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Análisis estacional de los parámetros de rendimiento físico según las posiciones de juego de los futbolistas amputados

Analysis of Physical Performance Parameters According to Playing Positions of Amputee Football Players

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Resumen

El objetivo de este estudio fue de examinar los parámetros de rendimiento físico de jugadores de fútbol amputados durante una temporada según sus posiciones de juego. Un total de 16 jugadores de fútbol amputados participaron en este estudio. Se realizaron pruebas de fuerza de prensión manual, fuerza de espalda, piernas, brazos, reacción visual, sprint de 10-20-30 m, pruebas de flexibilidad, frecuencia cardíaca en reposo y mediciones de frecuencia cardíaca máxima realizadas al principio, a mitad de temporada y al final de la temporada. Se determinaron diferencias estacionales significativas en las pruebas de fuerza de agarre de la mano izquierda, espalda, piernas y brazos de los defensores, y en las puntuaciones de las pruebas de velocidad de 10-20-30 m. Además, se encontraron diferencias estacionales significativas en las puntuaciones de las pruebas de fuerza de espalda, piernas, brazos, reacción visual de la mano derecha, sprint de 10-20-30 m y flexibilidad de los centrocampistas. Se encontraron diferencias significativas en el agarre de la mano derecha e izquierda de los delanteros, en la fuerza de la espalda, las piernas y los brazos, y en las puntuaciones medias de las pruebas de sprint de 20 a 30 m. Se determinó que el plan de entrenamiento anual tuvo diferentes aportes positivos al rendimiento físico de los jugadores según sus posiciones de juego. Durante la temporada de competición, los cambios en el rendimiento estuvieron determinados por la reacción, la fuerza, la flexibilidad y el sprint de los mediocampistas y por la fuerza y el rendimiento en sprint de los delanteros y defensores.

Palabras Clave

flexibilidad, fútbol para amputados, fuerza, reacción, sprint.

Abstract

This study examines the physical performance parameters of amputee football players during a season according to their playing positions. A total of 16 amputee football players participated in this study. Hand grip strength, back, leg, arm strength, visual reaction, 10-20-30m sprint, flexibility tests, resting heart rate, and maximal heart rate measurements performed at the beginning, mid-season, and the end of the season. Seasonally significant differences were determined in defenders' left-hand grip, back, leg, and arm strength tests, and 10-20-30m sprint test scores. Moreover, seasonal significant differences were found in the test scores of the back, leg, arm strength, right-hand visual reaction, 10-20-30m sprint, and flexibility of midfield players. Significant differences were found in strikers' right- and left-hand grip, back, leg, and arm strength, and 20-30m sprints test mean scores. It was determined that the annual training plan had different positive contributions to the players' physical performance according to their playing positions. During the competition season, performance changes were determined

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by the midfielders' reaction, strength, flexibility, and sprint and the strength and sprint performance of the forwards and defenders.

Keywords

flexibility, amputee football, strength, reaction, sprint.

1 Introduction

Sport is essential for a healthy and long life (World Health Organization [WHO], 2003). It is a well-known fact that sport is a phenomenon that regulates human metabolism, body systems, and mental health (Lankhorst et al., 2015). It is stated in many studies that sports have positive effects on both disabled people and healthy people (Wilson & Clayton, 2010). In order to achieve these positive effects, there are many sports that people with disabilities can do according to their types of disability (Brittain, 2004). Wheelchair basketball, goalball, sitting volleyball, wheelchair table tennis, swimming, track and field, and football are beneficial sports for disabled people. Amputee Football, one of the most popular disciplines, is an adaptation of football for people with physical disabilities (Şanal et al., 2022; Frère, 2007).

Amputee football was first invented by Don Bennett in 1982 (World Amputee Football Federation [WAFF], 2020). It is a sport that is played with its own rules on a football field 60 meters long by 40 meters wide, with goals at both ends of the field, with two teams, seven players on each team (one goalkeeper, six players), with a total of fourteen players (Frère, 2007; Sarıgöz at al., 2017; Tatar, 2011). The goalkeepers are people with arm amputations. The amputated arm is inside his shirt, and they are not allowed to use it. Other players are people with have amputations below or above the knee. These athletes use crutches during the match. Nowadays, the number of amputee football teams has led to the formation of different amputee football leagues, and the teams have entered a fierce competition to compete in the super league and international championships.

