DOI: https://doi.org/10.53350/pjmhs22166485

ORIGINAL ARTICLE

Comparison of Strength Parameters in Amputee Football Players According to the Degree of Amputation

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ABSTRACT

Background: Amputee football is a sports branch for the disabled that has become popular in recent years. However, studies on determining and improving the performance parameters of amputee football players are limited.

Aim: The purpose of this study is to compare the strength parameters of amputee football players (AF) depending on the degree of amputation.

Methods: 35 amputee football players aged 16-48 years, actively participating in amputee football superleague, participated in our study. Descriptive research, one of the quantitative data collection instruments, was chosen as the research type. In the study, participants with transtibial amputation (TTA) (n=17, age=32.41±2.13, height= 173.47±1.82, weight=69.17±2.47) and transfemoral amputation (TFA) (n=18, age=26.50±1.26, height= 177.00±1.29, weight= 72.22±2.92) were divided into two groups according to amputation level. After recording the demographic data (age, height, weight, amputation level) of the participants, the waist-to-hip ratio was measured. During the study, participants' back, leg, and handgrip strengths were measured using a Takai brand dynamometer. For the statistical operations in the study, SPSS 25 package programme was used. Independent Samples T Test was used for the analysis of variables between groups. The Pearson correlation test was used to determine the relationship between the variables.

Results: According to the results of the study, no significant difference was found between the TTA and TFA groups in terms of back strength, leg strength, hand grip strength, and hip-to-hip ratio ($p > 0.05$). Pearson's correlation analysis between variables revealed that for participants with TTA, there was a relationship between back strength and height (p=.031) and weight (p=.012), between leg strength and waist circumference (p=.037) and hip circumference (p=.035), and between handgrip strength and height. (p=.006), a high correlation was found between waist-to-hip ratio and age (p=.002), weight (p=.004) and BMI (p=.000) ($p < 0.05$). A high correlation was found between back strength, leg strength (p=.007) and handgrip strength (p=.020), waist-hip ratio and BMI (p=.032) in participants with TFA ($p<0.05$).

Conclusion: In evaluating the research results, it was found that the level of amputation had no effect on back, leg, and hand grip strength. In addition, it was found that there was a significant relationship between the participants' leg strength-back strength, back strength-hand grip strength, back strength-height, and hand grip strength-height. It is anticipated that in more comprehensive studies in which 1st and 2nd division amputee football teams may participate, different results will be obtained.

Keywords: amputee football, strength, back strength, leg strength, amputation level.

INTRODUCTION

Amputation is the loss of a limb that occurs before or after birth due to endocrine disorders, trauma, circulatory disorders, tumors, or chronic infections, etc[1]. The reasons for amputation vary from country to country. In developed countries, peripheral vascular disease and diabetes are the most common causes of amputation[2]. In low-income countries, trauma is the leading cause of amputation[3]. It has been argued that studies on the prevention and treatment of trauma-related amputations in low-income countries should be strengthened[4]. Regardless of the cause of amputation, the physical and physiological changes that occur in the body are almost similar, although there are some individual differences. Amputation causes physical changes such as physiological[5], biochemical[6], musculoskeletal[7], postural[8], and psychosocial changes[9,10,11]. The most important factor determining the severity of these changes is amputation level[12]. When naming the amputation level, the anatomical name of the amputated area is used. However, to facilitate classification, amputations in the immediate area are also listed under one name. In this way, the general amputation levels of hip disarticulation, transfemoral amputation, knee disarticulation, transtibial amputation, and ankle amputation are distinguished[13].

Body composition and physical structure are the most important factors affecting performance in sports. Physical structure is critical for the application of performance variables such as strength, power, flexibility, speed, endurance, and agility in the appropriate form[14]. Studies conclude that the trend increase in muscle mass, lean core volume, and mass in the tibial and femoral regions leads to an increase in anaerobic power values and strength[15,16,17,18].

Strength and power are among the critical factors for athletic success and high[19]. Back and leg strength are common measurement methods to determine strength performance in sports such as football that require core strength endurance[20]. Handgrip strength is an important parameter in sports that require manual dexterity, such as shooting[21]. In amputee football, handgrip strength is thought to be important for using the canadian in proper form[22].

When examining the literature, it was found that body composition affects many parameters. Studies on the effects of amputation on the body are limited. It is known that the level of amputation causes some problems, especially in the representation of motor skills[23, 24]. Therefore, the aim of this study is to investigate the strength parameters such as leg, back and handgrip strength in amputee football players according to the amputation level and to examine the relationship between body composition and strength parameters.

MATERIAL AND METHODS

Structure of the study: Descriptive research method, one of the quantitative data collection techniques, was used in this study[25]. The necessary permissions were obtained from the Physically Disabled Sports Association to conduct the study. The research was conducted in accordance with the criteria of the Declaration of Helsinki. As part of the research, the required approval was obtained from the Ethics Committee of the Institute of Health Sciences of Bandırma Onyedi Eylul University with decision number 2022/85. Participants were asked to sign the "Voluntary Informed Consent" form, and they were informed about the research and the tests to be performed. Participants were informed that the study was voluntary and that they could withdraw from the study at any time.

