Comparison of Isokinetic Powers (Flexion And Knee Extension) of Basketball And Football Players (Age 17 – 20)

Ugur Senturk, Ibrahım Erdemır, Faruk Guven, Cuma Ece

Abstract**—**The objective of this study is to compare flexion and extension movements in knee-joint group by measuring isokinetic knee power of amateur basketball and football players. For this purpose, total 21 players were included, which consist of football players (n=12) and basketball players (n=9), within the age range of 17 – 20. After receiving the age, length, body weight, vertical jump and BMI measurements of all subjects, the measurement of lower extremity knee-joint movement (Flexion-Extension) was made with Isokinetic dynamometer (isomed 2000) at 60^o/sec. and 240^o/sec. angular velocity. After arrangement and grouping of collected information forms and knee flexion and extension parameters, all data were analyzed with SPSS for Windows. Descriptive analyses of the parameters were made. Non-parametric t test and Mann-Whitney U test were used to compare the parameters of football players and basketball players and to find the inter-group differences. The comparisons and relations in the range $p<0.05$ and $p<0.01$ between the groups were surveyed. As a conclusion, no statistical differences were found between isokinetic knee flexion and extension parameters of football and basketball players. However, it was found that the football players were older than the basketball players. In addition to this, the average values of the basketball players in the highest torque and the highest torque average curve were found higher than football players in comparisons of left knee extension. However, it was found that fat levels of the basketball players were found to be higher than the football players.

Keywords**—**Isokinetic contraction, isokinetic dynamometer, peak torque, flexion, extension, football, basketball

U. Senturk is with School of Physical Education and Sport, Çanakkale 18 Mart University, Turkey (e-mail: ugur_senturk@mynet.com).

I. Erdemır is with School of Physical Education and Sport, Balıkesir University, Turkey (e-mail: iboerdemir@yahoo.com).

F. Guven is with Institute of Education Sciences, Sakarya University, Sakarya, Turkey (Phone: +90 332 223 47 71; fax: +90 332 241 16 08;(e-mail: ronovatio10@hotmail.com).

C. Ece is with School of Physical Education and Sport, Sakarya University, Sakarya, Turkey; (e-mail: cumaece@hotmail.com).

I. INTRODUCTION

In our day, sports continue to grow as a significant sector thanks to plannings which are based on scientific principles. In sports, it is necessary to draw upon multiple sciences in those exercises which push the limits of human power [4]. Physical exercises regularly performed each day ensure that muscles, bones, joints and body functions work in the most proper way. Strength and improvement of strength are very significant in order to attain a superior motor performance level which is a precondition for success in sports. Strength exercises cover joints as well as muscles. Therefore, joint flexibility is also important.

Improvement of muscular strength is based on the thickness of a muscle's cross-section. Methods containing various types of contraction (isometric, isotonic and isokinetic) are used in measuring and increasing dynamic muscle strength. Since the ends of 1960, an isokinetic dynamometer has become a popular tool in muscle measurement, assessment and improvement [6]. In order to assess the balance of strength between the reciprocal muscle groups, their strength ratios are measured. Researches carried out on hamstring-quadriceps strength ratio make it possible to taking right decisions on muscular balance and dynamic stabilization in the knee joint. Determining the isokinetic strength profiles of sportsmen in various branches is very significant in terms of meeting the necessities of the relevant branch and in terms of the continuity of the sportsmen's top level performances [4]. Isokinetic contraction means the maximum contraction of a muscle at a constant velocity along the entire joint movement. If the velocity is not constant, it will not be possible to measure the strength, work and power that emerge in dynamic exercises or to reach accurate results. Velocity is constant during isokinetic dynamometer measurements, so the velocity of the moving body part or the extremity does not exceed the preset velocity regardless of the force applied by the person. The resistance applied by the dynamometer against the force created by the muscles to exceed that speed is equal to the force applied at each point of the extent of movement [3]. Isokinetic dynamometric measurement systems are devices which enable both to measure the strengths of muscle groups at various velocities of movement and to perform various exercises, especially

isokinetic exercises [1]. In this context, the current study aims to compare the flexion and extension movements in the knee-joint group of sportsmen in various branches, to determine, by assessing the isokinetic contraction characters, the velocities at which the actual isokinetic loading occurs, and to interpret them in detail.

II. METHOD

The research model is based on the isokinetic dynamometer method. Isokinetic dynamometric measurement systems are devices which enable both to objectively and sensitively measure the strengths of muscle groups at various speeds of movement and to perform various exercises, especially isokinetic exercises. By these systems, isometric and isokinetic exercises and measurements are carried out at the full range of motion or between specific angles. Results are obtained as numeric values on a graphic.

