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Investigation of Some Bio-Motoric Characteristics and Reaction Time of Turkish Hockey Players

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Abstract: This study was conducted to determine some selected bio-motorical properties and reaction time characteristics of Turkish hockey players. The study was applied on 10 male and 7 female teams participating in the Turkish Hockey Federation 2015-2016 season Super League and participated in the study of 76 female and 119 male elite hockey players. Age, height, body weight, body mass index, vertical jump, anaerobic power, right and left hand grip strength, leg strength, back strength, flexibility, balance, and visual reaction time measurements were taken from the research group. The anaerobic power parameter was determined by the formula from the vertical jump measurement, the flexibility parameter by the sit-in test, and the balance parameter by the flamingo balance test. SPSS 22.0 program was used for analysis of the data. In the comparison of the two groups, independent samples T-test, and for multiple group comparison one-way analysis of variance and LSD correction test and Pearson correlation test were used. Significant differences were found in favor of male hockey players in height, body weight, body mass index, vertical jump, anaerobic power, right hand grip strength, left hand grip strength, leg strength, back strength and visual reaction time parameters in the obtained results ($p<0.05$). No significant differences were found between the right and left hand dominant hockey players ($p>0.05$). According to the results of one way analysis of variance, significant differences were found among age groups in height, body weight, BMI, anaerobic power, leg strength and back strength ($p<0.05$).There were statistically correlation between all other parameters except that flexibility and balance, according to correlation analysis ($p<0.05$). In conclusion, it can be said that biomotor features and visual reaction time in hockey players influenced by gender and age factors, but not dominant hand factor.
Keywords: Hockey, Bio-otoric properties, Reaction, Sports.

INTRODUCTION

Although hockey is an Olympic sport and hockey are not enough resources associated with little name recognition in Turkey. For years, sports science and ongoing research in the world because of the difficulties associated with this sport need to find subjects are forced to find a place more popular due to both the lack of enough research is done in Turkey [1].

Physical characteristics such as sporting games, strength, speed, speed, skill, mobility and physical fitness (obesity etc.) enable to reach the targeted results with regular and programmed studies since childhood and youth age [2-5]. In this sense, it is important to know the motor and anthropometric characteristics of the young people in the performance-oriented branches and to establish the profile specific to the branch. In addition, anthropometric and physiological studies contribute to the selection of the athlete and the training model to be applied and to the creation of intuition for the targeted achievement [6].

The effect of anthropometric properties on performance body structure, composition, weight and height characteristics are considered to be important factors in motor functions and performance. The anthropometric measures were related to motor performance and the potential effect on performance level was noticed [7].

It is considered that to present the bio-motoric characteristics of the Turkish hockey players, to present the normative data about the Turkish hockey players in terms of the characteristics indicated by the researcher and to contribute to this field. The aim of this study is to find adult female - male hockey players; to determine some bio-motoric properties and reaction time, to discuss these characteristics in the light of the literature and to compare the results with some country athletes who are successful in the hockey field and also to contribute scientifically in the fields mentioned in the hockey field.

METHOD

Samples

The study population hockey player in Turkey, and Turkey Hockey Federation sample 2015-2016 season Located in the super league; 119 hockey players in 10 male teams, 76 hockey players in 7 female hockey teams and 195 hockey players in total.

Study Protocol

Research in our country actively hockey playing senior male and female hockey player in the 2015-2016 season, which includes Turkey super league participating teams and players in the super league Amasya for the first and second periods, Gaziantep for the third period, the fourth period, while Antalya / Alanya provinces obtained in research were evaluated. The hockeys participating in the investigation were informed about the purpose of the study first. When they agreed to voluntarily participate in the study, the volunteer approval form was signed and the measurements were taken in accordance with the following headings. For this study from Hockey Federation and Turkey Mugla Sıtkı Kocman University Research Ethics Board (Decision No. 166) required permits are obtained.

Height and Weight

0.01 cm sensitivity was measured with a digital height measuring device, without shoes [8]. Subjects with electronic scales of 0.1 kg sensitivity were measured in shorts, t-shirts and socks and without shoes [8].

Vertical Jump and Anaerobic Power

The subjects were marked in front of the centimeter-marked wall, with the feet extending to the side of the shoulder-width open and body-marked wall side. Then each trial was given three trials in the same position and the best of them was taken into consideration. The distance between the subject's standing distance and the distance they jumped and tapped was found in meters [9]. The meter unit formula and the Lewis Nomogram were used to translate the obtained data into the anaerobic gentle [9, 10]

Hand Grip Strength

Hand grip strengths of the individuals participating in the study were measured using the Takei brand hand dynamometer. Measurements were made when the individual was standing, with the elbow and wrist fully extended. In dominant and non-dominant hands, the measurements were repeated three times at 5 'intervals and the averages were calculated and recorded in kg [11].

Back Strength

Subjects placed their feet on the dynamometer stand in a twisted state with their arms raised, their backs flat, and their body leaning slightly forward, using their maximum backward muscles to pull up the dynamometer bar vertically with their hands. This traction was repeated three times and the best value for each subject was recorded [12].

Leg Strength

Measurements of the subjects were made using the leg dynamometer. After warming for five minutes, subjects placed their legs on the dynamometer stand in a bent position, pulled up vertically using their maximum range legs, while the arms were stretched, the back straight and the body slightly inclined forward. This traction was repeated three times, and the best value for each subject was recorded [12].

Flexibility

In the measurements, the sit-in flexibility platform (Lafayette, USA) was used for flexibility measurement and the participants sat after a certain warm-up time and the bare feet rested flat against the test stand, with the body bent forward and bending the knees to the front of the body and the test was completed after 1-2 seconds of waiting. Participants were repeated the test three times and their best scores were recorded [13].