Athletes perform long-term various strength, endurance, flexibility, coordination, resistance and sprint training for success in competitions. (Iri et al., 2009). Although teams have goals to achieve success, success in sports today is only possible with scientific methods. In order to achieve success, it is intended to increase the athlete's performance physically and psychologically with a long-term training schedule (Günaydın, 2019). In other words, performance depends on aerobic and anaerobic energy gain, sprint, strength, neuromuscular functions, psychological, and technical-tactical skills (Astrand & Rodalh, 1986). For this reason, teams apply long-term training programs and individual training methods for the skills that athletes lack by testing their athletes. However, different training programs may be needed according to the positions played by the footballer. This study aims to examine the physical performance characteristics of seasonally amputated football players doing the same training (except the goalkeeper) according to their positions.

2 Methods

2.1 Design and Participants

The design of this study is a quantitative research, multi-subject experimental design. The sample was selected by the non-random sampling method. Since the seasonal performance was followed in the research, the participants who applied the same training program in an amputee football team were included in the study. Accordingly, 16 athletes competing Malatya Metropolitan Amputee Football Team in the Turkish Amputee Football Super League consist of the research sample. The demographic characteristics of the participants are given in Table 1. The study was approved by the Scientific Research Ethics Committee of X.X.X.X. University with the decision of 08.10.2020 and number 2020/94.

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Table 1. The physical characteristics of amputee football players.

Variables		n	Min.	Max.	X	SD
Age (year)	Defence	6	19,00	45,00	28,50	9,36
	Midfielder	6	17,00	38,00	28,16	7,21
	Striker	4	25,00	48,00	30,75	10,40
	Total	16	17,00	48,00	28,93	8,97
Body Height (cm)	Defence	6	145,00	181,00	169,83	12,42
	Midfielder	6	163,00	191,00	175,50	10,73
	Striker	4	165,00	170,00	167,50	1,88
	Total	16	145,00	191,00	171,37	10,70
Body Weight (kg)	Defence	6	47,00	85,00	64,20	11,92
	Midfielder	6	52,00	86,00	64,24	10,81
	Striker	4	56,00	72,00	63,00	5,65
	Total	16	47,00	86,00	64,11	10,39

cm=centimeter, kg=kilogram.

2.2 Procedures

Before starting the investigation, the athletes were informed about the investigation. Then, the athletes who wanted to participate signed the *Voluntary Participation Form*. Since the goalkeepers had arm amputations, they were not included in the study. Testing took place during the afternoon practice time.

The investigation obtained information such as age, height, body weight, and amputation level of the athletes at the season's beginning. Within the scope of the investigation, with the tests and measurements carried out at the beginning, middle, and end of the season, Right-hand grip strength, left-hand grip strength, back strength, leg strength, arm strength, right-hand visual reaction, left-hand visual reaction, 10m sprint, 20m sprint, 30m sprint, flexibility, resting heart rate, and maximum heart rate. At the start of the season, measurements were taken in the first week of the Amputee Football Super League. Mid-season measurements were taken after the matches of the 9th round of the League were completed. Moreover, the end of the season measurements were taken after the matches of the 18th round of the League were completed. Measurements were performed in the same order in each trial after 10-15 min of individual athlete warm-up time before training. Athletes were given two attempts for each trial, and their best scores were recorded. In addition, the team's annual training program was not interfered with. All players did the same training (except the goalkeeper). The team's annual training schedule is given in Table 2.

Table 2. Annual Training Plan.

Pre-Season (16 Week)	First Part Season (10 Week)	Season Break (8 Week)	Last Part Season (10 Week)	Transition (8 Week)
Anatomical Adaptation, Max. Strength, Specific Endurance, Sprint, Anaerobic and Aerobic Power	Maintenance of strength, endurance, sprint, and power. Technical and Tactical Training	Technical and Tactical Training	Maintenance of strength, endurance, sprint, and power. Technical and Tactical Training	Rest

Nota: Bompa & Buzzichelli, (2019).

2.3 Testing Procedures

Force measurements: Hand grip strength values were taken using a Takei 5401-C hand grip dynamometer; Back, arm, and leg strength were measured with a TKK5401 dynamometer, Takei Co., a Japanese brand. During the measurements, the athletes removed auxiliary materials such as prostheses and orthoses (Günay et al., 2010).

Reaction measures: Visual reaction measurements were made using the Hubbard Scientific Reaction Timer brand reaction device. The athletes' left- and right-hand visual reaction times were measured. According to the device, 1 second is 100 milliseconds.

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Sprint measurements: For sprint measurements, separate 10m, 20m, and 30m sprint tests were applied, and measurements were performed with an industrial-type wireless electronic photocell. The athletes' 10m, 20m, and 30m sprint tests were performed on the artificial field where the athletes compete (Günay et al., 2010).