Population and Sampling: Population of the study is "17 to 20 year-old male sportsmen in amateur sport clubs in the branches of basketball and football" in the central Balıkesir city (Turkey). The study's specific sampling on the other hand is a total of twenty one healthy amateur male sportsmen including 12 football players and 9 basketball players who participated in the study voluntarily from among the study population and who had no disability, played in amateur football or basketball clubs, trained regularly, did not smoke or use alcohol or any drugs which could affect their blood levels and their performances.

The sportsmen who took part in the study were informed about the objective, method, expected benefits and possible risks of the study. We ensured that each participant signed the "Information and Consent Form" (Attachment 1). The measurement method by an isokinetic dynamometer started with the selection of subjects, then the subjects completed a personal information form, then their heights and weights were assessed, they were instructed to warm up and then the measurements were carried out by the isokinetic dynamometer method.

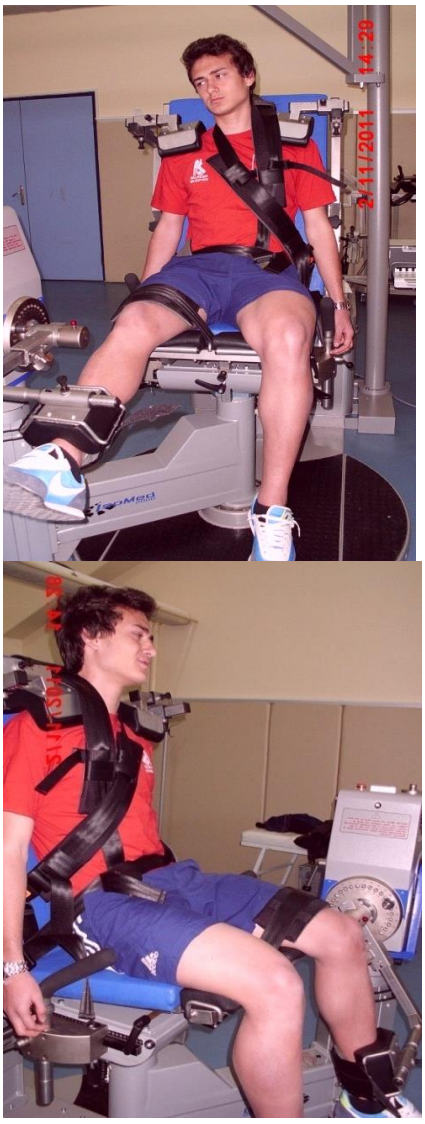
Data Collection Tools and Techniques

Weights and heights of the subjects were measured by a Tanita bc418 (as kg and cm, respectively, with a 0,01 precision) and both of the measurements were carried out after an exhalation, on bare feet, with subjects having only shorts and a t-shirt on them.

We carried out our measurements by the isokinetic dynamometer method (isomed 2000). Our reason for preferring this method is because an isokinetic test enables us to perform a qualitative measurement of the musculoskeletal performance. As isokinetic assessment can determine the range of motion where there is a muscular weakness, a targeted strengthening can be applied to that range. It is also possible to have a sportsman watch their own performance during a test or exercise, to show them numeric results and give notices. It is a method which features a high reliability and accuracy in calculating muscular strength and torque production.

On a test day, angular speeds were set to 60°/sec. and 240°/sec. during a lower-extremity knee-joint motion measurement of 3 of the sportsmen. It took long, however, to complete the measurements of all 21 sportsmen. The measurements extended to a long period of time like four months due to various factors such as intense training schedules of the sportsmen, variable availability of the exercise physiology laboratory measurement center, operation method of the measurement tools, access to the measurement center, and status of communication with the sportsmen.

A bicycle ergometer was used for the lower extremity in warming up. The subjects were instructed to perform warming up exercises for 5 minutes by 55 ± 5 rpm on a bicycle ergometer. During the warm-up period, pulse rate was maintained at a range of 100 to 120 pulses / minute. Five minutes of stretching exercises were used before and after the tests to avoid any disability.



On the other hand, the subjects were given loud verbal notices to perform their strongest contraction during the exercise in order for the maximalcontractions to be performed deliberately.

Pieces necessary to set the dynamometer: A knee adapter, a connection point of the knee adapter, a torso belt, a piece which fixes the contralateral part (lower extremity), and a lumbar pillow.

