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Yüzücülerde Fiziksel Performans: Kuvvet ve Fonksiyonel Hareket Analizi

Physical Performance in Swimmers: Strength and Functional Movement Analysis

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Öz

Yüzme, tüm vücut kaslarını çalıştıran ve yatay pozisyonda yapılan bir branş olması nedeniyle her yaş grubunda tercih edilen bir spordur. Yüzmede biyomotor özellikler arasında kas kuvveti ve kas dayanıklılığı önemli bir yere sahiptir. Antrenörler ve kondisyonerler, yüzücülerin suda gösterdikleri performansı artırmak amacıyla kara antrenmanlarını (dryland training) giderek daha fazla tercih etmeye başlamışlardır. Kuvvet antrenmanlarında dikkate alınması gereken en önemli faktörlerden biri, fonksiyonel hareket ile kas kuvveti arasındaki ilişkidir. Bu nedenle bu çalışma, yüzücülerde kuvvet ile fonksiyonel hareket arasındaki ilişkiyi incelemek amacıyla gerçekleştirilmiştir. Araştırmaya, Çanakkale Belediye Spor Kulübü'nde en az 3 yıldır yüzme antrenmanı yapan 40 erkek yüzücü katılmıştır. Yüzücülerin statik kas kuvvetini belirlemek amacıyla plank duruş testi, fonksiyonel hareket skorlarını belirlemek amacıyla ise 7 hareketten oluşan Fonksiyonel Hareket Tarama (FMS) testi uygulanmıştır. Elde edilen verilerin analizi için SPSS paket programı kullanılmıştır. Sporcuların demografik özellikleri belirlenmiş, elde edilen verilerin normallik dağılımı Kolmogorov-Smirnov testi ile test edilmiştir. Sporcuların FMS hareket örüntüleri ile statik kuvvet parametreleri arasındaki ilişkiyi belirlemek amacıyla parametrik olmayan testlerden Spearman Sıra Farkları Korelasyon testi kullanılmıştır. Anlamlılık düzeyi p<0,05 ve p<0,01 olarak belirlenmiştir. Araştırma sonucunda, yüzücülerde fiziksel performans kriterleri ile fonksiyonel hareket örüntülerinden derin çömelme, omuz hareketliliği, aktif düz bacak kaldırma, gövde stabilitesi şınavı ve toplam FMS skoru arasında pozitif ve anlamlı ilişkiler tespit edilmiştir.

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Abstract

Since swimming is a branch that works all the body muscles and is performed in a horizontal position, it is preferred in all age groups. Muscular strength-muscular endurance has an important place among biomotor features in swimming. Trainers, trainers or conditioners have started to prefer drylan training more and more to improve the in-water performance of swimmers. One of the most important factors to be considered in strength training is the relationship between functional movement and muscle strength. For this reason, the study was conducted to examine the relationship between strength and functional movement in swimmers. 40 men swimmers who have been doing swimming training in Çanakkale Belediye Spor for at least 3 years participated in the research. In order to determine the static muscle strength of the swimmers, the plank stance test was applied, and to determine the functional movement scores of the swimmers, the Functional Movement Analysis test consisting of 7 movements was applied. SPSS package program was used for the analysis of the data obtained in the research. The demographic characteristics of the athletes were determined. The normality of the obtained data was tested with the Kolmogorov-Smirnov test. In order to determine the correlation between the FMS Movement Patterns of the athletes and the Static Strength Parameters, the Spearman Rank Differences Correlation test, one of the nanparametric tests, was performed. Significance level was determined as p<0.05, p<0.01. As a result of the research, a positive and significant relationship was found between physical performance criteria, deep squat, shoulder mobility, active straight-leg raise, trunk stability push-up, and total FMS score from functional movement patterns in swimmers.

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Introduction

Swimming is a sport that individuals of all ages can do physically and physiologically. The most important features of this branch, which is performed in water and on the horizontal axis, are that it is one of the preferred branches in the developmental age. For this reason, children are introduced to swimming at a young age (Baydemir et al., 2019). Swimming is a sport that is widely practiced as an individual and team sport, performed in an aquatic environment and requires coordination of dynamic movements. Swimming is based on the effort to maximise the propulsion force while minimising the hydrodynamic resistance of the individual against the water. Achieving this balance requires not only physical capacity but also technical and biomechanical skills.

Physical capacity is a determining factor in swimming performance and includes elements such as strength, endurance, flexibility and coordination. In particular, maximal strength capacity is one of the main means of increasing swimming speed and optimising movement efficiency in water (Rejman et al., 2016). While the strength of upper body muscle groups plays a critical role in the correct execution of stroke movements, lower body strength is vital for acceleration in starts and turns. West et al. (2016) reported that lower extremity strength in the start and turn phases of sprint swimmers showed a strong correlation with race time.

