

**A SYSTEMATIC REVIEW**

# Examination of sports performance parameters aimed to be explored in research on amputee football players: A Systematic Review

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## Abstract

This systematic review aims to examine the research on the sports performance of amputee football players in terms of content and to critically analyze the significance of the tested parameters in order to improve the sports performance of amputee footballers. Research data was collected considering the inclusion and exclusion criteria on PubMed, Web of Science and Google Scholar. 88 articles were found in the first search on the Web of Science, Google Scholar and PubMed databases using predefined keywords. As a result of the evaluation made within the scope of inclusion and exclusion criteria, 15 research articles were included in this study. As a result, it has been determined that studies on amputee footballers do not carry out research to improve the sports performance of athletes, but mostly focus on studies examining the relationship between anthropometric characteristics and physical performance of athletes, or examining two or more existing sports performance parameters. Although it is important to obtain these findings, it is also important to design training models to improve current performance and investigate their effects rather than determining the current performance of athletes. It is recommended for researchers to develop new training models in future studies and to carry out studies to improve the sports performance of amputee athletes.

**Keywords:** *Amputee Football, Amputee Soccer, Sports Performance, Examination, Measurement*

## Introduction

While sports or any physical activity are of great importance in ensuring the social, physical and psychological development of people, these activities are much more important for people with disabilities (PWD) (Esatbeyoğlu and Karahan, 2014). There are many sports activities that PWD can participate in, and it is known that one of the most popular of these activities is amputee football. Athletes who have either a unilateral lower limb amputation (defensive, midfield, and offensive players) or a unilateral upper limb amputation (goalkeeper) or who are classified as other groups (group with congenital hand, foot, and upper limb anomalies) compete in the team sport of "amputee football" (Simim et al., 2018; Maehana et al., 2018). A total of 50 minutes (25 minutes in each half and 10 minutes

between halftime) is played on an artificial or natural grass field with a field size of 60 x 40 m (WAFB, 2016). Since the duration of the game is 50 minutes in total, amputee football is a sport where both aerobic and anaerobic pathways are involved in energy production (Mikami et al., 2018). Especially, anaerobic performance is very important due to sudden explosive movements such as sprinting, sudden changes of direction and accelerations during the match (Tatar et al., 2018; Aytar et al., 2012). Also, it is a fact that this game requires speed, agility, balance and flexibility in terms of game dynamics (Lowther et al., 2002). Moreover, the use of prostheses during the game is prohibited and only the use of crutches is allowed. In that regard, it can be argued that it is a sport branch in which upper limb muscular strength and endurance are dominant due to isomet-

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ric, concentric, and eccentric contractions while using crutches (Tatar et al., 2018; Aytar et al., 2012; Özkan et al., 2014).

In order to perform at an elite level in football, it is necessary to have the physiological and morphological characteristics required by the sport branch and positions (Slimani and Nikolaidis, 2019; Hazir et al., 2010), similarly, in amputee football, the muscular strength and endurance required by the branch and the position played, it is necessary to have an appropriate body composition and somatotype body structure (Simim et al., 2013; Miyamoto et al., 2019). Therefore, the development of such features has been the subject of many studies. However, the primary issue with studies aiming to improve the athletic performance indicators of amputee football players in the literature is that it is not yet clear which sports performance indicators researchers focus on improving athletes. Therefore, it is important for future research to determine the sports characteristics of these athletes that are most desired to be developed and ignored. In this context, the aim of the research is to examine the research on the sports performance of amputee football players in terms of content.

## Methods

This research was designed using the systematic review technique. Research data was collected considering the inclusion and exclusion criteria of the research published, as a result of the search made by using the keywords "amputee football, amputee soccer" in English. The search was performed on Web of Science, Google Scholar and PubMed databases in an electronic environment between 25.06.2022-15.08.2022. In accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, a systematic review of the available literature was undertaken (Moher et al., 2009) (Figure 1.). The first search identified 88 articles. In the

initial assessment carried out in accordance with the inclusion and exclusion criteria, 15 articles were found suitable and were included in the study, while 73 studies were excluded. More precisely, in the initial evaluation carried out on the Google Scholar database in compliance with the inclusion and exclusion criteria 7 articles were found suitable and were included in the study, while 41 were excluded. Then, from the Web of Science database, 7 articles were found suitable and were included in the study, while 20 were excluded. Finally, from PubMed database, 1 article was included, while 12 were excluded, which made a total of 15 studies that were included in the research (Figure 1).