Flexibility measures: Flexibility measurements were performed using a sit-and-reach bench. Athletes place the soles of their feet on the bench in a seated position, and the knees are bent forward with tension. The point they reach the most on the coffee table is recorded (Günay et al., 2010).

Measurements of blood pressure values: The athletes' blood pressure values were measured with a Sinbo brand wrist-type blood pressure monitor. Resting heart rate measurements were taken before the athletes began warming up, and their maximum heart rate was taken just after they attempted the 30m sprint test a second time.

2.3.1 Statistical analysis

The SPSS 24.00 package program was used to analyze the data obtained. The Shapiro-Wilk test was used for normality analysis of research data, and kurtosis and bulge values were examined. As a result of the normality analysis, it was determined that the data presented a normal distribution. For this reason, parametric tests were used in the statistical comparisons (Tabaschnick & Fidell, 2013). In the analysis of the data, the Repeated ANOVA test was used. Bonferroni post hoc analysis was applied to determine the origin of the difference in comparison between groups. The significance level was accepted as $p < 0.05$ in the statistical analysis.

3 Results

It has been determined that there are significant seasonal differences in the physical performance parameters of defenders in the left-hand grip, back strength, leg strength, arm strength, 10m sprint, 20m sprint, and 30m sprint test ($p < 0.05$) (Table 3). According to the results of the post hoc analysis performed to determine which groups the difference is, the difference in back strength and leg strength is between the beginning-middle and the beginning-end of the season. The parameters of left-hand grip, arm strength, 10m sprint, 20m sprint, and 30m sprint were determined that the difference was between the averages of the beginning-end of the season. In comparing the parameters of right-hand grip, right-hand visual reaction, left-hand visual reaction, flexibility, resting heart rate, and maximum heart rate, there were no statistically significant differences in the seasonal analysis ($p > 0.05$).

Table 3. Analysis of the seasonal physical performance parameters of the defenders participating in the research.

Defence (n=6)	**Season**			**F**	**p**	**Post Hoc**
	Before (1)	Middle (2)	End (3)			
Right Hand Grip (kg)	41,78±4,93	42,50±5,22	44,45±5,15	1,705	,231	-
Left Hand Grip (kg)	36,01±5,29	39,26±4,47	40,23±5,75	8,408	,007*	1-3
Back Strength (kg)	57,16±17,64	71,50±12,34	81,50±7,03	18,161	,000*	1-2, 1-3
Leg Strength (kg)	63,16±24,76	83,33±18,39	95,00±19,32	15,874	,001*	1-2, 1-3
Arm Strength (kg)	56,33±16,03	65,83±14,19	72,00±17,08	6,075	,019*	1-3
Right Hand Visual Reaction(msec)	46,50±8,45	42,33±8,82	37,16±4,95	5,144	,067	-
Left Hand Visual Reaction(msec)	47,33±5,08	42,33±8,50	39,66±12,46	1,914	,223	-
10 m sprint (sec)	2,43±0,17	2,34±0,20	2,34±0,25	5,105	,030*	1-3

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20 m sprint (sec)	4,23±0,23	4,03±0,26	3,97±0,38	4,406	,042*	1-3
30 m sprint (sec)	6,07±0,33	5,77±0,23	5,66±0,31	5,588	,023*	1-3
Flexibility (cm)	25,50±6,25	25,66±7,06	26,33±8,33	,191	,829	-
Resting Heart Rate (bpm)	75,33±2,06	75,83±2,85	75,83±2,63	,115	,893	-
Max. Heart Rate (bpm)	145,16±5,23	145,00±5,36	144,83±5,52	1,000	,402	-

*p<0.05, kg:kilogram, cm:centimeter, msec:millisecond, sec:second, bpm:beats per minute.

It has been determined that there are significant seasonal differences in physical performance parameters of midfielders in back strength, leg strength, arm strength, right-hand visual reaction, 10m sprint, 20m sprint, 30m sprint, and flexibility tests (p<0.05) (Table 4). According to the posthoc analysis results, for which groups was the difference, the difference in the right-hand visual reaction, 10m sprint, and 30m sprint was between the beginning-end and the middle-end of the season. Back strength, leg strength, arm strength, 20m sprint, and flexibility tests determined that the difference was between the season's beginning and end. When comparing the parameters of the right-hand grip, left-hand grip, left-hand visual reaction, resting heart rate, and maximum heart rate, it was determined that there were no seasonal differences (p>0.05).