There are mainly four techniques in swimming sport, which consists of different techniques. These techniques are named as freestyle, backstroke, breaststroke and butterfly independently. Swimming techniques are also separated from each other in terms of movement patterns. In free and backstroke technique, all body muscle groups work. Physically and physiologically, the backstroke technique is easier to swim than the freestyle technique. Due to swimming in the supine position, breathing is easier. Both techniques consist of a cyclic movement pattern due to consecutive movements. Breaststroke and butterfly technique is a technique that requires more rhythm. In addition, they are techniques in which the right and left sides are used at the same time in terms of movement pattern. In these branches where both lower and upper extremities are used at the same time, a proper body composition is required.

Functional movement analysis (FMS) is used as an important tool to assess performance and injury risk in swimming. FMS, which measures elements such as mobility, stability and movement coordination by evaluating the movement patterns of athletes, provides a versatile result (Cook et al., 2014). Swimmers need to balance mobility and stability on land in order to demonstrate a correct technique in the aquatic environment. McCall et al. (2015) reported that swimmers with high FMS scores experienced fewer injuries and were more efficient in movement patterns in the water than those with low FMS scores. It has been emphasised that the functional movement capacity of shoulder and hip joints is a determining factor on performance in swimmers (Kiesel et al., 2007).

Although swimming is divided into different classes in terms of technique, muscular strength-muscular endurance is at the forefront in all techniques. For this reason, land exercises in swimming should be trained according to the anthropometric characteristics of swimmers. Strength training in swimming positively affects the risk of injury as well as faster swimming. Since the methods used in strength training are aimed at the whole body muscle group, it ensures that other biomotor abilities are not lost in terms of function. Flexibility, mobility, stability, etc. should be taken into consideration in the studies planned by targeting the intensity of loading, and the studies that improve these abilities should be included in land training.

The specific biomechanical and physiological requirements of swimming make it necessary to develop technical and physical capacities together (Feitosa et al., 2024). Moving against the resistance of water leads to more energy consumption and a different movement economy compared to other branches (Mujika et al., 2014). Therefore, it is important to develop programmes based on functional movement analyses as well as strength training for swimmers in order to improve performance and reduce the risk of injury. Bishop et al. (2008) stated that strength training is effective in improving movement quality and this directly contributes to swimming techniques.

The effect of strength training on swimmers has been the subject of extensive research. Out-of-water strength training has been widely applied to improve swimming performance. In particular, plyometric training and resistance training allow swimmers to gain an advantage at the start of a race by increasing their explosive strength (García-Ramos et al., 2019). In addition, there are studies in the literature showing that the effect of strength capacity on swimming performance is not always direct (Bishop et al., 2008). In-water strength measurement methods have an important place in the development of customised training programmes for individual swimmers and offer a more holistic approach to performance analysis. However, there are limited studies in the swimming literature in which the effects of strength and functional movement analysis on performance are examined together. In this context, multidimensional approaches to the evaluation of physical performance in swimmers constitute both an academic and practical need (Suchomel et al., 2018). This study aims to fill the gaps in the literature and make valuable contributions to the field of applied sports sciences by comprehensively examining the effects of strength and functional movement characteristics on swimming performance in swimmers.

Material & methods

Participants

40 men swimmers who have been doing swimming training in Çanakkale Belediye Spor for at least 3 years participated in the research (age 15.10±0.92, height 164.73±6.56, weight 52.55±7.65, BMI 19.10±1.58).

Measurements

Measurements of Height and Body Weight

The height and body weight of the swimmers were measured using a Seca device (Seca 664, Hamburg, Germany). Swimmers wore swimsuits for measurements and measurements were made with bare feet.

Body Mass Index (BMI)

Body Mass Index (BMI) of swimmers was measured in kg with the formula “kg/height2 (m)” (Williams and Wilkins, 2000).

Plank Test

The swimmers were asked to lie face down, forearms and elbows bilaterally shoulder-width apart, and to stand on their toes, to raise the pelvis, and to maintain a straight line parallel to the ground with the neck, shoulders, back, hips and legs. The time was started when the stance was achieved, and the time in seconds until the stance was broken was recorded.