Chair Settings: Rotational degree: 40°; Back angle: 85°; Sitting / Lying position: Sitting; Distance between the Chair and the Dynamometer:

Dynamometer Settings: Tilting degree: 0°, Height: 8, Rotational degree: 40°

Isolation and stabilization: The backside angle of the dynamometer's chair was adjusted to 85° and the relevant subject was seated. The rotational axis of the knee-joint (lateral femoral condyle) was adjusted so that it is on the same line as the rotational axis of the dynamometer shaft. Connection point of the knee-joint of the dynamometer was fixed about 3 cm proximal to the dorsal aspect of the foot of the extremity to be measured. For stabilization, belts were fastened over the pelvis, breast and other knee-joint. In order to prevent the movement of the other knee, the ankle was placed into the leg fixer on the lower part of the chair. Mechanical ROM lock (stop) was made firm in accordance with the subject's angle of joint motion.

The first movement: Knee extension.

Average ROM (Range of Motion): 103.60 ± 17.86 degrees for the right extremity and 102.30 ± 23.38 degrees for the left extremity.

The muscles which work during the joint movement:

Knee Flexion: M. biceps femoris, m. semitendinosus and m. semimembranosus are the main muscles involved. M. sartorious, m. gracilis, m. gastrocnemius and m. popliteus also contribute to the performance of the movement.

Knee extension: M. quadriceps femoris is the essential muscle.

TABLE 2.

Angular Velocity	Number Of Repetitions	Resting Time
60 degree/s	10 repetitions	30 s
240 degree/s	10 repetitions	30 s

After the measurements, the 1st and the 10th repetitions of the subjects during the test were not included in the calculations.

Data Analysis

After the arrangement and grouping of the collected information forms and isokinetic knee flexion and extension parameters, descriptive analyses of the parameters (Minimums & Maximums, Arithmetic Means and Standard Deviation) was proceeded with. Then the results obtained were tabulated and graphed.

The non-parametric t test and the Mann-Whitney U test were implemented to compare the parameters of the basketball and football players and to determine the inter-group differences. Comparisons and correlations at the levels of $p<0,05$ and $p<0,01$ were examined between the groups.

FINDINGS

Demographic Characteristics

A total of 21 healthy male sportsmen including 12 football players with an average height of 182.42 ± 4.46 cm and an average body weight of 74.08 ± 7.98 kg, and 9 basketball players with an average height of 185.87 ± 8.93 cm and an average body weight of 75.78 ± 13.21 kg, all of whom were aged between 17 and 20 years and played in amateur football or basketball clubs, participated in the study.

TABLE 1.
PHYSICAL CHARACTERISTICS OF THE FOOTBALL AND BASKETBALL PLAYERS

	Football (12)		Basketball (9)			
Parameters	X	SD	X	SD	Z	P
Age	19.25	1.22	15.67	0.87	-3.90	0.00
Height	182.42	4.46	185.67	8.93	-0.75	0.46
Body Weight	74.08	7.98	75.78	13.21	-0.11	0.92
Vertical Jump	43.00	3.86	48.44	7.89	-1.64	0.11
Body Mass Index (BMI)	21.77	1.94	22.7	4.27	-0.50	0.65

As seen in Table 1, the vertical jump of the football players was 43.00± 3.86 while the vertical jump of the basketball players was 48.44 ± 7.89. In comparison of the ages of the two groups, it was found that the football players were older than the basketball players (z=3.90).

TABLE 3.
RIGHT KNEE EXTENSION COMPARISON BY AN ISOKINETIC DYNAMOMETER AT AN ANGULAR VELOCITY OF 240°/S

Futbooll			Basketball			
Parametres	X	SD	X	SD	Z	P
Peak Torque	155.08	19.95	167.33	40.07	-0.78	0.46
Peak Work	117.75	37.00	124.22	25.73	-0.21	0.86
Peak Torque Average Curve	136.00	15.15	139.22	32.81	-0.75	0.46
Average Work	112.87	14.80	108.34	25.30	-0.14	0.92
Total Work	909.75	120.04	866.56	202.74	-0.28	0.81
Peak Strength	307.75	41.54	301.89	68.48	-0.04	0.97
Average Strength	263.00	60.49	255.78	67.08	-0.18	0.86