Balance

Flamingo Balance Test: The aim of the test is to balance one dimension on a certain beam on one foot. In the test, the preferred wing is to try to keep the balance on the axis for as long as possible on the length of the two beams. It can hold the foot with the hand on the same side with the speed of simulating flamingo by flexing the released leg, it can be used to achieve the other arm balance. In order to get the correct position, the test manager can be loaded in the arm and the test is started when the support is reached. In this case the balance was tried to be maintained for one (1) minute, penalty points were counted every time the balance was lost or any part of the body contacted the ground [8].

Visual Reaction Time

Visual reaction time was measured using a Newtest Powertimer instrument. The unit is 1/1000 sec. the time of visual reaction of the species was recorded. In the visual reaction, the lights on the left and right buttons illuminate intricately and detect a visual reaction without any sound stimuli. Five repetitive exercise tests were performed before measurements were recorded. Athletes made their hands ready on the buttons before being commanded. Measurement was started after the investigator gave the read command. The light stimulus waited 2-4 seconds until it arrived. Ten replicate measurements of all participants were taken and the best and worst values were calculated and the arithmetic mean was calculated [9].

STATİSTİCAL ANALYSİS

Statistical analysis of the SPSS package program (SPSS for Windows, Version 22.0, SPSS Inc., USA) was performed in the Excel program (Microsoft Office, version 2007, Microsoft Corp., Redmond, WA,

USA) Chicago, Illinois, USA). Data; arithmetic mean, standard deviation. Shapiro-Wilk test for normality test; Levene test was applied for homogeneity test. The skewness and kurtosis values for the data sets with no normal distribution were checked and it was assumed that the data sets within the range of ± 2 showed normal distribution. Independent t-test was used to compare the two groups. One-way analysis of variance and LSD correction tests were used for multiple group comparisons. Statistical results were assessed at $p < 0.05$ significance level.

RESULTS

In this part of the study, the data and analyzes obtained from the research group are presented. The mean, standard deviation, minimum and maximum values are given as the result of the obtained data.

Table-1: Mean, standard deviation, minimum and maximum values of the bio-motor characteristics measured by the research group (N = 195)

	Min.	Max.	Mean	Std. Dev.
Age (year)	14.00	38.00	20.44	4.32
Height (cm)	142.00	190.00	170.93	9.22
Weight (kg)	41.00	105.00	63.60	11.16
Body mass index (kg/m^2)	16.41	31.35	21.64	2.46
Vertical Jump (cm)	4.00	65.00	41.64	8.89
Anaerobic power (kg.m/sec)	32.76	145.52	90.79	21.44
Right hand grip strength (kg)	16.70	62.50	35.85	9.28
Left hand grip strength (kg)	18.30	64.30	36.27	9.01
Leg strength (kg)	18.00	152.00	77.48	28.35
Back strength (kg)	30.00	162.50	88.27	28.08
Flexibility (cm)	2.00	43.00	26.44	6.53
Balance (eror)	0.00	12.00	3.15	2.66
Visual reaction time (msec)	20.50	60.13	36.76	6.21

Table 1 presents some bio-motoric parameters and reaction time values measured by the research group.

Table-2: Mean, standard deviation, minimum and maximum values of some measured bio-motoric parameters of male (n = 119) and female (n = 76) hockey players

		Min.	Max.	Mean	Std. Dev.
Male n: 119 %: 61.0	Age (year)	14.00	38.00	20.97	4.62
	Height (cm)	163.00	190.00	176.13	6.32
	Weight (kg)	48.00	105.00	69.58	9.23
	Body mass index (kg/m^2)	17.96	31.35	22.40	2.47
	Vertical Jump (cm)	4.00	65.00	45.01	8.56
	Anaerobic power (kg.m/sec)	32.76	145.52	102.75	17.17
	Right hand grip strength (kg)	20.00	62.50	41.65	6.52
	Left hand grip strength (kg)	27.90	64.30	42.03	5.94
	Leg strength (kg)	35.00	152.00	92.81	23.82
	Back strength (kg)	54.00	162.50	105.60	20.42
	Flexibility (cm)	2.00	43.00	26.37	7.48
	Balance (eror)	0.00	11.00	2.93	2.56
	Visual reaction time (msec)	20.50	57.13	35.75	5.71
Female n: 76 %: 39.0	Age (year)	14.00	29.00	19.61	3.69
	Height (cm)	142.00	177.00	162.78	6.83
	Weight (kg)	41.00	72.00	54.24	6.54
	Body mass index (kg/m^2)	16.41	29.55	20.44	1.92
	Vertical Jump (cm)	20.00	50.00	36.37	6.56
	Anaerobic power (kg.m/sec)	44.55	97.05	72.06	10.67
	Right hand grip strength (kg)	16.70	38.30	26.76	4.33
	Left hand grip strength (kg)	18.30	37.00	27.25	4.37
	Leg strength (kg)	18.00	89.50	53.48	15.18
	Back strength (kg)	30.00	91.50	61.14	12.72
	Flexibility (cm)	14.00	35.00	26.55	4.73
	Balance (eror)	0.00	12.00	3.50	2.78
	Visual reaction time (msec)	25.75	60.13	38.33	6.66

In Table 2, male and female hockeys participating in the research have some measured bio-motoric parameters and reaction time characteristics. Male players account for 61% of the research group and female players account for 39%.