Table 4. Analysis of the seasonal physical performance parameters of the midfielders participating in the research.

Midfielders (n=6)	**Season**			**F**	**p**	**Post Hoc**
	Before (1)	Middle (2)	End (3)			
Right Hand Grip (kg)	37,01±4,10	41,50±6,59	43,26±7,09	3,473	,121	-
Left Hand Grip (kg)	33,95±8,54	38,81±11,99	41,06±11,57	3,779	,105	-
Back Strength (kg)	68,50±21,06	77,83±23,79	94,33±28,74	6,246	,017*	1-3
Leg Strength (kg)	80,00±23,94	89,83±29,20	110,16±30,57	9,628	,005*	1-3
Arm Strength (kg)	67,66±23,37	74,33±26,19	81,83±24,55	5,842	,050*	1-3
Right Hand Visual Reaction(msec)	41,66±9,64	39,16±9,06	36,16±8,49	14,677	,001*	1-3 2-3
Left Hand Visual Reaction(msec)	40,33±12,67	37,83±9,82	34,16±6,17	2,413	,177	-
10 m sprint (sec)	2,40±0,32	2,27±0,23	2,17±0,24	15,047	,001*	1-3 2-3
20 m sprint (sec)	4,00±0,60	3,75±0,50	3,61±0,53	4,060	,050*	1-3
30 m sprint (sec)	6,06±0,65	5,52±0,39	5,21±0,28	11,715	,016*	1-3 2-3
Flexibility (cm)	26,50±3,01	27,50±3,56	28,66±4,32	5,619	,023*	1-3
Resting Heart Rate (bpm)	75,33±3,44	74,50±4,50	75,33±3,50	,698	,517	-
Max. Heart Rate (bpm)	145,83±10,16	145,16±10,59	145,33±10,63	,730	,440	-

*p<0.05, kg:kilogram, cm:centimeter, msec:millisecond, sec:second, bpm:beats per minute.

It has been determined that there are significant seasonal differences in the physical performance parameters of forwards in right-hand grip strength, left-hand grip strength, back strength, leg strength, arm strength, 20m sprint, and 30m sprint tests (p<0.05) (Table 5). According to the posthoc analysis results for which groups are different, the difference in the leg strength test was between the middle-end and the beginning-end of the season. The difference was found to be between the mid-end season averages in the back strength and 30m sprint tests. In comparing the parameters of the left-hand visual reaction, right-hand visual reaction, 10m sprint, flexibility, resting heart rate, and maximum heart rate, there were no statistically significant differences in the seasonal analyses (p>0 .05).

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Table 5. Analysis of the seasonal physical performance parameters of the strikers participating in the research.

Strikers (n=4)	Season			F	P	Post Hoc
	Before (1)	Middle (2)	End (3)			
Right Hand Grip (kg)	39,10±6,61	39,65±6,35	40,60±5,96	7,075	,026*	1-3
Left Hand Grip (kg)	36,62±5,76	37,02±5,63	38,32±5,41	8,618	,017*	1-3
Back Strength (kg)	63,50±8,18	69,00±8,98	75,00±10,86	13,382	,006*	2-3
Leg Strength (kg)	81,50±4,65	86,25±4,78	96,25±4,64	24,080	,001*	1-3, 2-3
Arm Strength (kg)	58,75±2,87	60,75±5,67	68,00±3,46	13,376	,006*	1-3
Right Hand Visual Reaction(msec)	40,00±9,48	37,50±11,38	32,25±9,94	4,804	,057	-
Left Hand Visual Reaction(msec)	35,75±7,36	34,75±7,27	32,75±7,93	,894	,457	-
10 m sprint (sec)	2,23±0,44	2,17±0,54	2,13±0,45	1,102	,391	-
20 m sprint (sec)	3,71±0,37	3,63±0,41	3,56±0,35	5,979	,037*	1-3
30 m sprint (sec)	5,36±0,30	5,21±0,21	5,04±0,18	7,101	,026*	2-3
Flexibility (cm)	27,00±5,71	28,75±5,56	28,62±5,46	2,577	,156	-
Resting Heart Rate (bpm)	75,25±0,95	75,50±1,73	75,25±3,30	,030	,970	-
Max. Heart Rate (bpm)	144,00±11,19	141,50±9,00	141,50±9,00	1,744	,253	-

*p<0.05, kg:kilogram, cm:centimeter, msec:millisecond, sec:second, bpm:beats per minute.