### Inclusion Criteria

- The sample of subjects should consist of amputee football players.
- In the research, it should be aimed to measure and examine at least one of the sports performance parameters (strength, power, endurance, speed, flexibility, reaction time) of amputee football players.
- The research should be published as an article in English between the years of 2012. and 2022.
- The research should be published as original article in full-text on English language.

### Exclusion Criteria

- Not examining at least one of the sports performance parameters (strength, power, endurance, speed, flexibility or reaction time) of amputee football players.
- Articles where only an abstract is available or systematic reviews were not included in the research.
- Articles were not included if they were not in English language.

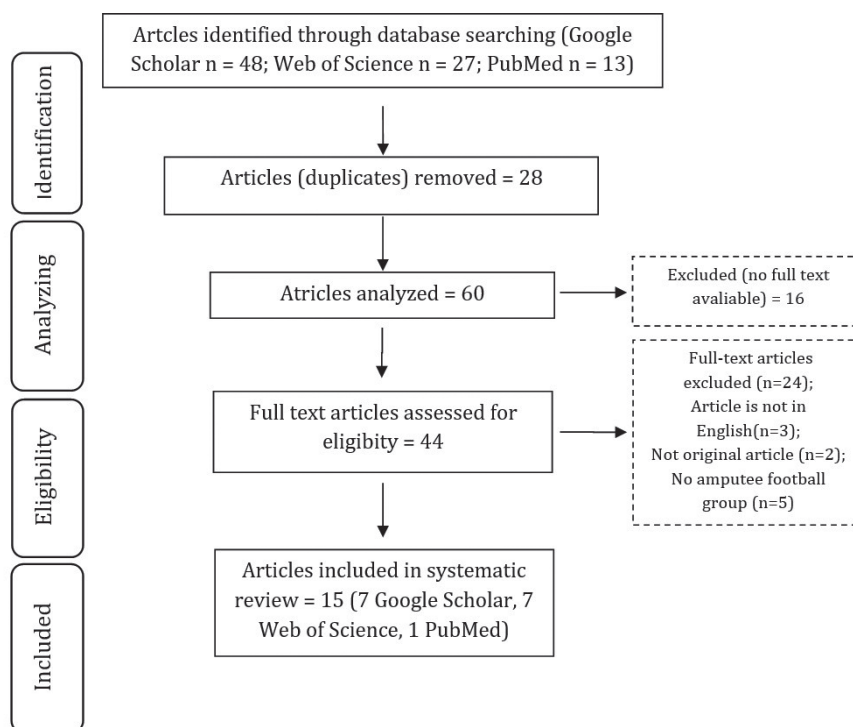


FIGURE 1. PRISMA flow chart of article selection process

### Description of selected studies

First, the basic parameters of the study are shown, such as the sample (age and number of respondents), then the tested parameters and finally the results of the study (Table 1).

## Results

The results of the study are summarized in Table 1.

In the selected research, there was a group that had to fulfill the inclusion criteria (the amputee football players) in order

