etnik................	Beyaz	High keV Air (cps)..	415234	Bölge uzunlugu (mm)..	80.0
Sistem...............	7294	R-degeri (%Yag).....	1.379(6.9)	Bölge eni (mm).......	15.0
Taraf................	Sol	Akim (μA)...........	750	Bölge açisi (drc)....	61

Bölge	BMD[1] g/cm²	Genç Eriskin[2] %	T	Yas Grubu[3] %	Z
BOYUN	1.050	98	-0.2	98	-0.2
TOPLAM	1.109	104	0.3	103	0.3

1 - Presizyon ve kesinlik için appendix'e bakiniz.
Istatistiksel olarak tekrarlanmis ölçümlerin 68%'i 1 SD içinde olur. (±0.02 g/cm²)
2 - TÜRK REFERANSI (20-85 YAS) KULLANILMISTIR / T-SKOR YAS ARALIGI 20-45 PEAK BONE DEGERLERIDIR.
3 - Yasa ve Etnik'e göre.
7 - Lunar BMD TOPLAM için 1.109 g/cm². J Bone Miner Res 1994'e bakiniz; 9:1503-1514