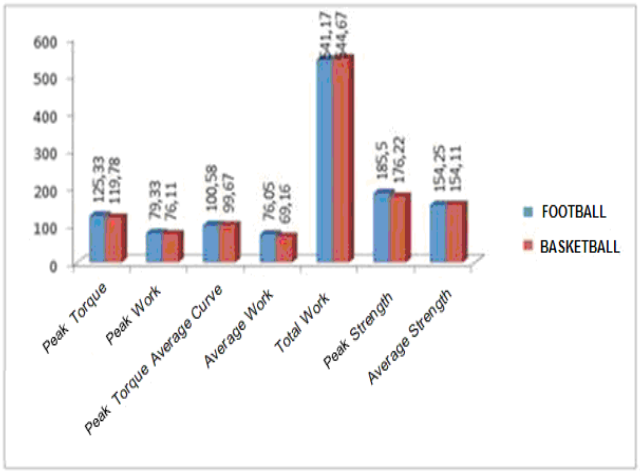
As could be seen from Table 3, the peak torque (Z=-0.78), the peak work (Z=-0.21), the peak torque average curve (Z=-0.75), average work (Z=-0.14), total work (Z=-0.28), the peak strength (Z=-0.04) and the average strength (Z=-0.18) were found based on by the Right Knee Extension Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 240°/s, however, no statistically significant differences were found (p<0.00).

TABLE 4.
LEFT KNEE EXTENSION COMPARISON BY AN ISOKINETIC DYNAMOMETER AT AN ANGULAR VELOCITY OF 240°/S

Footbaall (12)			Basketball (9)			
Parameters	X	SD	X	SD	Z	P
Peak Torque	160.92	50.87	169.89	31.36	0.00	1.00
Peak Work	125.67	15.21	123.00	23.75	-050	0.65
Peak Torque Average Curve	145.42	23.86	140.44	21.28	-0.50	0.65
Average Work	100.36	27.91	107.60	18.75	-0.46	0.65
Total Work	917.42	126.76	860.56	149.64	-1.07	0.31
Peak Strength	312.17	42.25	293.00	60.57	-0.85	0.42
Average Strength	280.58	44.65	252.11	44.83	-1.46	0.15

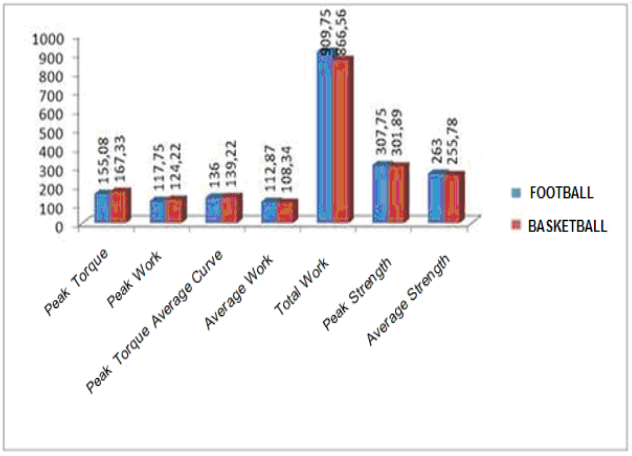
As could be seen from Table 4, the peak torque (Z=-0.00), the peak work (Z=-0.50), the peak torque average curve (Z=-0.50), average work (Z=-0.46), total work (Z=-1.07), the peak strength (Z=-0.85) and the average strength (Z=-1.46) were found based on by the Left Knee Extension Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 240°/sec. No statistically significant differences were found between the average values.

GRAPHIC 3.
RIGHT KNEE EXTENSION COMPARISON BY AN ISOKINETIC DYNAMOMETER AT AN ANGULAR VELOCITY OF 240°/S



Left Knee Extension (Angular Velocity 240°C/s)
ROM: The movement was performed by a joint motion of 102.30 ± 23.38 degrees.
Isokinetic loading range: Left Knee Extension was applied by an angular velocity of 240°C/sec.

GRAPHIC 4.
LEFT KNEE EXTENSION COMPARISON BY AN ISOKINETIC DYNAMOMETER AT AN ANGULAR VELOCITY OF 240°/



Right Knee Flexion (Angular Velocity 240°C/s)
ROM: The movement was performed by a joint motion of 103.60 ± 17.86 degrees.
Isokinetic loading range: Right Knee Flexion was applied by an angular velocity of 240°C/sec.

TABLE 5.
RIGHT KNEE FLEXION COMPARISON BY AN ISOKINETIC DYNAMOMETER AT AN ANGULAR VELOCITY OF 240°/S

	Footbal (12)		Basketball (9)			
Parameters	X	SD	X	SD	Z	P
Peak Torque	125.33	157.00	119.78	31.78	0.00	1.00
Peak Work	79.33	99.00	76.11	20.36	-0.25	0.81
Peak Torque Average Curve	100.58	146.00	99.67	32.88	-0.04	0.97
Average Work	76.05	96.20	69.16	19.13	-0.53	0.60
Total Work	541.17	688.00	544.67	139.76	-0.07	0.97
Peak Strength	185.50	244.00	176.22	56.16	-0.39	0.70
Average Strength	154.25	204.00	154.11	46.43	-0.11	0.92