All the players who participated in the research team, according to the physical performance parameters right-hand grip, left-hand grip, back strength, leg strength, arm strength, right-hand visual reaction, left-hand visual reaction, 10m sprint, 20m sprint, and 30m sprint were determined that there were significant seasonal differences in the tests (p<0.05) (Table 6). According to the posthoc analysis results for which groups are different, the difference in back strength, leg strength, arm strength, right-hand visual reaction, and 30m sprint parameters was between the beginning-middle, the middle-end of the season and the beginning-end of the season. The difference in the parameters of right-hand and left-hand grip is between the beginning-end and the middle-end of the season. The difference in the parameters of the 10m and 20m sprint is between the beginning-end and the beginning-middle of the season. Moreover, finally, the visual reaction parameter of the left hand was seen as the difference between the beginning and the end of the season. In comparing the parameters of flexibility, resting heart rate, and maximum heart rate, there were no statistically significant differences in the seasonal analyses (p>0.05).

Table 6. Analysis of the seasonal physical performance parameters of the players participating in the research.

Team (n=16)	Season			F	P	Post Hoc
	Before (1)	Middle (2)	End (3)			
Right Hand Grip (kg)	39,32±5,20	41,41±5,74	43,04±5,92	5,76	,008*	1-3, 2-3
Left Hand Grip (kg)	35,39±6,45	38,53±7,86	40,06±7,92	9,43	,006*	1-3, 2-3
Back Strength (kg)	63,00±17,05	73,25±16,43	84,68±19,54	22,20	,000*	1-2, 1-3, 2-3
Leg Strength (kg)	74,06±21,82	86,50±20,25	101,00±22,23	28,12	,000*	1-2, 1-3, 2-3
Arm Strength (kg)	61,18±17,24	67,75±18,28	74,68±18,32	17,432	,000*	1-2, 1-3, 2-3

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Right Hand Visual Reaction(msec)	43,06±8,99	39,93±9,13	35,56±7,49	17,535	,000*	1-2, 1-3, 2-3
Left Hand Visual Reaction(msec)	41,81±9,79	38,75±8,75	35,87±9,30	5,22	,030*	1-3
10 m sprint (sec)	2,37±0,30	2,27±0,30	2,22±0,30	15,08	,000*	1-2, 1-3
20 m sprint (sec)	4,01±0,46	3,83±0,41	3,73±0,45	10,56	,002*	1-2, 1-3
30 m sprint (sec)	5,89±0,54	5,53±0,36	5,34±0,37	18,84	,000*	1-2, 1-3, 2-3
Flexibility (cm)	26,25±4,79	27,12±5,35	27,78±6,05	3,23	,054	-
Resting Heart Rate (bpm)	75,31±2,35	75,25±3,23	75,50±2,94	0,09	,908	-
Max. Heart Rate (bpm)	145,12±8,31	144,18±8,10	144,18±8,16	2,85	,073	-

*p<0.05, kg:kilogram, cm:centimeter, msec:millisecond, sec:second, bpm:beats per minute.

4 Discussion

In amputee football, athletes move with crutches during the game. Players perform football skills such as passing, shooting, changing direction, and dribbling with the help of crutches. For this reason, the firm grip of the athlete on the crutches provides comfort in the movements that the athlete can perform during competition. Otherwise, the athlete may drop crutches or miss a pass or shoot. In literature, Yavaş (2019) determined significant seasonal differences in the handgrip and 30m sprint parameters of the U16 Anatolian Selçuk team, the handgrip strength of the U14 Konyaspor team, and the handgrip parameters of the U16 Konyaspor team ($p < 0 .05$). Findings from our research and studies from the literature show that long-term (seasonal) training on the grip strength of amputee football players is practical on hand grip strength. In this regard, strength training and exercises that increase hand grip strength should be included in training programs to monitor amputee football athletes' grip strength performance periodically and maintain hand strength.

Back strength in amputee football is crucial in moving the athlete's body, changing direction, and achieving athletic success when using crutches. Kiliç and Tosur (2018), the average leg strength of athletes competing in the 3rd League is 160.43±25.20 kg, the average back strength is 154.10±25.82 kg, and the average leg strength of the athletes competing in the Regional Amateur League is 163.00±29.75 kg, the mean back strength is 144.85±25.92 kg, the mean leg strength of the athletes competing in the Amateur Super League is 132.57±2.49 kg, mean back strength is 134.86±21.49 kg. Yavaş (2019), no significant seasonal differences were found in back and leg strength ($p>0.05$). Although there are some differences in the findings of our research and literature studies, the findings generally support each other. The difference is thought to be because, in athletes' back strength measurements, healthy football players use the dynamometer with both legs, while amputee football players use one leg. In amputee football, drills and exercises that increase back strength should be included in workouts to monitor back strength performance that affects athletes' crutches periodically and maintain grip strength at a high level.