Table-3: Mean, standard deviation, minimum and maximum values of some measured bio-motoric properties of hockey players using right (n = 181) and left (n = 14)

		Min.	Max.	Mean	Std. Dev.
Right dom.	Age (year)	14.00	38.00	20.41	4.37
	Height (cm)	142.00	190.00	170.96	9.24
n: 181	Weight (kg)	41.00	105.00	63.63	11.27
%: 92.8	Body mass index (kg/m^2)	16.41	31.35	21.64	2.50
	Vertical Jump (cm)	20.00	65.00	41.96	8.63
	Anaerobic power (kg.m/sec)	44.55	145.52	91.35	21.38
	Right hand grip strength (kg)	16.70	62.50	35.90	9.45
	Left hand grip strength (kg)	18.30	64.30	36.15	9.07
	Leg strength (kg)	18.00	152.00	77.30	28.51
	Back strength (kg)	30.00	162.50	87.87	28.06
	Flexibility (cm)	2.00	43.00	26.53	6.60
	Balance (eror)	0.00	12.00	3.24	2.69
	Visual reaction time (msec)	20.50	60.13	36.90	6.36
Left dom.	Age (year)	14.00	27.00	20.71	3.83
	Height (cm)	154.00	185.00	170.50	9.32
n: 14	Weight (kg)	51.00	83.00	63.21	10.06
%: 7.2	Body mass index (kg/m^2)	18.07	24.78	21.64	1.92
	Vertical Jump (cm)	4.00	53.00	37.50	11.31
	Anaerobic power (kg.m/sec)	32.76	116.20	83.52	21.58
	Right hand grip strength (kg)	24.00	50.70	35.24	6.93
	Left hand grip strength (kg)	24.30	51.60	37.87	8.26
	Leg strength (kg)	40.00	128.00	79.86	27.14
	Back strength (kg)	58.00	146.00	93.50	28.89
	Flexibility (cm)	11.00	35.00	25.21	5.74
	Balance (eror)	0.00	5.00	2.00	1.88
	Visual reaction time (msec)	30.50	41.63	34.85	3.42

Table 3 presents the measured bio-motoric and reaction time characteristics of right and left hand dominant hockey players participating in the study. It was determined that right handed dominant players constituted 92.8% of the research group and 7.2% of the left dominant players.

Table-4: Average, standard deviation, minimum and maximum values of some bio-motoric parameters measured by hockey players according to age groups

		Min.	Max.	Mean	Std. Dev.
Under 19 n: 94 %: 48.2	Height (cm)	142.00	190.00	169.35	9.97
	Weight (kg)	41.00	105.00	59.94	10.92
	Body mass index (kg/m^2)	16.41	31.35	20.76	2.27
	Vertical Jump (cm)	4.00	65.00	40.53	9.45
	Anaerobic power (kg.m/sec)	32.76	131.33	84.05	20.22
	Right hand grip strength (kg)	16.70	57.00	34.28	9.53
	Left hand grip strength (kg)	18.30	55.30	34.89	9.36
	Leg strength (kg)	18.00	143.00	71.25	27.38
	Back strength (kg)	30.00	146.00	82.18	25.72
	Flexibility (cm)	2.00	43.00	27.05	6.32
	Balance (eror)	0.00	12.00	3.43	2.75
	Visual reaction time (msec)	21.00	56.13	37.57	6.42
20-24 years n: 72 %: 36.9	Height (cm)	154.00	190.00	171.11	8.34
	Weight (kg)	48.00	85.00	65.18	9.50
	Body mass index (kg/m^2)	18.00	29.55	22.19	2.29
	Vertical Jump (cm)	25.00	65.00	42.47	9.06
	Anaerobic power (kg.m/sec)	62.86	139.54	94.16	20.52
	Right hand grip strength (kg)	20.60	62.50	36.75	8.90
	Left hand grip strength (kg)	21.10	64.30	36.70	8.90
	Leg strength (kg)	35.00	138.00	79.83	26.83
	Back strength (kg)	43.70	162.50	89.74	27.70
	Flexibility (cm)	9.00	40.00	25.78	6.78
	Balance (eror)	0.00	11.00	3.06	2.75
	Visual reaction time (msec)	20.50	57.13	35.43	5.69
25-29 year n: 22 %: 11.3	Height (cm)	160.00	184.00	174.50	6.44
	Weight (kg)	51.00	85.00	69.18	9.82
	Body mass index (kg/m^2)	17.31	27.76	22.66	2.47
	Vertical Jump (cm)	35.00	50.00	41.91	4.85
	Anaerobic power (kg.m/sec)	71.40	126.22	99.19	16.52
	Right hand grip strength (kg)	19.10	49.00	38.31	8.27
	Left hand grip strength (kg)	19.00	48.40	38.95	7.87
	Leg strength (kg)	28.00	152.00	89.95	33.23
	Back strength (kg)	42.00	150.00	102.59	31.81
	Flexibility (cm)	13.00	42.00	25.50	6.57
	Balance (eror)	0.00	7.00	2.55	2.20
	Visual reaction time (msec)	29.88	60.13	37.52	6.64
Upper 30 n: 7 %: 3.6	Height (cm)	168.00	190.00	179.00	8.72
	Weight (kg)	64.00	98.00	79.14	11.80
	Body mass index (kg/m^2)	22.15	27.15	24.57	1.76
	Vertical Jump (cm)	40.00	60.00	47.14	7.56
	Anaerobic power (kg.m/sec)	89.60	145.52	120.23	21.55
	Right hand grip strength (kg)	20.00	50.00	39.82	10.58
	Left hand grip strength (kg)	35.90	46.00	41.90	3.77
	Leg strength (kg)	75.00	115.00	97.86	16.20
	Back strength (kg)	70.00	140.00	110.00	26.77
	Flexibility (cm)	13.00	36.00	28.00	7.09
	Balance (eror)	1.00	5.00	2.43	1.27
	Visual reaction time (msec)	25.00	43.13	37.07	6.09

The bio-motoric and reaction time characteristics of the hockeys participating in the study are presented in Table 4 according to age groups. 48.2% of the research group of the players aged 19 and under, 36.9% of the players aged 20-24, 11.3% of the players aged 25-29, 3.6% of the players aged 30 and over.