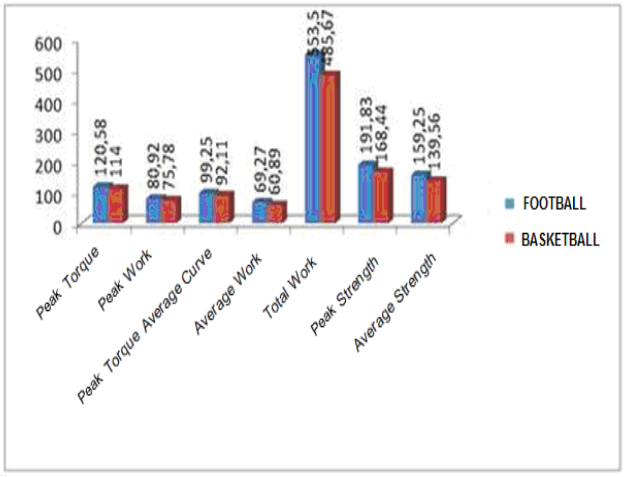
As could be seen from Table 5, the peak torque (Z=-0.00), the peak work (Z=-0.25), the peak torque average curve (Z=-0.04), average work (Z=-0.53), total work (Z=-0.07), the peak strength (Z=-0.39) and the average strength (Z=-0.11) were found based on by the Right Knee Flexion Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 240°/sec. No statistically significant differences were found between the average values.

TABLE 6.
LEFT KNEE FLEXION COMPARISON BY AN ISOKINETIC DYNAMOMETER AT AN ANGULAR VELOCITY OF 240°/S

	Footbal (12)		Basketball (9)			
Parameters	X	SD	X	SD	Z	P
Peak Torque	120.58	12.50	114.00	24.23	-0.18	0.86
Peak Work	80.92	8.47	75.78	16.74	-0.64	0.55
Peak Torque Average Curve	99.25	13.18	92.11	27.38	-0.21	086
Average Work	69.27	9.65	60.89	19.16	-0.85	0.42
Total Work	552.50	77.04	465.67	152.79	-0.89	0.38
Peak Strength	191.83	1631	168.44	47.44	-1.00	0.35
Average Strength	159.25	21.02	139.56	47.79	-0.64	0.55

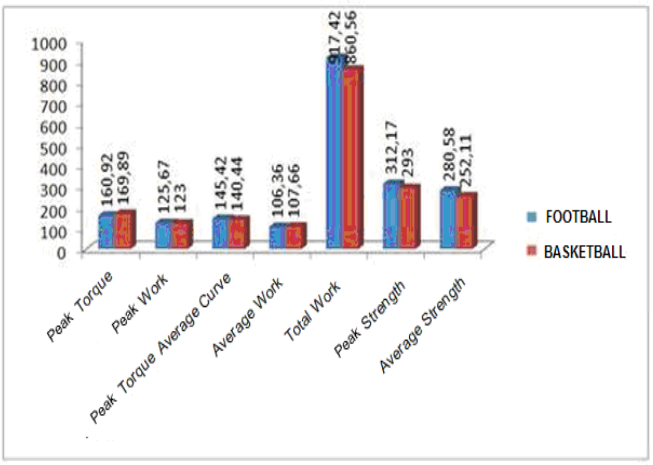
As could be seen from Table 6, the peak torque (Z=-0.18), the peak work (Z=-0.64), the peak torque average curve (Z=-0.21), average work (Z=-0.85), total work (Z=-0.89), the peak strength (Z=-1.00) and the average strength (Z=-0.64) were found based on by the Left Knee Flexion Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 240°/sec. No statistically significant differences were found between the groups.

GRAPHIC 5.
RIGHT KNEE FLEXION COMPARISON BY AN ISOKINETIC DYNAMOMETER AT AN ANGULAR VELOCITY OF 240°/S



Left Knee Flexion (Angular Velocity 240°C/s)
ROM: The movement was performed by a joint motion of 102.30 ± 23.38 degrees.
Isokinetic loading range: Left Knee Flexion was applied by an angular velocity of 240°C/sec.

GRAPHIC 6.
LEFT KNEE FLEXION COMPARISON BY AN ISOKINETIC DYNAMOMETER AT AN ANG ULAR VELOCITY OF 240°/S



Right Knee Extension (Angular Velocity 60°C/s)
ROM: The movement was performed by a joint motion of 103.60 ± 17.86 degrees.
Isokinetic loading range: Right Knee Extension was applied by an angular velocity of 60°C/sec.