**Table 1.** Research results

Authors	Sample	Purpose	TP	Results
Ozkan et al. (2012)	n = 15 25.5 ± 5.8 years	Examining the connection between anaerobic capacity, body composition, and sprint performance	BH, BW, BMI, BF%, speed, strength	Sprint performance was described as an important factor in anaerobic performance whereas body composition play a decisive role in anaerobic and sprint performance
Aytar et al. (2012)	n = 11 24.63 ± 6.48 years	Investigating the relationship between strength, balance and core stability	BH, BW Trunk strength, sacroiliac joint movement, dynamic core stability, Disability level	For the purposes of performance analysis and evaluation, the relationship between balance and sacroiliac mobility should be taken into consideration.
Simim et al. (2013)	n = 12 29.3 ± 8.6 years	Aim was to determine the physical and anthropometrical characteristics of amputee football athletes	BH, BW, heart rate peak, maximum heart rate, endurance (aerobic), speed, triceps, subscapular, suprailiac, and abdomen skinfold, BF%	The BF% between midfielders and defenders differed significantly..
Mine et al. (2014)	n = 10 25,80 ± 4,32 years	Examining the relationship between acceleration and speed performance in amputee footballers	BH, BW, speed, acceleration	Speed and acceleration (quickness) correlate positively. Both correlate positively, aswell, with sports success
Wieczorek et al. (2015)	n = 13	Investigating the relationship between strength, sprint time and hand grip	HG, speed, acceleration, WBW, BH	Results suggest that hand grip strength has no relationship with sprint effectiveness in elite players
Simim et al. (2017)	n = 16 32 ± 5 years	A research examined the match demands for amputee soccer and how they affected strength and endurance.	BH, BW, WBW Explosive strength, repetitive strength, (upper body strength)	Muscle endurance and upper body strength positively impacted the performance
Maehana et al. (2018)	n = 12	The aim of this study was to evaluate the heart rate response and match performance in amputee football players.	BH, BW total distance in match, high-intensity running : (≥13 km·h) RPE, HR	Exercise/match intensity was high in amputee soccer. Thus, it can be said that anaerobic capacity is crucial for their performance
Tatar et al. (2018)	n = 15 24.5 ± 5.8 years	Objective was to investigate the load distribution of players during kicking the ball, running and walking	BH, BW Loads on their non-amputated lower extremity, loads on their upper extremities	The frequency of repeated kicking during play may raise the risk of upper extremity injuries
Yildiz et al. (2018)	n = 12 28 ± 7 years	Purpose was to compare the acute effects of dynamic warm-up exercises and static stretching on free kick performance	BH, BW, free kick speed	The findings imply that dynamic warm-up exercises may be preferable for amputee soccer players before engaging in activities requiring a high power output
Gunaydin (2019)	n = 12	Determining the relationship between horizontal jump and sprint performance	BH, BW, BMI, speed, acceleration, horizontal jump	Results showed strong correlation between the one leg hop and 30m and 20m sprint tests and no correlation with 10m sprint performance.
Miyamoto et al. (2019)	n = 12 42.3 ± 4.6 years	Purpose was to determine the relationship between sprint motion and sprint speed	BH, BW, Speed, acceleration	Findings indicate that enhancing sprint speed requires the step length increase within a shorter time period in first foot step and crutch stance
Gunaydin (2020)	n = 20	Investigating the relationship between upper extremity strength and performance	BH, BW, speed, agility, jumping performance	Findings showed that the sprinting performance of amputee players was not related with lower extremity strength only, but also with upper extremity strength.

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**Table 1.** Research results

Authors	Sample	Purpose	TP	Results
Nowak et al. (2021)	n = 23	Determining anaerobic performance and antropological profile of elite AFP	Type of lower limb impairment, experience, BH, BW, BF%, HG, WBW, anaerobic performance	AFP with greater WBW have a lower ability to maintain power and may become exhausted faster
Nowak et al. (2021)	n = 11 28.45 ± 8.73 years	Finding correlation between locomotion speed, maximum power and upper limbs	BW, BH, BMI, BF%, LBM, anaerobic capacity, speed	Body composition, especially % BF may impact the anaerobic performance of amputee football players.
Kurtoğlu et al. (2022)	n = 35 16-48 years	Comparing strength parameteres depending on degree of amputation	BW, BH HG, Leg strenth	Level of amputation may affect motor abilities such as flexibility, speed, agility and endurance

TX – Training experience; TT – Type of training; TP – Tested parameters; n – number of respondents; BW- body weight; BH – Body height; HG – Hand grip strength; WBW – Whole body weight; BF% - Body fat percentage; AFP - amputee football player/s; LBM- lean body mass; BMI – Body mass index; RPE - rating of perceived exertion; HR – heart rate.

to participate in the research. The number of participants varied from research to research. The smallest number of subjects was included in the research by Mine et al. (2014) with only 10 participants, and the largest number in the research by Kurtolu et al. (2022) with as many as 35 participants. The total number of respondents in the systematic review amounted to 229 participants in the age range from 16 to 48 years. All the articles included were of experimental design. Every article measured body composition variables and also motor ability variables. Most of the articles included speed, acceleration and strength measurements.