In amputee football, athletes use their feet to perform all kinds of football skills. More strength in the legs is essential for sporting success since it is crucial to pass further or take precise hard shots from a distance in cases where it is difficult to enter the opponent's penalty area. Silvestre et al. (2006) found that the mean lower body power of defenders was 473.0 ± 52.4 watts, that of midfielders was 500.2 ± 41.3 watts, and that of forwards was 491.8 ± 23.5 watts. There are also studies reporting different results in the literature. Kılıç and Tosur (2018), in their study, they found that the average leg strength of athletes competing in the 3rd League was 160.43±25.20 kg, the average leg strength of athletes competing in B.A.L. was 163.00 ±29.75 kg, and that of the leg strength of the athletes who compete in the S.A.L. was 160.43±25.20 Kg. It has been determined that the average leg strength of the athletes who practice sports is 132,57±2.49kg. Yavaş (2019) found no significant seasonal differences in back and leg strength ($p>0.05$). Our research and

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some literature studies show that long-term (seasonal) leg strength training in amputee football players is practical for leg strength. In this regard, to periodically monitor the leg strength performance of amputee football athletes and maintain leg strength at a high level, training programs should include strength training and exercises that increase leg strength.

In amputee football, the sprint directly affects the football player's sprint performance. During the game, amputee football players run with a maximum effort of 2 to 4 seconds many times during the match. Sprint is vital in sporting success as it makes up approximately 1% to 11% of the distance athletes run in an amputee football game. In the literature, Silva and Morouço (2017) found significant differences in the 10m sprint and 30m sprint tests in their research. It is also stated in the literature that forwards have better averages in the 10m, 20m, and 30m sprint tests than midfielders and defenders (Cometti et al., 2001; Franks et al., 1999; Gill et al., 2007; Kaplan, 1997; Rienzi et al., 2000; Sporis et al., 2009; Taşkın, 2008). The findings of our research and literature studies show that long-term (seasonal) training is practical on the sprint parameters of amputee football players. In this context, various internal, plyometric, and central system-stimulating exercises should be included in the training to monitor amputee football players' sprint performance periodically, keep the sprint parameters at the highest level, and improve the sprint.

Flexibility in amputee football is crucial for sporting success in situations such as stealing, dribbling, controlling the ball coming off the ground at high and sprint acceleration. In the literature, Silva and Morouço (2017) found no significant differences in the flexibility parameter of football players under 15 years of age in their study. In the investigation, Nikolaidis et al. (2014) found no significant differences in the flexibility parameter playing the position of football players. Öberg et al. (1984) found no significant differences in football players' flexibility parameter playing position. Furthermore, in our study, the athletes' flexibility parameters improved seasonally. However, this development was not at a significant level. Literature studies show that long-term (seasonal) training is practical for the flexibility parameters of football players. Flexibility is believed to be due to the amputee football players in our research group and the fact that the anatomy and flexibility of the body show changes at different times of the day (Reilly et al., 2000). In this regard, exercises such as varied flexibility, resistance bands, and stretching should be included in the training to periodically monitor the flexibility performance of athletes in amputee football and maintain flexibility parameters at a high level.

Heart rate values in amputee football are essential in preparing current training programs and examining athletes' development during training and competition. These are very important in the preparation of a training program. Dupont et al. (2004) stated in their study that there was no significant difference in heart rate values. In his study, Casajús (2001) could not detect a significant difference in heart rate values, which examined professional football players seasonally. Our research findings and literature studies show similar results.

There are some limitations in this research, as in many scientific studies. Firstly, the participants were exclusively drawn from one team, potentially limiting the generalizability of the results. Moreover, it limits the number of people participating in the study. Research reliability would be further reduced if we chose more than one team because each team applies different training methods and periods. Additionally, we excluded goalkeepers because their amputations differ from the other players. Therefore, different research is required for goalkeepers. It is assumed that the athletes perform both training and physical performance tests with maximum effort.

5 Conclusion

As a result, it has been concluded that amputee football players' training in the same season (except for the goalkeeper) has positive contributions to the physical performance parameters according to the positions. These contributions were mainly practical between the beginning-end of the season. Between the beginning-middle of the season and the middle-end of the season, positive contributions weren't detected in the athletes. Seasonally, there was not a positive contribution to the reaction, flexibility, and heart rate of

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the defender and forward players and to the midfielders' hand grip and heart rate according to the positions.