TABLE 7.
RIGHT KNEE EXTENSION COMPARISON BY AN ISOKINETIC DYNAMOMETER AT AN ANGULAR VELOCITY OF 60°/S

Footbal (12)			Basketball (9)			
Parameters	X	SD	X	SD	Z	P
Peak Torque	232.08	41.14	246.22	26.19	-0.01	0.55
Peak Work	194.25	34.93	191.11	28.89	-0.07	0.97
Peak Torque Average Curve	213.08	37.60	230.78	22.49	-0.99	0.35
Average Work	170.08	31.74	166.26	31.40	-0.21	086
Total Work	1426.67	268.14	1330.11	250.51	-0.36	0.75
Peak Strength	181.00	63.89	172.56	20.74	-0.11	0.92
Average Strength	157.58	32.87	160.78	17.62	-0.36	0.75

As could be seen from Table 7, the peak torque (Z=-0.61), the peak work (Z=-0.07) the peak torque average curve (Z=-0.99) average work (Z=-0.21), total work (Z=-0.36), the peak strength (Z=-0.11) and the average strength (Z=-0.36) were found based on by the Right Knee Extension Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 60°/sec. No statistically significant differences were found between the groups.

TABLE 8.
LEFT KNEE EXTENSION COMPARISON BY AN ISOKINETIC DYNAMOMETER AT AN ANGULAR VELOCITY OF 60°/S

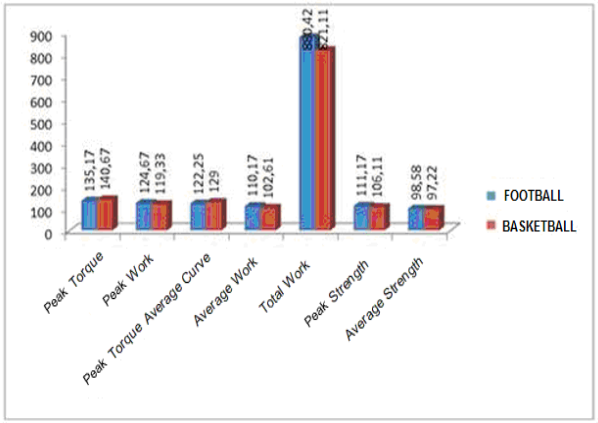
Footbal(12)			Basketball (9)			
Parameters	X	SD	Min	SD	Z	P
Peak Torque	225.25	37.05	178.00	38.62	-2.13	0.03
Peak Work	186.08	57.81	160.00	24.85	-1.50	0.15
Peak Torque Average Curve	203.83	42.93	163.00	34.34	-1.99	0.05
Average Work	185.29	29.66	145.90	25.48	-0.07	0.97
Total Work	1482.92	238.11	1168.00	203.90	-0.04	0.97
Peak Strength	179.58	57.42	118.00	30.63	-0.82	0.42
Average Strength	166.08	51.68	109.00	26.61	-0.85	0.42

*P<0.01 *P<0.05

As shown in Table 8, the peak work (Z=-0.07), average work (Z=-0.07), total work (Z=-0.04), the peak strength (Z=-0.82) and the average strength (Z=-0.85) were found based on by the Left Knee Extension Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 60°/s, and no statistically significant differences were found between the groups.

As could seen from Table 8, the peak torque (Z=-2.13) and the peak torque average curve (Z=-1.99) were found based on by the Left Knee Extension Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 60°/s, and statistically significant differences were found between the groups. As could be understood from these values, basketball players were better than the football players in terms of left knee extension isokinetic strength.

GRAPHIC 7.
RIGHT KNEE EXTENSION COMPARISON BY AN ISOKINETIC DYNAMOMETER AT AN ANGULAR VELOCITY OF 60°/S



Left Knee Extension (Angular Velocity 60°C/s)
ROM: The movement was performed by a joint motion of 102.30 ± 23.38 degrees.
Isokinetic loading range: Right Knee Extension was applied by an angular velocity of 60°C/sec.

III. Conclusion

According to the statistical data obtained based on the extension and flexion movements in the knee joints of the basketball and football players measured by an isokinetic dynamometer at the angular velocities of 60°/sec. and 240°/s:

As shown in Table 1, a total of 21 healthy male sportsmen including 12 football players with an average height of 182.42 ± 4.46 cm and an average body weight of 74.08 ± 7.98 kg, and 9 basketball players with an average height of 185.87 ± 8.93 cm and an average body weight of 75.78 ± 13.21 kg, all of whom were aged between 17 and 20 years and played in amateur football or basketball clubs, participated in the study (Table 1). The vertical jump of the football players was 43.00± 3.86 while the vertical jump of the basketball players was 48.44 ± 7.89. The body mass index (BMI) of the football players was 21.77± 1.94 and the BMI of the basketball players was 22.07± 4.27. In comparison of the ages of the two groups, it was found that the football players were older than the basketball players (z=3.90).