Table-5: Comparison of some measured bio-motoric parameters in terms of gender

		N	Mean	Std. Dev.	t	p
Height (cm)	Male	119	176.13	6.32	13.947	< 0.001
	Female	76	162.78	6.83		
Weight (kg)	Male	119	69.58	9.23	13.571	< 0.001
	Female	76	54.24	6.54		
Body mass index (kg/m^2)	Male	119	22.40	2.47	6.200	< 0.001
	Female	76	20.44	1.92		
Vertical Jump (cm)	Male	119	45.01	8.56	7.500	< 0.001
	Female	76	36.37	6.56		
Anaerobic power (kg.m/sec)	Male	119	102.75	17.70	15.106	< 0.001
	Female	76	72.06	10.67		
Right hand grip strength (kg)	Male	119	41.65	6.52	19.158	< 0.001
	Female	76	26.76	4.33		
Left hand grip strength (kg)	Male	119	42.03	5.94	19.967	< 0.001
	Female	76	27.25	4.37		
Leg strength (kg)	Male	119	92.81	23.82	14.084	< 0.001
	Female	76	53.48	15.18		
Back strength (kg)	Male	119	105.60	20.42	18.730	< 0.001
	Female	76	61.14	12.72		
Flexibility (cm)	Male	119	26.37	7.48	-0.214	> 0.831
	Female	76	26.55	4.73		
Balance (eror)	Male	119	2.93	2.56	-1.458	> 0.146
	Female	76	3.50	2.78		
Visual reaction time (msec)	Male	119	35.75	5.71	-2.881	< 0.004
	Female	76	38.33	6.66		

Table 5 gives an analysis of the measured bio-motoric and reaction time characteristics of male and female hockey players. There was a significant difference in favor of male hockey players in height, body weight, body mass index, vertical jump, anaerobic power, right hand grip strength, left hand grip strength, leg strength, back strength and visual reaction time characteristics ($p < 0.05$). There was no difference between the sexes in the flexibility and equilibrium characteristics ($p > 0.05$).

Table-6: Comparison of some measured bio-motoric parameters with dominant hand

		N	Mean	Std. Dev	t	p
Height (cm)	Right	181	170.96	9.24	0.180	0.857
	Left	14	170.50	9.32		
Weight (kg)	Right	181	63.63	11.27	0.135	0.892
	Left	14	63.21	10.06		
Body mass index (kg/m^2)	Right	181	21.64	2.50	0.001	0.999
	Left	14	21.64	1.92		
Vertical Jump (cm)	Right	181	41.96	8.63	1.819	0.070
	Left	14	37.50	11.31		
Anaerobic power (kg.m/sec)	Right	181	91.35	21.38	1.320	0.188
	Left	14	83.52	21.58		
Right hand grip strength (kg)	Right	181	35.90	9.45	0.329	0.746
	Left	14	35.24	6.93		
Left hand grip strength (kg)	Right	181	36.15	9.07	-0.690	0.491
	Left	14	37.87	8.26		
Leg strength (kg)	Right	181	77.30	28.51	-0.325	0.746
	Left	14	79.86	27.14		
Back strength (kg)	Right	181	87.87	28.06	-0.722	0.471
	Left	14	93.50	28.89		
Flexibility (cm)	Right	181	26.53	6.60	0.727	0.468
	Left	14	25.21	5.74		
Balance (eror)	Right	181	3.24	2.69	1.695	0.092
	Left	14	2.00	1.88		
Visual reaction time (msec)	Right	181	36.90	6.36	1.193	0.234
	Left	14	34.85	3.42		

Table 6 gives an analysis of the measured bio-motoric and reaction time characteristics of hockey players using the right or left hand dominantly. There was no significant difference in hockey players in terms of hand dominance in length, body weight, body mass index, vertical jump, anaerobic power, right hand grip strength, left hand grip strength, leg strength, back strength, flexibility, balance and visual reaction time characteristics ($p>0.05$).

Table-7: Analysis of some measured bio-motoric parameters according to age groups

		N	Mean	Std. Dev.	F	p	Diff.
Height (cm)	a) Under 19	94	169.35	9.97	3.993	0.009	d-a d-b
	b) 20-24 year	72	171.11	8.34			d-c
	c) 25-29 year	22	174.50	6.44			c-a
	d) Upper 30	7	179.00	8.72			b-a
Weight (kg)	a) Under 19	94	59.94	10.92	11.934	0.001	d-a d-b
	b) 20-24 year	72	65.18	9.50			d-c
	c) 25-29 year	22	69.18	9.82			c-a
	d) Upper 30	7	79.14	11.80			b-a
Body mass index (kg/m^2)	a) Under 19	94	20.76	2.27	11.393	0.001	d-a d-b
	b) 20-24 year	72	22.19	2.29			d-c
	c) 25-29 year	22	22.66	2.47			c-a
	d) Upper 30	7	24.57	1.76			b-a
Vertical Jump (cm)	a) Under 19	94	40.53	9.45	1.612	0.188	-
	b) 20-24 year	72	42.47	9.06			
	c) 25-29 year	22	41.91	4.85			
	d) Upper 30	7	47.14	7.56			
Anaerobic power (kg.m/sec)	a) Under 19	94	84.05	20.22	10.592	0.001	d-a d-b
	b) 20-24 year	72	94.16	20.52			d-c
	c) 25-29 year	22	99.19	16.52			c-a
	d) Upper 30	7	120.23	21.55			b-a
Right hand grip strength (kg)	a) Under 19	94	34.28	9.53	2.096	0.102	-
	b) 20-24 year	72	36.75	8.90			
	c) 25-29 year	22	38.31	8.27			
	d) Upper 30	7	39.82	10.58			
Left hand grip strength (kg)	a) Under 19	94	34.89	9.36	2.402	0.069	-
	b) 20-24 year	72	36.70	8.90			
	c) 25-29 year	22	38.95	7.87			
	d) Upper 30	7	41.90	3.77			
Leg strength (kg)	a) Under 19	94	71.25	27.38	4.538	0.004	d-a
	b) 20-24 year	72	79.83	26.83			c-a
	c) 25-29 year	22	89.95	33.23			b-a
	d) Upper 30	7	97.86	16.20			
Back strength (kg)	a) Under 19	94	82.18	25.72	5.157	0.002	d-a
	b) 20-24 year	72	89.74	27.70			c-a
	c) 25-29 year	22	102.59	31.81			b-a
	d) Upper 30	7	110.00	26.77			
Flexibility (cm)	a) Under 19	94	27.05	6.32	0.800	0.495	-
	b) 20-24 year	72	25.78	6.78			
	c) 25-29 year	22	25.50	6.57			
	d) Upper 30	7	28.00	7.09			
Balance (eror)	a) Under 19	94	3.43	2.75	0.918	0.433	-
	b) 20-24 year	72	3.06	2.75			
	c) 25-29 year	22	2.55	2.20			
	d) Upper 30	7	2.43	1.27			
Visual reaction time (msec)	a) Under 19	94	37.57	6.42	1.764	0.155	-
	b) 20-24 year	72	35.43	5.69			
	c) 25-29 year	22	37.52	6.64			
	d) Upper 30	7	37.07	6.09			