6 Conflict of Interest

The research was conducted in an environment free of any commercial or financial relationships that could be interpreted as a potential conflict of interest.

7 Author Contributions

Conceptualization, A.Ş. and G.Ö.; methodology, A.Ş. and G.Ö; software, A.Ş.; validation, A.Ş., and G.Ö.; formal analysis, A.Ş. and G.Ö; investigation, A.Ş.; resources, A.Ş.; data curation, A.Ş.; writing—original draft preparation, A.Ş. and G.Ö.; writing—review and editing, G.Ö.; visualization, A.A.; supervision, G.Ö. All authors have read and agreed to the published version of the manuscript.

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10 References

Astrand, P.O. & Rodalh, K. (1986). Textbook of Work Physiology: Physiological bases of exercise, 3rd Ed. Mcgraw-Hill College, New York. ISBN-13: 978-0736001403

Bompa, T.O., & Buzzichelli, C. (2019). Periodization: Theory and Methodology of Training. 5th Ed. Human kinetics. ISBN-13: 978-0-7360-7483-4.

Brittain, I. (2004). Perceptions of disability and their impact upon involvement in sport for people with disabilities at all levels. *Journal of sport and social issues*, *28*(4), 429-452. DOI: 10.1177/0193723504268729.

Casajús, J.A. (2001). Seasonal variation in fitness variables in professional football players. *Journal of sports medicine and physical fitness*. 41(4), 463-469. https://www.minervamedica.it/en/journals/sports-med-physical-fitness/article.php?cod=R40Y2001N04A0463

Cometti, G., Maffiuletti, N.A., Pousson, M., Chatard, J.C. & Maffulli, N. (2001). Isokinetic Strength and Anaerobic Power of the Elite, Subelite, and Amateur French Football Player. *International Journal Sports Medicine*. 22, 45-51. DOI: 10.1055/s-2001-11331

Dupont, G., Akakpo, K. & Berthoin, S. (2004). The effect of in-season, high-intensity interval training in football players. *The Journal of Strength & Conditioning Research.* 18(3), 584-589. https://journals.lww.com/nsca-jscr/Fulltext/2004/08000/Improved_running_economy_following_intensified.00034.aspx

Franks, A.M., Williams, A.M., Reilly, T., & Nevill, A. (1999). Talent identification in elite youth football players: physical and physiological characteristics. Communication to the 4th world congress on science and football, *Sydney Journal of Sports Sciences.* 17(10), 812. https://www.tandfonline.com/toc/rjsp20/17/10?nav=tocList

Frère, J. (2007). The History of 'Modern' Amputee Football. Amputee Sports for Victims of Terrorism, IOS Press, Ankara. ISBN: 978-1-60750-289-0

Gill, S.M., Gıl, J., Ruız, F., Irazusta, A., & Irazusta, J. (2007). Physıologıcal and anthropometric characteristics of young football players according to their playing position: relevance for the selection process. *Journal of Strength and Conditioning Research.* 21(2), 438-445. DOI:10.1519/00124278-200705000-00026

DOI: https://doi.org/10.17162/au.v13i4.1463

Günay, M., Tamer, K., & Cicioğlu, İ. (2010). Sports Physiology and Performance Measurement, 2nd Edition, Gazi Publishing, Ankara. 172-567. ISBN: 9786053445838

Günaydin, G. (2019). Is There A Relationship Between Horizontal Jump And Sprint Performance İn Professional Amputee Football Players? *Annals Of Medical Research*. 26(10). 2454-8 DOI: 10.5455/annalsmedres.2019.08.468

Iri, R., Sevinç, H. & Süel, E. (2009). The effect of football skill training applied to 12-14 age group children on basic motoric properties. *International Journal of Human Sciences*. 6(2), 122-131. Turkish. https://core.ac.uk/download/pdf/268072309.pdf

Kaplan, T. (1997). The effect of physical and physiological parameters on success in football teams. *Journal of Spormetre Physical Education and Sport Sciences.* 3(4),137-144 Turkish. https://dergipark.org.tr/en/pub/spormetre/issue/41427/500694

Kiliç, T., & Tosur, M.A.A. (2018). A Comparison of Some Parameters of Football Players According to the Leagues They Play In. *Journal of Education and Training Studies*. 6(11), 135-142. DOI:10.11114/jets.v6i11.3591