In a similar study which evaluated the relation between those who do physical exercises and those who do not in terms of

muscular strength and bone density, differences of age were found to be insignificant between the control and experiment groups (P>0.05). In the assessment of heights, it was determined that the Basketball and Football groups were statistically similar, while the control group was shorter than the experiment groups. In terms of body weight and bone density, on the other hand, statistically significant differences were shown between the control and experiment groups (P<0.001) [7].

As shown in Table 2, no statistically significant differences were found among the parameters of body fat mass (Z=-1.57), total fat percentage (Z=-1.57) and total fat mass (Z=-1.28) of the basketball and football players. A significant difference was found between the two groups in the level of p<0.05 in the comparisons of fat percentages (Z=2.43) in Table 2.

As could be seen from Table 3, the peak torque (Z=-0.78), the peak work (Z=-0.21), the peak torque average curve (Z=-0.75), average work (Z=-0.14), total work (Z=-0.28), the peak strength (Z=-0.04) and the average strength (Z=-0.18) were found based on by the Right Knee Extension Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 240°/s, however, no statistically significant differences were found (p<0.00).

[7] For instance, carried out a study in which they evaluated the difference of muscular strength and bone density between 40 sportsmen who were actively engaged in basketball and football and 20 healthy people who did not do exercises, all of whom were 20 to 25 years old. The authors determined that the basketball and football groups scored higher in terms of right knee extension isokinetic muscular strength at 60°/sec. and 240°/sec. compared with the control group (P≤0.001).

As could be seen from Table 4, the peak torque (Z=-0.00), the peak work (Z=-0.50), the peak torque average curve (Z=-0.50), average work (Z=-0.46), total work (Z=-1.07), the peak strength (Z=-0.85) and the average strength (Z=-1.46) were found based on by the Left Knee Extension Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 240°/sec. No statistically significant differences were found between the average values.

[7]. Determined in their assessment of the difference of muscular strength and bone density between those who did exercises and those did not that the basketball and football groups scored higher in terms of isokinetic muscular strength at 60°/sec. and 240°/sec. compared with the control group (P≤0.001).

As could be seen from Table 5, the peak torque (Z=-0.00), the peak work (Z=-0.25), the peak torque average curve (Z=-0.04), average work (Z=-0.53), total work (Z=-0.07), the peak strength (Z=-0.39) and the average strength (Z=-0.11) were found based on by the Right Knee Flexion Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 240°/sec. No statistically significant differences were found between the average values.

A significant correlation was found between the leg volume and mass, on the one hand, and anaerobic performance on the other hand and this result is in parallel with other studies which examine the relation between the leg volume and mass, on the one hand, and anaerobic performance on the other hand. Also, a significant correlation was found between the anaerobic strength obtained and the knee extension/flexion strengths at 60°/sec. and 240°/sec. and it was shown that a significant positive correlation existed between the knee extension strength at 60°/sec. and 240°/sec. and the knee flexion strength at 60°/sec. These results are similar to the results obtained in those studies which examine the relation between isokinetic knee stregnth and anaerobic performance [10]. As could be seen from Table 6, the peak torque (Z=-0.18), the peak work (Z=-0.64), the peak torque average curve (Z=-0.21), average work (Z=-0.85), total work (Z=-0.89), the peak strength (Z=-1.00) and the average strength (Z=-0.64) were found based on by the Left Knee Flexion Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 240°/sec. No statistically significant differences were found between the groups.

As could be seen from Table 7, the peak torque (Z=-0.61), the peak work (Z=-0.07) the peak torque average curve (Z=-0.99) average work (Z=-0.21), total work (Z=-0.36), the peak strength (Z=-0.11) and the average strength (Z=-0.36) were found based on by the Right Knee Extension Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 60°/sec. No statistically significant differences were found between the groups.