Participants: Amputee football players constitute the population of the research. WSSPAS: Web-Based Sample Size & Power Analysis Software[26] was used. When type I error (α) was analysed as 0.05 and power (1-β) as 0.80 and effect size as 0.7 in power

analysis, it was found that at least 15 participants should be included in the study for each group (TTA, TFA), with a total number of 30 participants was conducted. In this regard, 17 participants with TAA, 18 participants with TFA, and a total of 35 participants between the ages of 16and 38 who played in the Amputee Football Super League between 2020and 2021 participated in the study. Athletes who played in the amputee football league for at least 2 seasons were included in the study. The following were not included in the study: a) lower back pain of unknown cause, b) clinical surgery on the leg or back, c) intense athletic activity in the last 48 hours, d) taking medications that increase physical performance in the last 3 months, e) fatigue or excitement, participants with f) arm amputation, g) active infection and corresponding antibiotic use were not included.

Data collection: All participants were first evaluated regarding their participation in general sports (active sports year, whether they participated in another sport, how many days per week they trained, etc.). These evaluations were performed by the study investigator. Participants who met the inclusion criteria were included in the study. Participants' demographic characteristics (age, height, and weight) were recorded according to Anthropometric Standardization Reference Manual (ASRM) standards and techniques prescribed by Martin and Saller[27], and waist and hip circumferences were also measured according to International Biological Program (IBP) recommendations. Force parameters were measured using the Gullit Strip[28, 29]. As part of the strength parameters, participants' back, leg, and handgrip strengths were determined. A TAKEI brand back and leg dynamometer was used to measure back and leg strength. For the leg strength of the participants; After sitting on the dynamometer with knees bent, centered on the dynamometer, the arms are extended without bending the elbows, the back position is straight and the body is slightly bent forward, the dynamometer bar that the person grips with both hands is moved vertically upward with the legs at maximum height without disturbing the position. was performed by pulling[30]. For back strength: participants were asked to hold the dynamometer bar without bending the arms, with the knees locked and the trunk flexed. The back is straight and the body is slightly bent forward. Participants were asked to perform the back extension movement with their back as far as possible without changing their position. Participants had 3 repetitions and the best score was recorded[31]. Handgrip strength was measured using a TAKAI brand hand dynamometer. It was ensured that the participants were able to turn the hand dynamometer pointer to the side where the researcher in charge was standing without bending the elbows and slightly open away from the body. Participants were tried three times and the best value was recorded. The back and leg measurements were taken after the participants removed their prostheses.

Analysis of Data: Data analysis was performed using the SPSS package program 25. Normality analysis of the data was tested using the Shapiro-Wilk test since the number of participants < was 50[32]. Since the data did not have a normal distribution, statistical analyzes of the force parameters between groups were performed using the Mann-Whitney U test, one of the nonparametric tests. The Pearson correlation test was used to determine the relationships between the data. The significance level in the study was set at 0.05.

RESULTS

Table 1: Demographic Information of Participants

Variables	TTA $\bar{x} \pm ss$ (n=17)	TFA $\bar{x} \pm ss$ (n=18)
Age (Year)	29.70 ± 5.09	26.50 ± 5,37
Weight (kg)	69.17 ± 10.19	72.22 ± 12.42
Height (cm)	173.47 ± 7.51	177.00 ± 5.49
BMI (kg/cm^2)	22.96 ± 2.86	23.02 ± 3.64

When Table 1 is examined, it was determined that participants with TTA were age= 29.70±5.09 years, body weight= 69.17±10.19, height= 173.47±7.51, and BMI= 22.96±2.86. Age=26.50±5.37, body weight=72.22±12.42, height=177.00±5.49, BMI=23.02±3.64 of participants with TFA.

Table 2: Mann Whitney U Test Results of Participants' Strengh Parameters

Variables	TTA $\bar{x} \pm ss$	TFA $\bar{x} \pm ss$	Z	p
Waist Circumference (cm)	81.94±8.73	83.05±11.06	-.050	.960
Hip Circumference (cm)	93.94±7.03	94.38±7.91	-.083	.934
Back Strenght (kg)	106.67±37.26	110.08±34.94	-.083	.934
Leg Strenght (kg)	108.73±25.01	105.94±25.16	-.347	.729
Handgrip (kg)	44.37±6.90	46.58±5.59	-.264	.792
Waist-Hip Ratio (cm/cm)	0.87±0.04	0.87±0.07	-.099	.921

When Table 2 is examined; there is no statistically significant difference between TTA (waist circumference=81.94±8.73, hip circumference=93.94±7.03, back strength=106.67±37.26, leg strength=108.73±25.01, handgrip strength=44.37±6.90, waist-hip ratio=0.87±0.04) and TFA (waist circumference=83.05±11.06, hip circumference=94.38±7.91, back strength=110.08±34.94, leg strength=105.94±25.16, hand grip strength=46.58±5.59, waist-hip ratio=0.87±0.07) ($p > 0.05$).