Lankhorst, K., van der Ende-Kastelijn, K., de Groot, J., Zwinkels, M., Verschuren, O., Backx, F., ... & Takken, T. (2015). Health in Adapted Youth Sports Study (HAYS): health effects of sports participation in children and adolescents with a chronic disease or physical disability. *Springerplus*, *4*(1), 1-10. DOI 10.1186/s40064-015-1589-z

Nikolaidis, P., Ziv, G., Lidor, R., & Arnon, M. (2014). Inter-individual variability in soccer players of different age groups playing different positions. *Journal of Human Kinetics*. 40, 213. DOI 10.2478/hukin-2014-0023

Öberg, B., Ekstrand, J., Möller, M., & Gillquist, J. (1984). Muscle strength and flexibility in different positions of soccer players. *International Journal of Sports Medicine.* 1984;5(04), 213-216. DOI:10.1055/s-2008-1025908

Reilly, T., Wıllıams, A.M., Nevıll, A., & Franks, A. (2000). A multidisciplinary approach to talent identification in football. *Journal of Sports Sciences*. 18, 695–702. DOI: 10.1080/02640410050120078

Rienzi, E., Drust, B., Reilly, T., Carter, J.E.X.L., & Martin, A. (2000). Investigation of anthropometric and work-rate profiles of elite South American international football players. *Journal of sports medicine and physical fitness.* 40(2),162. https://www.proquest.com/docview/202669861?pq-origsite=gscholar&fromopenview=true

Şanal, A., Atar, Ö., Özen, G., & Dindar, M. D. (2022). The Relationship Between Life Satisfaction and Body Image in Amputee and Disabled Soccer Players in Turkiye. *Synesis*, *14*(2), 152-161. ISSN: 1984-6754

Sarıgöz, A.O., Kayıhan, G., Erkılıç, A.O., & Özkan, A. (2017). A Brief History of Amputee Football in Turkey. *International Journal of Cultural and Social Studies (Uksad)*. 3 (Special Issue 2), 53-60. Turkish. https://dergipark.org.tr/en/pub/intjcss/issue/33182/369305

Silva, R., & Morouço, P. (2017). Assessment of anthropometric characteristics and physical abilities throughout a sporting season in football. *Comparison between Motricidade.* 15(17). 19 DOI: 10.6063/motricidade.7573

Silvestre, R., West, C., Maresh, C.M., & Kraemer, W.J. (2006). Body Composition and Physical Performance In Men's Football: A Study Of A National Collegiate Athletic Association Division I Team. *The Journal of Strength & Conditioning Research*. 20(1), 177-183. https://journals.lww.com/nsca-jscr/toc/2006/02000

Sporis, G., Jukic, I., Ostojic, S.M., & Milanovic, D. (2009). Fitness profiling in football: Physical and physiologic characteristics of elite players. *Journal of Strength & Conditioning Research.* 23(7), 1947- 1953. DOI: 10.1519/JSC.0b013e3181b3e141

Tabaschnick, B.G., & Fidell, L.S. (2013). Using multivariate statistics, 6th Ed. Boston, Pearson. https://www.pearsonhighered.com/assets/preface/0/1/3/4/0134790545.pdf ISBN 9780134790541.

DOI: https://doi.org/10.17162/au.v13i4.1463

Taşkin, H. (2008). Evaluating sprinting ability, density of acceleration, and speed dribbling ability of professional football players with respect to their positions. *The Journal of Strength & Conditioning Research*. 22(5), 1481-1486. DOI: 10.1519/JSC.0b013e318181fd90

Tatar Y. (2011). Sports and Exercise for the Disabled. In:Physical Medicine and Rehabilitation Ed. M. Beyazova and Y.G. Sacred, 2nd Ed. Sun Bookstore, Ankara. 3483–3505. ISBN:9789752776333.

World Amputee Football Federation. (2020). Rules of Amputee Football, Access: 29.02.2020. https://www.worldamputeefootball.org/history.htm

Wilson, P. E., & Clayton, G.H. (2010). Sports and disability. *Pm&r*, *2*(3), S46-54. DOI: 10.1016/j.pmrj.2010.02.002

World Health Organization. (2003). Health and development through physical activity and sport (No. WHO/NMH/NPH/PAH/03.2). World Health Organization. https://apps.who.int/iris/bitstream/handle/10665/67796/WHO?sequence=1

Yavaş, B. (2019). Measurement of Some Physiological and Motoric Characteristics of U14, U16 Football Teams in a Football Season. *Gaziantep University Journal of Sport Sciences*. 6(2),196-208. Turkish. https://dergipark.org.tr/en/pub/gaunjss/issue/62715/943769