Investigation of the Effect of Core Exercises Applied to Football Players on Respiratory Parameters

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Abstract. In addition to strength development, the increase in respiratory capacity has an important place in increasing the performance of athletes. For these reasons, the study aimed to examine the effect of core exercises applied to football players on respiratory parameters. The research group consisted of 12 randomly selected control groups and 12 core training groups, a total of 24 football players between the ages of 14-17 playing football at Niğde Youth and Sports Club. While the control group continued their routine football training, the core group performed static and dynamic core exercises for 45 min, 3 days a week for 8 weeks, in addition to general training. SPSS 26 program was used to analyze the data. The normality distributions of the data were determined with the Shapiro-Willk test. Percentage frequency distributions of the data were made, the Independent T test was used for inter-group comparisons, and the Paired T test was used for intra-group comparisons. As a result of the analysis, it was determined that core exercises had a positive effect on respiratory parameters.

1 Introduction

Football is a multifaceted sport that requires physical endurance, agility, strength, and coordination. These requirements require football players' training programs to include different types of exercises to optimize their performance and reduce the risk of injury. The core muscle group is critical for maintaining body stability, power generation, and performing balanced movements. Strengthening the core muscles can improve not only performance but also respiratory capacity and efficiency [1].

Recent research has emphasized the positive effects of core exercises on athletic performance. It has been reported that these exercises can significantly improve dynamic balance, postural control, and general strength development in football players [2,3]. In addition, the fact that the core muscles are in an anatomical and functional relationship with the respiratory muscles creates a potential area for improving respiratory function [4]. It has been shown that core exercises increase the strength of respiratory muscles and promote respiratory parameter development, thus positively affecting the aerobic capacity and

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endurance of athletes [5]. In this context, the inclusion of core exercises aimed at improving respiratory health in training programs can contribute to performance enhancement and recovery processes [6]. The development of respiratory parameters can increase aerobic capacity and endurance and improve field efficiency [7]. However, the limited number of studies that have specifically examined the effects of core exercises on respiratory function necessitates further investigation of this topic.

The aim of this study was to examine the effects of core exercises on the respiratory parameters of football players. It is expected that the findings will make significant contributions to enriching the content of football training programs and supporting the performance development of athletes.

2 Method

2.1 Research Group

A total of 24 football players, 12 in the control group and 12 in the core training group, randomly selected between the ages of 14 and 17, playing football at Niğde Gençlik and Sports Club participated in the study.

2.2 Exercise Protocols

While the control group continued their routine football training, the Experimental group (Core group) performed static and dynamic core exercises for 45 min, 3 days a week for 8 weeks, in addition to general training.

Table 1. Static and dynamic core exercise program

Movements	**1. Week**	**2. Week**	**3. Week**	**4. Week**	**5. Week**	**6. Week**	**7. Week**	**8. Week**
Rest	0-90s	0-60s	0-60s	0-60s	0-60s	0-60s	0-60s	0-60s
Number of Sets	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3
Tempo	Slow	Middle	Middle	Middle	High	High	High	High
Side Plank Hold (sn)	25*2	25*2	30*2	30*2	35*2	35*2	40*2	40*2
Floor Bridge (piece)	20*2	20*2	25*2	25*2	30*2	30*2	35*2	35*2
Hip&Shoulder Abduction (piece)	20*2	20*2	25*2	25*2	30*2	30*2	35*2	35*2
Deadbugs (piece)	20*2	20*2	25*2	25*2	30*2	30*2	35*2	35*2
Bird Dog (piece)	20*2	20*2	25*2	25*2	30*2	30*2	35*2	35*2
Sit up (piece)	20*2	20*2	25*2	25*2	30*2	30*2	35*2	35*2
Plank (sn)	45*2	45*2	50*2	50*2	40*2 T	40*2 T	50*2 T	50*2 T

[8] T; One Leg in the Air

2.3 Respiratory Function Test

A Mikrolab 3300 spirometer was used to measure respiratory parameters. After the test was presented in detail to the participants, try it several times. The forced vital capacity (FVC), forced expiratory volume in 1 sec. (FEV1), and peak maximal flow (PEF) were measured from the respiratory parameters. The measurements were made by the football players while they were comfortably seated. After the nose clip was attached to the players' noses, the nose was closed, the mouthpiece was placed between the teeth and lips, and the specified measurements were performed. This process was repeated three times, and the best score was included in the study [9].

2.4 Analysis of Data

SPSS 26 software was used to analyze the data. The normality distribution of the data was determined by the Shapiro-Wilk test, and it was determined that the data were normally distributed (Table 2). Percentage frequency distributions of the data were made. Paired T-test was used for intra-group comparisons, and the independent samples T-test was used for inter-group comparisons.