Table 7 shows the analysis of the bio-motoric and reaction time characteristics of the hockey players according to age groups. According to the results of one way ANOVA test, no significant difference was found between age groups in vertical jump, right hand grip strength, left hand grip strength, flexibility, balance and visual reaction time characteristics (p>0.05). Body length, body weight, body mass index, anaerobic power, leg strength and back strength were significantly different between age groups (p<0.05).

According to the results of the LSD correction test conducted to determine the significance among the groups after the one-way analysis of variance, between the ages of 30 years and over in the height, body weight, body mass index and anaerobic power parameters and other age groups; Between the ages of 25-29 and 19 years and under; There was a significant difference between 20-24 age group and 19 age group and below (p<0,05). A significant difference was found between the ages of 30 and over, 25-29 years, 20-24 years and 19 years and under groups in leg and back strength characteristics (p<0,05).

Table-8: Correlation analysis of the measured characteristics of the study group

		1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	r	1	.324	.472	.425	.207	.454	.238	.270	.354	.362	.044	-.108	-.144
	p		.000	.000	.000	.004	.000	.001	.000	.000	.000	.545	.134	.044
2. Height	r		1	.774	.268	.449	.764	.728	.754	.589	.649	.033	-.071	-.209
	p			.000	.000	.000	.000	.000	.000	.000	.000	.645	.325	.003
3. Weight	r			1	.813	.324	.868	.735	.760	.670	.727	-.002	-.010	-.204
	p				.000	.000	.000	.000	.000	.000	.000	.977	.886	.044
4. Body mass in.	r				1	.086	.622	.464	.477	.482	.515	-.020	.036	-.148
	p					.233	.000	.000	.000	.000	.000	.786	.621	.043
5. Vertical J.	r					1	.737	.445	.467	.435	.460	.190	-.150	-.207
	p						.000	.000	.000	.000	.000	.058	.054	.004
6. Anaerobic P.	r						1	.720	.751	.679	.728	.082	-.127	-.241
	p							.000	.000	.000	.000	.254	.077	.001
7. Right hand grip	r							1	.895	.738	.819	.024	-.056	-.206
	p								.000	.000	.000	.739	.090	.004
8. Left hand grip	r								1	.720	.797	.100	-.087	-.199
	p									.000	.000	.165	.227	.005
9. Leg Strength	r									1	.834	.103	-.055	-.202
	p										.000	.151	.120	.005
10. Back Strength	r										1	.071	-.135	-.178
	p											.327	.060	.013
11. Flexibility	r											1	-.091	-.072
	p												.203	.317
12. Balance	r												1	.065
	p													.369
13. Visual Reac.T.	r													1
	p													

Table 8 gives a correlation analysis of some bio-motoric properties measured by the research group. According to the table, in all parameters except age, balance and flexibility; all other parameters except height, balance and flexibility; all other parameters except body weight and balance and flexibility; In all other parameters except balance and flexibility with body mass index; vertical jump and all other parameters except for balance and flexibility with anaerobic power; right and left hand grip strength and all other parameters except balance and flexibility; all other parameters except for leg and back strength and balance and flexibility; Visual reaction time was significantly correlated with all other parameters except balance and flexibility ($p<0.05$). There was no significant relationship between flexibility and balance characteristics and all other parameters ($p>0.05$).

DISCUSSION

The results of this study to determine some bio-motoric and reaction time characteristics of Turkish hockey players have been discussed with other studies in the literature. The results obtained can be considered as the average of the bio-motoric characteristics of Turkish elite hockey players regardless of gender. In addition, when the relationship between the measured characteristics of the hockeys participating in the survey is examined, all parameters except age, balance and flexibility are examined. All other parameters except height, balance and flexibility; all other parameters except body weight and balance and flexibility; With body mass index, in all parameters except balance and flexibility; vertical jump and all other parameters except for balance and flexibility with anaerobic power; right and left hand grip strength and all other parameters except balance and flexibility; all other parameters except for leg and back strength and balance and flexibility; visual reaction time, balance and flexibility were found to be significantly correlated with all other parameters. No significant relationship was observed between the flexibility and balance properties and all other parameters.

When we distinguished the hockey players who participated in our study dominantly according to the hand factor they used, it was seen that the right dominant players constituted 92.8% of the research group and 7.2% of the left dominant players. The features mentioned above are important for determining the normative distribution and for determining the bio-motoric properties and visual reaction time parameters of Turkish elite hockey players.

When the study group was divided into two according to gender property, we found significant difference in favor of male hockey players in height, body weight, body mass index, vertical jump, anaerobic power, right hand grip strength, left hand grip strength, leg strength, back strength and visual reaction time. There is no difference between the genders in the flexibility and equilibrium characteristics. We also found that right dominant and left dominant hockey players are not different from each other in terms of measured characteristics when we divide our research group in terms of hand factor used dominantly.