In a study which related to the difference in the knee-joint hamstring - quadriceps (h/q) rates and disability tendencies of wrestlers and football players [9]. Aimed to measure, from different angles, the agonist-antagonist and bilateral forces of the hamstring and quadriceps muscle groups of wrestlers and footballers (H/Q differences), to assess the training methods in the light of results, and to reveal the relevant disability tendencies in sportsmen. Their study included 20 wrestlers, 20 football players and the control group of 20 persons (total 60 subjects). It was a condition that the subjects who were sportsmen played sports 5 days a week and had been active sportsmen for at least 5 years. Knee flexion / extension muscle strengths of the participants were measured at the angular velocities of 60°/sec. and 180°/sec. No statistically significant difference was found in the H/Q peak torque rates of the dominant extremities of the wrestler, football player and control groups at the angular velocities of 60°/sec. and 180°/sec. (p>0.05). It was determined that the H/Q rates of the sportsman groups who participated in the study were not so high to cause 1st degree disabilities and that the sportsmen had no disproportionate strength development or any serious tendency for disability. This showed that football players and

wrestlers worked by scientific and right training methods.

As listed in Table 8, the peak work (Z=-0.07), average work (Z=-0.07), total work (Z=-0.04), the peak strength (Z=-0.82) and the average strength (Z=-0.85) were found based on by the Left Knee Extension Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 60°/s, and no statistically significant differences were found between the groups.

As shown in Table 8, the peak torque (Z=-2.13) and the peak torque average curve (Z=-1.99) were found based on by the Left Knee Extension Comparison of football and basketball players by an Isokinetic Dynamometer at an Angular Velocity of 60°/s, and statistically significant differences were found between the groups.

[2]. Xamined the relation between the isokinetic strength of the knee extensor muscles in professional football players and test results on velocity conditions. Their study assessed the relation between velocity tests and the isokinetic strength of the knee extensor/flexor muscles of 18 football players playing in the 1st, 2nd and 3rd professional leagues. The isokinetic strength of the knee extensor/flexor muscles was tested for both legs at the velocities of 60°/s, 180°/sec. and 300°/sec. In order to relate strength to speed, the results obtained were compared with the degrees in the first and the second 33rd meters of the 60 m sprint by applying the test with 34 repetitions at a velocity of 300°/sec. which was deemed suitable in terms of durability. It was shown that the sportsmen with higher percentages of durability had higher accelerations in the second 30 m sprint stage. The flexion/extension strength rates of all the sportsmen were examined and it was determined that the sprint values of those which had a 65 to 70% FIE rates at a velocity of 300°/sec. were significantly better at the level of $p<0.05$.

Consequently, no statistical differences were found between the isokinetic strength knee flexion and extension parameters of football and basketball players. The football players, however, were found to be older than the basketball players. Besides, in left knee extension comparisons, the values of the basketball players were higher than those of the football players in the peak torque and the peak torque average curve. And the fat rate averages of the basketball players were higher than those of the footballers.

REFERENCES

[1] Adaş, R.T. İzokinetik dinamometre ile yapılan ölçümlerde farklı eklemlere ait yük aralığının terspiti. Adana. 2008.

[2] Emlek, Y. Acar, M.F. Acarbay, Ş. Çeçen, A. Selamoğ, Ju. Profesyonel Futbolcularda Diz Ekstansör Kaslarının İzokinetik Kuvveti ile Sürat Koşulları Test Sonuçları İlişkisinin İncelenmes, 2001

[3] Kurdak, SS. Özgünen, KT. Adaş, Ü. Zeren, Ç. Aslangiray, B. Yazıcı, S. Analysis of isokinetic knee extension/flexion in male elite adolescent wrestlers. Journal of Sports Science and Medicine, 2005.

[4] Magalhaes, D. Farklı branşlardaki sporcuların izokinetik kuvvet profillerinin belirlenmesi, 2004.

[5] Muratlı, S. Antreman Ve Istasyon Çalişmaları. Ankara, 1976.

[6] Sallı, A. Uğurlu, H. Emlik, D. Diz osteoartritinde konsantrik, kombine konsantrik-eksantrik ve izometrik egzersizlerin semptomplar ve fonksiyonel kapasite üzerine etkinliğinin karşılaştırılması. Türk Fiz. Tıp Rehab. Derg. 2006.

[7] Şirin, EF. İnce, A. Lök, S. Spor Yapanlar İle Spor Yapmayanların İzokinetik Kas Kuvvetleri İle Kemik Yoğunluğu Arasındaki İlişkinin Değerlendirilmesi, 2004.

[8] ve ağrı üzerine etkisi. Türk Fiz. Tıp Derg.

[9] Ziylan, T. Özdemir, M. Taştekin, G. Güreşci Ve Futbolcuların Diz Eklemi Hamstring - Quadriceps (H/Q) Oranlarındaki Farklılıkların Belirlenmesi ve Sakatlık Eğilimleri ile ilgili araştırma, 2002.

[10] B. Wellman, Health care *and* consumer choice*:* medical ... 203–212, 1997.