Table 3: Pearson Correlation Results of Variables for Participants with TTA

Variables	Back S.	Leg S.	Handgrip	Waist C.	Hip C.	Age	Height	Weight	Waist- Hip Ratio	BMI
Back S.	1	.114	.246	.099	.054	.963	.031*	.012*	.458	.217
Leg S.	.114	1	.215	.037*	.035*	.503	.292	.093	.161	.180
Handgrip	.246	.215	1	.138	.150	.555	.006*	.057	.263	.557
Waist- Hip Ratio	.458	.161	.263	.000*	.026*	.002*	.998	.004*	1	.000*

S.: Strenght, C.: Circumference

Table 4: Pearson Correlation Results of the Variables of Participants with TFA

Variables	Back S.	Leg S.	Hand grip	Waist C.	Hip C.	Age	Height	Weight	Waist- Hip Ratio	BMI
Back S.	1	.007*	.020*	.678	.876	.660	.214	.982	.518	.640
Leg S.	.007*	1	.618	.652	.784	.642	.636	.913	.287	.996
Handgrip	.020*	.618	1	.908	.732	.342	.071	.815	.610	.691
Waist- Hip Ratio	.580	.287	.610	.000*	.302	.654	.438	.077	1	.032*

S.: Strenght, C.: Circumference

When Table 3 was examined, it was found that there was a high correlation between back strength and height (R=.523, p=.031) and weight (R=.595, p=.012) of participants with TTA ($p < 0.05$). A high correlation was found between leg strength and waist circumference (R=.508, p=.037) and hip circumference (R=.513, p=.035) ($p < 0.05$). There was a significant correlation between

handgrip strength and height (R=.641, p=.006) ($p < 0.05$). A high correlation was found between hip-to-hip ratio and age (R=.555, p=.002), weight (R=.655, p=.004), and BMI (R=.776, p=.000). ($p < 0.05$).

When Table 4 was examined, it was found that there was a high correlation between back strength and leg strength (R=.614, p=.007) and handgrip strength (R=.543, p=.020) in participants with TFA ($p < 0.05$). It was found that there was a high correlation between waist-to-hip ratio and BMI (R=.507, p=.032) in participants with TFA ($p < 0.05$).

DISCUSSION

It is known that some physiological and motor characteristics differ in amputees compared to normal individuals[33, 34, 35]. Studies on the effect of amputation level on motor characteristics in amputees are limited. In this study conducted to investigate the strength parameters in relation to amputation rate in amputee soccer players, it was found that amputation rate (TTA, TFA) had no effect on leg strength, back strength, and handgrip strength ($p > 0.05$). It was found that there was a high correlation between back strength and height and weight, between leg strength and waist and hip circumference, and between handgrip strength and height ($p < 0.05$). A high correlation was found between back strength, leg strength, and handgrip strength of participants with TFA ($p < 0.05$). Although there is a high correlation between waist-to-hip ratio and BMI values of participants with TTA and TFA amputation, a higher significance value was found in favor of participants with TTA.

Studies have shown that there are significant relationships between leg strength and balance performance[36,45]. Wong et al. in the study of; It was found that balance performance between individuals with transfemoral amputation and those with transtibial amputation was lower in favor of those with transfemoral amputation[37,44]. In examining the research findings, it was found that fall performance was lower among individuals with the same level of amputation, age, gender, race, etc. It was found that there were differences in terms of variables[38]. When analyzing the results of our study, it was found that the average leg power of participants with TTA was higher than the average leg power of participants with TTA, but this difference was not at a significant level. This is likely due to the small sample size (Wong et al., 2019 (n=305), Wong et al., 2016 (n=782)).

Transfemoral amputation negatively affects the abductor and adductor muscles of the hip. It also negatively affects flexion and extension of the back and abdominal muscles[39]. There is also a direct relationship between limb length in the amputated area and the generated force moment and isokinetic contraction force. It has been found that the force generated increases with increasing limb length[40]. As the level of amputation increases, there are problems in maintaining spinal balance. This leads to postural deformity, low back pain, and balance problems[41]. It is also known that amputation negatively affects bone mineral density[42]. In this direction, Heitzmann et al. analyzed in his study, in which he investigated the strength parameters in individuals with transtibial amputation, that the hip and leg flexion strength in these individuals is lower than in healthy individuals[43].

As a result, it was found that studies on strength parameters did not yield similar results to our study. However, correlation analysis revealed a high correlation between amputation rate and some variables. This relationship also differed between participants with TTA and TFA.

CONCLUSION

The results of our study show that the force parameters associated with amputation depend on variables such as body composition, waist-to-hip ratio, and amputation height. It is considered that this situation should be taken into account in the exercises for amputee football players. When the average values of strength parameters were examined, they were found to be higher in favor of the participants with TTA, but no significant difference was found after TFA. It is believed that more meaningful results can be obtained in larger sample groups. It is considered that the level of amputation may also affect motor characteristics such as speed, endurance, agility, and flexibility. It is believed that academic studies to determine these data should increase.

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