When the study group was divided into 19 age group and below, 20-24 age group, 25-29 age group and 30 age group and over age group, vertical leap, right hand grip strength, left hand grip strength, flexibility, balance and visual reaction time There was no significant difference between age groups. Body length, body weight, body mass index, anaerobic power, leg strength and back strength were significantly different between age groups. Body length, body weight, body mass index and anaerobic power parameters were between 30 and over with other age groups; Between the ages of 25-29 and 19 years and under; There was a significant difference between 20-24 age group and 19 age group and below. Leg and back strength characteristics were significantly different between 30 and over, between 25 and 29, between 20 and 24, and between 19 and under. When this condition is taken into consideration, it can be considered that bio-motoric properties develop as age increases.

In the study of Sarı, the right hand grip strength values of the hockey players were 17.58 kg pre-test, 17.93 kg final test and 17.14 kg pre-test and 18.08 kg final test, respectively. Statistically, the increase in grip strength values was significant ($p<0.05$).

Manna *et al*. reported that they did; The study of the effect of training on the physiological and biochemical properties of Indian hockeys found a significant increase in hand grip strength after 6 weeks training program in the named study [14].

The mean values of the right and left hand grip strengths obtained in our study are in parallel with similar studies in the literature. Hockey is thought to be a region where the upper extremity is used more intensively, and because of the fact that special hands and arms are rod-guiding limbs, they are constantly working and accordingly the strength development is more intense.

Duvan *et al*. found that the median age of the study was 17.00 and the sport age was 5.42. The mean values of dominant hand reaction time of 9 elite male fencing athletes were found as 171.00 at rest and 231.22 at maximal load intensity [15]. Akyüz *et al*. found that the mean values of the right hand reaction time and the left hand reaction time of the 56 young national wrestlers with a mean age of 19.09 were found as 195.80 and 194.70 respectively [16]. Both studies showed that the reaction time averages were better and higher than our data when compared to our study.

Ali the leg strength value of the subject group was 49.83 in the thesis study conducted by Gazi University, Physical Education and Sports School with a training program of 30 women on total 15 subjects and 15 control groups who had never played badminton sports before, and the control group 48.26 [17].

Savaş and Uğraş, In the study they performed on 21 national women boxers with a mean age of 18.80, the 6 week training program found preliminary test leg strength average values as 126.54 and final test average values as 129.52. Parallel to the work done above, there was a significant difference in leg strength among hockeys of various age groups [18].

Çınar *et al*. 38 In the study comparing the physical parameters of 38 elite 44 female boxers and 36 female handball players, they found that average back strength of female handball players was 88.28 and average back strength of female boxers was 94.43 [19].

Göral ve Göral found that the average of the back strength of female soccer players is 90.74 in the study they performed on 18 female soccer players with a mean age of 20.44 and a training average of 5.67. In our study, there was a significant difference in the back strength of the hockey players in support of the above studies [20].

Although foreign researchers have done a lot of work on hockeys, a sufficient number of literatures have not been reached in terms of sports scientists in our country.

Smith *et al*. conducted a study on 27 elite hockey players with a mean age of 20.0 ± 3,43 years [21], Zachrich, averaged age of 24 elite hockey players [22], 20.9 ± 1.2 years, Lemmink and Visscher, 21 Dutch hockey player was found 21.5 ± 1.3 years [23]. Williams *et al.* conducted a survey of 24 elite hockey players 21.6 ± 2.2 years [24], Cochrane and Stannard, 18 male elite hockey players, 21.8 ± 5.9 years [25], Aziz *et al*. stated that the average age of 40 male Singapore national team players was 22.6 ± 4.2 years [26].

In terms of age groups, researches on hockeys in different countries showed that the average age of athletes determined as elite group varies between 18-25 years [27-38]. According to the literature mentioned above, my study has been concluded that participating hockey players are in the normative range in terms of their average age. According to the research done, the mean length of elite hockey players changed from 166 ± 6 cm to 178.8 ± 1 cm [23, 25, 26, 34-40]. However, Lythe found that the mean length height was 180,1 ± 4,9 cm in his study of 18 elite male hockey players [31], while Zachrich found that the average of 24 elite hockey players was 188,0 ± 13,4 cm [22].

When comparing the literature with the hockeys that constituted our subject group, we found that body weight was higher than some studies [22, 23, 25, 26, 30, 32, 36-38] were found to be milder in several studies [29, 33-35, 39, 40]. It is seen that elite hockey players who constitute our subject group have an average value of body weights according to body weights of the international peers in the literature. From this point of view, our subjects reached the international norm.

The body mass index averaged 22,80 ± 2,66 kg / m2 in our subject group. Koley and Vashisth conducted a study on 80 male hockey players playing elite hockey in India (20.46 ± 4.22 kg / m2, average body mass index) in Koley *et al*. and the body mass index of the male elite hockey player was 20,97 ± 1,81 kg / m2 [37]. In another study, Sparling *et al*. found that the body mass index average of the American Olympic hockey team was 22.0 ± 1.3 kg / m2 [41], Konarski *et al*. of the Polish national team was 23.12 ± 1.05 kg / m2 [30], Podgorski *et al*., reported that the body mass index values of the Polish hockey player 23,4 ± 2,1 kg / m2 [40], Zachrich 24 elite hockey player 26,2 ± 1,6 kg / m2 [22].

The body mass index values obtained from our elite hockey subjects in our study are in parallel with the researches in the literature. When studies on the vertical jump characteristics of hockey players were examined Hofman *et al*. found that male players were 48.4 cm and female players 34.5 cm [42]. Keogh *et al.* found that the vertical jump performance of female hockey players was 35 cm and the hand grip strength of female hockey players was 36 kg [43].

In the literature review made on anaerobic power, Reilly *et al*. found that the anaerobic power norm of male hockey players was 859 W [44], and the relative anaerobic power norm was 11.5 W / kg; Lemmink and Visscher conducted a study on 21 hockey players with a peak power average of 760.2 ± 94.6 W, a relative peak power average of 11.35 ± 1.41 W / kg, an average power average of 505.3 ± 53.0 W and the relative average power average of 7.53 ± 0.60 W / kg [23]; Spencer *et al*. calculated peak power averages of 977.9 ± 90.1 W and relative peak power averages of 16.1 ± 1.0 W / kg for 18 national team hockey players [29].