Functional Movement Screen (FMS) Test

FMS was used to determine the functional movement status of swimmers. He participated in the tests barefoot with the swimmers in training shorts and T-shirts. The test was applied in the hall where the land trainings were held. 7 basic movement patterns were evaluated (Deep Squat, Hurdle Step, Inline Lunge, Shoulder Mobility, Active Straight-Leg Raise, Trunk Stability Push-Up, Rotary Stability) based on a science-based biomechanical scanning and evaluation system. Each move was evaluated by an expert and the best 3 lowest 0 points were given. All movement scores were recorded as meeting and total FMS score points.

Statistical Analyses

SPSS package program was used for the analysis of the data obtained in the research. The demographic characteristics of the athletes were determined. The normality of the obtained data was tested with the Kolmogorov-Smirnov test. In order to determine the correlation between the FMS Movement Patterns of the athletes and the Static Strength Parameters, the Spearman Rank Differences Correlation test, one of the nanparametric tests, was performed. Significance level was determined as $p<0.05$, $p<0.01$.

Results

Table 1. Descriptive Characteristics of the Athletes Participating in the Research

Variables	N	X	SS	Min	Max
Age (year)		15.10	0.92	13	17
Height (cm)		164.73	6.56	154	179
Weight (kg)		52.55	7.65	43	67
BMI		19.10	1.58	16.33	22
Deep Squat		1.90	0.37	0	2
Hurdle Step		2.08	0.26	2	3
Inline Lunge	40	1.95	0.50	1	3
Shoulder Mobility		1.95	0.63	1	3
Active Straight-leg Raise		1.90	0.45	1	3
Trunk Stability Push-up		2.53	0.50	2	3
Rotary Stability		2.60	0.49	2	3
FMS Total Score		14.95	2.03	12	18
Plank (sn)		36.68	9.62	15	50

Descriptive statistics of the swimmers participating in the study are given in Table 1.

Table 2. Test of Normality

	Kolmogorov-Smirnov[a]		
Variables	**Statistic**	**df**	**Sig.**
Age (year)	.232	40	.000
Height (cm)	.116	40	.188
Weight (kg)	.228	40	.000
BMI	.105	40	.200*
Deep Squat	.529	40	.000
Hurdle Step	.536	40	.000
Inline Lunge	.390	40	.000
Shoulder Mobility	.306	40	.000
Active Straight-leg Raise	.306	40	.000
Trunk Stability Push-up	.351	40	.000
Rotary Stability	.390	40	.000
FMS Total Score	.156	40	.016
Plank (sn)	.221	40	.000

*p>0.05

Kolmogorov-Smirnov values were taken into account since the athletes participating in the research were over 30 as a result of the normality test performed to test whether the data obtained in the research showed a normal distribution. As a result of the analysis, it was determined that BMI was normally distributed, while other parameters were not normally distributed (p>0.05). The data obtained are given in Table 2.

Table 3. Correlation Analysis of Participants' FMS Movement Patterns and Static Force Parameters

		Deep Squat	Hurdle Step	Inline Lunge	Shoulder Mobility	Active Straight-leg Raise	Trunk Stability Push-up	Rotary Stability	FMS Total Score	Plank
Deep Squat	r	1.000	.081	.158	-.028	-.028	-.085	.349*	.262	.325*
	p	.	.619	.331	.863	.863	.600	.028	.103	.041
Hurdle Step	r		1.000	-.163	-.127	-.127	.081	.232	.092	.107
	p		.	.316	.436	.436	.620	.149	.574	.509
Inline Lunge	r			1.000	-.011	-.011	.006	.327*	.329*	.312
	p			.	.945	.945	.972	.040	.038	.050
Shoulder Mobility	r				1.000	1.000**	.319*	.585**	.824**	.791**
	p				.	.	.045	.000	.000	.000
Active Straight-leg Raise	r					1.000	.319*	.585**	.824**	.791**
	p					.	.045	.000	.000	.000
Trunk Stability Push-up	r						1.000	.347*	.535**	.503**
	p						.	.028	.000	.001
Rotary Stability	r							1.000	.859**	.846**
	p							.	.000	.000
FMS Total Score	r								1.000	.973**
	p								.	.000
Plank (sn)	r									1.000
	p									.