## Discussion

PWD can participate in competitions and thus feel the true feeling of sports. This allows them to perceive themselves as "athletes" rather than as PWD. With the confidence of this feeling, individuals can learn to cope with their obstacles (Özer, 2001) and their lives can become more enjoyable. Therefore, it is very important to continue scientific research on PWD.

The aim of this research was to examine the research on the sports performance of amputee football players in terms of content. In the initial assessment carried out in accordance with the inclusion and exclusion criteria, 15 articles were found suitable for the study and were included in the study.

When the studies on amputee football players were examined, it was shown that these studies did not focus on improving the physical performance parameters of the athletes. We show that many studies compare physical performance parameters of athletes according to their anthropometric structures (Simim et al., 2013; Ozkan et al., 2012; Nowak et al., 2021) or their current athletic capacities (Simim et al., 2017; Aytar et al., 2012; Tatar et al., 2018; Maehana et al., 2018; Kurtoğlu et al., 2022). In addition, we show that many studies examine the relationship between two or more sports characteristics (Gunaydin, 2019; Miyamoto et al., Mine et al., 2014; 2019; Gunaydin, 2020; Nowak et al., 2021; Wiczorek et al., 2015). Moreover, one study examined the effect of different warming practices on sports performance (Yildiz et al., 2018). Within this frame of reference, it is important to conduct studies investigating various training models in order to improve the sports performance parameters of amputee football players.

It is thought that it is possible to optimize the sports performance of athletes with new training models. In addition to traditional training models, it can be recommended to apply new training models such as artificial electrical muscle stimulation

(EMS) training (İlbak and AÇak, 2022). In this context, innovative methods in training will be an effective strategy for individuals with missing limbs. Because even muscles that are very difficult to operate can be exercised with EMS (Taşpınar, 2007). Therefore, it will be possible to prevent the situation of not being able to get full efficiency from the training of athletes who are faced with movement restrictions due to the lack of limbs.

It is known that physical characteristics such as bodily structure are the leading factors affecting performance. If the athletes do not have the body composition (weight, BMI, % fat etc.) suitable for their branch, it is not possible for them to reach the desired performance level for this branch. In this context, Kurtoğlu et al. (2022), reported that sports performance is affected by the amputee level (Kurtoğlu et al. 2022). Moreover, just because the physical features are suitable does not mean that the athlete can show the best performance (Özkan et al., 2005). In line with the study's findings, there is a linear association between anthropometric characteristics and athletic performance (Ozkan et al., 2012; Nowak et al., 2021), and that there is a difference between athletes in terms of anthropometric characteristics according to the position played (Simim et al., 2013).

When the sports performance parameters emphasized in the research papers on amputee football players were examined, it was shown that the most examined ones were speed, strength and acceleration. However, it we see that little attention was paid to sports performance parameters such as agility, flexibility, and other motor skills. Whereas, Lowther et al. (2002) emphasized that sports performance parameters such as high-level speed, endurance, strength, agility, flexibility and the technical and tactical skills are very important in amputee football. In addition, since football is a game that requires all these features due to its game structure and rules, it is a fact that improving all these features of the athletes will positively affect the results of the competitions.

## Conclusion

Our findings indicate that studies on amputee footballers do not carry out research to improve the sports performance of athletes, but mostly focus on examining the relationship between anthropometric characteristics and physical performance of athletes, or examining two or more existing sports performance parameters. Although it is important to obtain these findings, it is also important to design training models to improve current performance and investigate their effects rather than determining the



current performance of athletes. In this context, it is recommended for researchers to develop new training models in future studies and to carry out studies to improve the sports performance of amputee athletes.

### Limitations

This study has potential limitations. Only scientific studies published in English were included in this study. Only scientific studies published in article format were included in this research. Only articles published on the Web of Science, Google Scholar and PubMed databases were included in this study. Also, the heterogeneity of the studies included prevented us from performing a meta-analysis.

### Future research

Although it is important to obtain findings regarding anthropometric characteristics and relations between motor abilities and their current performance, it is also important to design training models to improve athletic performance and investigate their effects. In this context, it is recommended for researchers to develop new training models in future studies and to carry out studies to improve the sports performance of amputee football players.

**Received:** 8 December 2022 | **Accepted:** 20 December 2022 | **Published:** 15 January 2023

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