In other branches, peak power and relative peak power values of soccer players were 809 W and 11.05 W / kg, respectively; 1002.73 W and 11.05 W / kg for basketballs; 956.01 W and 11.24 W / kg for volleyballs; 994.79 W and 11.27 W / kg in handballs; 1016.84 W and 10.94 W / kg in the rugby players, respectively [45].

The sample we received in our study may be considered to have values close to international norms.

In conclusion, it can be said that bio-motor characteristics and visual reaction time in hockey players are affected by gender and age factor but not with dominant hand factor. It is thought that this study is important for the presentation of the bio-motoric characteristics of the Turkish elite hockey players and it is suggested to investigate the different features that affect the sportive performance of the field researcher.

The results we obtained in our study of elite hockey players in Turkey used as a normative value in terms of both age and gender. Hockey players playing in league of different levels can be compared to both biomotoric and hockey-specific skills. 1st and 2nd place in Turkey detection of bio-motoric and reaction properties of the hockey player who played in the team and made the comparison. Turkey hockey super league play area at the end of the first three sets of male female hockey player, forming a sort of female and male hockey player to play in the fall league team identified bio-motoric and reaction properties and made the comparison. Turkey hockey super league of men playing female hockey player, other countries playing in the top league in the struggle to detect bio-motoric and reaction characteristics of male and female hockey player made the team.

Although there is no difference between the flexibility and equilibrium values between men and women as a result of our study, it has been observed that the current values of some athletes in both cinste are low, so it is suggested that coaches and sports scientists focus on flexibility and balance studies in hockey training.

Our study has observed that some players are 14 and 38 years in the super league level Based on the data obtained as a result, so when considering bio-motoric development of properties with the idea may not be appropriate such an application, Turkey Hockey Federation is suggested arrangements league considering this issue.

REFERENCES

1. Özdal M. Çim Hokeyi Oyuncularında Aerobik Antrenman Programının Bazı Dolaşım ve Solunum Parametrelerine Etkisi. Yüksek Lisans Tezi, Gaziantep Üniversitesi, Gaziantep. 2012.
2. Ayan S, Ergin M, Alıncak F. The evaluation of the participation of game and physical education lesson of the mild severe degree mental retardation and autistic students. European Journal of Special Education Research. 2017 Jan 12.
3. BİLGİÇ M, PANCAR Z, ŞAHİN FB, ÖZDAL M. Sedanter Çocuklarda İki Farklı Anaerobik Güç Testi Arasındaki Korelasyonun İncelenmesi. Gaziantep Üniversitesi Spor Bilimleri Dergisi. 2016;1(2):40-8.
4. Alıncak F. Attitudes of secondary school students including physical activity involving playing games. European Journal of Physical Education and Sport Science. 2016 Sep 27.
5. Pancar Z, Özdal M, Çinar V. The effect of 4-weekly low intensity physical activity program in thyroid hormone levels in obese and overweight children. European Journal of Physical Education and Sport Science. 2017 Sep 16.
6. Hentbol DM. voleybol ve futbol üniversite takımlarının bazı motorik ve antropo-metrik özelliklerinin başarıya olan etkilerinin karşılaştırılması. Ondokuz Mayıs Üniversitesi, Yüksek Lisans Tezi, Samsun. 2005.
7. Akça F. Türkiye Kano Milli Takımı Durgunsu Kayakçılarının Antropometrik Somatotip Özellikleri Ve Çeşitli Performans Testi Sonuçlarının Performansla Ilişkisinin Incelenmesi. Yüksek Lisans Tezi, Ankara Üniversitesi, Ankara, 2006.
8. Zorba E. Herkes i9in Spor Ve Fiziksel Uygunluk. GSGM Egitim Dairesi.:38-45.
9. Tamer K. Sporda Fiziksel Fizyolojik Performansın Ölçülmesi ve Değerlendirilmesi. Türkerler Kitabevi, Ankara. 1995.
10. Günay M, Tamer K, Cicioğlu İ. Spor fizyolojisi ve performans ölçümü. Gazi Kitabevi; 2010.
11. Luna-Heredia E, Martín-Peña G, Ruiz-Galiana J. Handgrip dynamometry in healthy adults. Clinical Nutrition. 2005 Apr 1;24(2):250-8.
12. Weineck J. Futbolda Kondisyon Antrenmanı. Ankara: Spor Kitabevi. 2001.
13. Topkaya İ, Tekin TA. Futbol: genel kuramsal bir çerçeve ve teknik ve temel taktik öğretim. Nobel Yayın; 2004.
14. Manna I, Khanna GL, Dhara PC. Training induced changes on physiological and biochemical variables of young Indian field hockey players. Biology of Sport. 2009 Jan 1;26(1):33.
15. Duvan A, Toros T, Şenel Ö. Maksimal Yüklenme Yoğunluğunun Elit Türk Eskrimcilerin Görsel Reaksiyon Zamanları Üzerine Etkisi. Niğde Üniversitesi Beden Eğitimi Ve Spor Bilimleri Dergisi. 2010;4(3).
16. Akyüz M, Koç H, Uzun A, Özkan A, Taş M. Türkiye güreş milli takımında yer alan genç sporcuların bazı fiziksel uygunluk ve somatotip özelliklerinin incelenmesi. Journal of Physical Education and Sport Sciences. 2010;12(1).
17. Ali KG. Bayan Öğrencilere Uygulanan 8 Haftalık Temel Badminton Antrenmanının Bazı Fiziksel ve Fizyolojik Parametreler Üzerine Etkisi. Sağlık Bilimleri Enstitüsü, Beden Eğitimi ve Spor Anabilim Dalı. Yüksek Lisans Tezi, Ankara: Gazi Üniversitesi, 2011.
18. Savaş S, Uğraş A. Türk Bayan Milli Boks Takımının Seçilmiş Bazı Fiziksel ve Fizyolojik Özelliklerinin İncelenmesi / research of physıcal and physıologıcal propertıes turkısh natıonal boxıng team. Beden Eğitimi ve Spor Bilimleri Dergisi. 2017;10(1).