*p<0.05, **p<0.01

As a result of the Spearman Rank Differences Correlation test, which was carried out to reveal whether there is a relationship between the FMS movement patterns and the static strength value (plank) of the athletes participating in the research; A significant positive correlation was determined between deep squat and rotary stability (r=.349, p<0.05), between deep squat and plank (r=.325, p<0.05), between inline lunge and rotary stability (r=.327, p<0.05), Between inline lunge and FMS total score (r=.329, p<0.05), between shoulder mobility and active straight-leg raise (r=1.000, p<0.01), between shoulder mobility and trunk stability push-up (r=. 319, p<0.05), between shoulder mobility and rotary stability (r=.585, p<0.01), between shoulder mobility and FMS total score (r=.824, p<0.01), between shoulder mobility and plank (r=. .791, p<0.01), between active straight-leg raise and trunk stability push-up (r=.319, p<0.05), between active straight-leg raise and rotary stability (r=.585, p<0.01) , between active straight-leg raise and FMS total score (r=.824, p<0.01), between active straight-leg raise and plank (r=.791, p<0.01), between trunk stability push-up and rotary stability (r=.347, p<0.05), between trunk stability push-up and FMS total score (r=.535, p<0.01), trunk stability pu Between sh-up and plank (r=.503, p<0.01), between rotary stability and FMS total scores (r=.859, p<0.01), between rotary stability and plank (r=.846, p<0.01) between FMS total score and plank (r=.973, p<0.01). The data obtained were given in Table 3.

Dicussion

In this study, which was conducted to examine the relationship between strength and functional movement in swimmers, a positive and significant relationship was determined between physical performance criteria in swimmers, strength and functional movement patterns such as deep squat, shoulder mobility, active straight-leg raise, trunk stability push-up, and total FMS score. When the literature was examined, there were studies that compare the FMS movement patterns in swimmers according to the levels and the results in terms of biomotor characteristics. Bond et al. (2014), in their study to examine the relationship between anthropometric features, FMS and 100m freestyle in adolescent swimmers, found that anthropometric features were associated with 100m freestyle swimming performance in swimmers and swimmers who swim faster had less skinfold thickness (Bond et al., 2014). Lucas et al. (2021), on the other hand, examined the FMS scores of young elite and non-elite swimmers and the relationship between these scores and 100m freestyle. As a result of the research, they determined that the FMS scores were positively related to the 100m freestyle and the FMS scores of the elite swimmers were higher than the non-elite swimmers (Lucas et al., 2021).

Researchers have conducted studies on dynamic balance and FMS scores in swimmers. Bullock et al. (2017) searched for a relationship between the FMS scores of a total of 70 high school and university swimmers and their Y-Balence test upper quartile scores in their study. As a result of the research, they found that the FMS scores of high school students were below the average, individual basic movements differed between high school and university swimmers, and the dynamic balance differed (Bullock et al., 2014).

Studies examining the relationship between athletic performance and FMS scores are frequently encountered in the literature. Although there is a relationship between FMS and performance, it has been concluded that they are not the same concepts and should be evaluated as different structures. They stated that children and young people with high FMS scores have better agility, running speed, strength and cardiovascular endurance (Pfeifer et al., 2019; Padua et al., 2009; Butler et al., 2012; Lloyd et al., 2015; Girard et al., 2016; Bennett et al., 2021).

There are studies in the literature emphasizing that strength training and functional movement abilities are effective factors in improving swimming performance. In particular, it has been emphasized that strength is a critical element affecting performance in water, but this strength should be compatible with technical movements (Mujika et al., 2014; Bishop et al., 2008). The effect of strength on swimming performance is especially evident in starts and turns (Baydemir et al., 2019). The study by West et al. (2016) is parallel to the findings that strong leg muscles improve performance in starts and turns. On the other hand, it is also stated in the literature that strength training alone is not sufficient and that the increase in performance may be limited unless combined with technique (Bishop et al., 2008).

Functional movement analysis has an important effect on swimming performance because it is a method that evaluates the efficiency and safety of body movements. Increasing the range of motion of the shoulder and hip joints in particular reduces water resistance and provides a more efficient swimming movement. Kiesel et al. (2007) stated that the risk of injury increases and performance is negatively affected in individuals with low functional movement analysis scores. Similarly, in our study, it was determined that low functional movement analysis scores have negative effects on swimming performance. These findings once again reveal the important role of functional movement in swimming performance. There are studies in the literature indicating that considering strength and functional movement abilities together is critical for optimizing performance. Suchomel et al. (2018) stated that developing strength and functional movements together provides an increase in overall performance in athletes.

Conclusions

In the study, a positive significant relationship was determined between the physical performance criteria of strength and functional movement patterns of deep squat, shoulder mobility, active straight-leg raise, trunk stability push-up, and total FMS score in swimmers. As a result, it can be said that special training and strength training aimed at improving functional movement abilities should be considered in a holistic manner in order to increase strength in swimmers, and that this approach can both optimize performance and support the long-term health and sustainable success of athletes.

Conflicts of interest -The authors declare no conflict of interest

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