19. Savucu Y, Çınar V, Polat Y. Elit bayan boksör ve hentbolcularin bazi fiziksel parametrelerinin incelenmesi. Sport Sciences. 2009;4(3):162-70.
20. Göral K, Göral Ş. Kadın futbolcularda sprint sürati, dikey sıçrama ve kuvvet parametreleri arasındaki ilişkilerin incelenmesi. Manas Sosyal Araştırmalar Dergisi. 2009;4:119.
21. Smith D, Holmes PS, Whitemore L, Devonport T. The effect of theoretically-based imagery scripts on field hockey performance. Journal of Sport Behavior. 2001;24(4):408-19.
22. Zachrich TP. Max VO2 and Ventilatory Threshold in University Level Hockey Players (Doctoral dissertation, Bowling Green State University). 2008.
23. Lemmink KA, Visscher SH. Role of energy systems in two intermittent field tests in women field hockey players. The Journal of Strength & Conditioning Research. 2006 Aug 1;20(3):682-8.
24. Williams AM, Ward P, Chapman C. Training perceptual skill in field hockey: Is there transfer from the laboratory to the field?. Research quarterly for exercise and sport. 2003 Mar 1;74(1):98-103.
25. Cochrane DJ, Stannard SR. Acute whole body vibration training increases vertical jump and flexibility performance in elite female field hockey players. British journal of sports medicine. 2005 Nov 1;39(11):860-5.
26. Aziz AR, Chia M, Teh KC. The relationship between maximal oxygen uptake and repeated sprint performance indices in field hockey and soccer players. Journal of sports medicine and physical fitness. 2000 Sep 1;40(3):195.
27. Dabinett JA, Reid K, James N. Educational strategies used in increasing fluid intake and enhancing hydration status in field hockey players preparing for competition in a hot and humid environment: a case study. International journal of sport nutrition and exercise metabolism. 2001 Sep;11(3):334-48.
28. Bishop D, Spencer M, Duffield R, Lawrence S. The validity of a repeated sprint ability test. Journal of Science and Medicine in Sport. 2001 Mar 1;4(1):19-29.
29. Spencer M, Fitzsimons M, Dawson B, Bishop D, Goodman C. Reliability of a repeated-sprint test for field-hockey. Journal of Science and Medicine in Sport. 2006 May 1;9(1-2):181-4.
30. Konarski J, Matuszynski M, Strzelczyk RY. Different team defense tactics and heart rate during a field hockey match. Studies in Physical Culture & Tourism. 2006;13:145-7.
31. Lythe J. *The physical demands of elite men's field hockey and the effects of differing substitution methods on the physical and technical outputs of strikers during match play* (Doctoral dissertation, Auckland University of Technology).
32. MacLeod H, Morris J, Nevill A, Sunderland C. The validity of a non-differential global positioning system for assessing player movement patterns in field hockey. Journal of sports sciences. 2009 Jan 1;27(2):121-8.
33. Bishop D, Maxwell NS. Effects of active warm up on thermoregulation and intermittent-sprint performance in hot conditions. Journal of Science and Medicine in Sport. 2009 Jan 1;12(1):196-204.
34. Leslie V. Physiological and match performance characteristics of field hockey players (Doctoral dissertation, © Vikki Leslie).
35. Jennings DH, Cormack SJ, Coutts AJ, Aughey RJ. International field hockey players perform more high-speed running than national-level counterparts. The Journal of Strength & Conditioning Research. 2012 Apr 1;26(4):947-52.
36. Sharma A, Tripathi V, Koley S. Correlations of anthropometric characteristics with physical fitness tests in Indian professional hockey players. Journal of Human Sport and Exercise. 2012;7(3).
37. Koley S, Jha S, Sandhu JS. Study of back strength and its association with selected anthropometric and physical fitness variables in inter-university hockey players. The Anthropologist. 2012 Jul 1;14(4):359-63.
38. Koley S, Vashisth D. Correlations of back endurance with anthropometric Variables and performance Tests in Indian Elite Male Hockey Players. Human Biology Review. 2014;3(2):175-83.
39. Scott PA. Morphological characteristics of elite male field hockey players. The journal of sports medicine and physical fitness. 1991 Mar;31(1):57-61.
40. Podgorski T, Krysciak J, Domaszewska K, Pawlak M, Konarski J. Influence of maximal exercise on organism's antioxidant potential in field hockey players. Medicina Sportiva. 2006;10(1/4):102.
41. Sparling PB, Snow TK, Rosskopf LB, O'Donnell EM, Freedson PS, Byrnes WC. Bone mineral density and body composition of the United States Olympic women's field hockey team. British journal of sports medicine. 1998 Dec 1;32(4):315-8.
42. Hofman Z, Smeets R, Verlaan G, Lugt RV, Verstappen PA. The effect of bovine colostrum supplementation on exercise performance in elite field hockey players. International Journal of Sport Nutrition and Exercise Metabolism. 2002 Dec;12(4):461-9.
43. Keogh JW, Weber CL, Dalton CT. Evaluation of anthropometric, physiological, and skill-related tests for talent identification in female field hockey. Canadian Journal of Applied Physiology. 2003 Jun 1;28(3):397-409.
44. Reilly T, Secher N, Snell P, Williams C, Williams C. Physiology of sports. Routledge; 2005 Jul 12.
45. Kalinski M, Norkowski H, Kerner M, Tkaczuk W. Anaerobic power characteristics of elite athletes in national level team-sport games. European Journal of Sport Science. 2002 Jun 1;2(3):1-21.