Table 2. Normal distribution table of data

	Statistic	df	Sig.
FVC pre-test	,876	12	,077
FVC post-test	,777	12	,055
FEV1 pre-test	,874	12	,074
FEV1 post-test	,928	12	,360
PEF pre-test	,865	12	,056
PEF post-test	,909	12	,209

3 Results

Table 3. Demographic characteristics of football players

	Control group					**Experiment Group**				
Variable	**n**	**x**	**Ss**	**Min.**	**Max.**	**n**	**x**	**Ss**	**Min.**	**Max.**
Age (years)	12	15,08	1,38	14	17	12	14,08	0,28	14	15
Height (cm)	12	158,58	12,92	138	180	12	159,75	8,87	147	178
Kilogram (kg)	12	51,66	16,49	30,00	73,00	12	48	7,41	40	65

When Table 3 is examined, it is determined that the average age of the football players in the control group is 15.08 years, their average height is 158.58 cm, and their average kilogram

weight is 51.66 kg, while the average age of the football players in the experimental group is 14.08 years, their average height is 159.75 cm, and their average kilogram weight is 48 kg.

Table 4. Intragroup comparison of respiratory parameter averages of control group football players

Variable	**Paired Group**	**n**	**x**	**SD**	**t**	**p**
FVC (lt)	Pre-test	12	3,20	0,93	-8,10	0,00
	Post-test		4,33	1,06		
FEV1 (lt/sn)	Pre-test	12	2,38	0,69	-9,16	0,00
	Post-test		3,77	0,75		
PEF (lt/m)	Pre-test	12	3,28	1,58	-8,04	0,00
	Post-test		5,09	1,76		

p<0,05

When Table 4 was examined, it was determined that there was a significant difference in the intra-group comparison of the respiratory parameters of the control group football players and the difference was in favor of the post-test.

Table 5. Intragroup comparison of respiratory parameter means of balance group football players

Variable	**Paired Group**	**n**	**x**	**SD**	**t**	**p**
FVC (lt)	Pre-test	12	3,40	0,781	-8,137	0,00
	Post-test		4,44	0,924		
FEV1 (lt/sn)	Pre-test	12	2,41	0,861	-4,307	0,00
	Post-test		3,91	1,361		
PEF (lt/m)	Pre-test	12	3,06	1,443	-5,91	0,00
	Post-test		6,06	2,008		

p<0,05

When Table 5 was examined, it was determined that there was a significant difference in the intra-group comparison of the respiratory parameters of the experimental group of football players, and the difference was in favor of the post-test.

Table 6. Intergroup comparison of pre-test results of average respiratory parameter values of football players in the control experimental group

Variable	Grup	n	x	Ss	t	p
FVC (lt)	Control	12	3,20	0,93	-0,56	0,58
	Experiment	12	3,40	0,78		
FEV1 (lt/sn)	Control	12	2,38	0,69	-0,12	0,91
	Experiment	12	2,41	0,86		
PEF (lt/m)	Control	12	3,28	1,58	0,34	0,73
	Experiment	12	3,06	1,44		

When Table 6 is examined, no difference was found in the comparison of the pre-test results of the respiratory parameter averages of the control-experimental group football players between the groups.

Table 7. Table 7. Intergroup comparison of post-test results of average respiratory parameter values of football players in the control experimental group

Variable	Grup	n	x	Ss	t	p
FVC (lt)	Control	12	4,33	1,06	-0,26	0,80
	Experiment	12	4,44	0,92		
FEV1 (lt/sn)	Control	12	3,77	0,75	-0,32	0,75
	Experiment	12	3,91	1,36		
PEF (lt/m)	Control	12	5,09	1,76	-1,26	0,22
	Experiment	12	6,06	2,01		

When Table 7 is examined, no difference was found in the comparison of the post-test results of the respiratory parameter averages of the control-experimental group football players between the groups.

4 Conclusion

Respiratory functions occur through the coordinated work of respiratory muscles, such as the diaphragm, intercostal muscles, and abdominal muscles. Core exercises can improve respiratory patterns and ventilation efficiency by strengthening these muscle groups [1]. Studies have shown that strengthening the core muscles, especially the diaphragm, facilitates more effective functioning and thus increases respiratory capacity [10]. The current study examined the effects of core exercises on the respiratory parameters of football players.

In this study, it was determined that there was a significant difference in the intragroup comparison of the respiratory parameters of the control group and experimental football players, and the difference was in favor of the post-test results. No difference was found in the intergroup comparison of the pre-test and post-test results of the respiratory parameter averages between the control and experimental groups of football players. Despite this, it was determined that respiratory parameter development was higher in the experimental group than in the control group. It is thought that this condition caused the diaphragm to work more effectively and thus contributed to the development of respiratory parameters.

Wu et al., [11] emphasized that the effect of core exercises on respiratory parameters may vary among individuals and that exercise protocols should be optimized. Zahra et al., [12] reported that regular core exercises significantly improved FVC and FEV1 values. Demir and Kaya [13] reported that core stabilization exercises significantly increased the respiratory parameters FVC and FEV_1 in amateur football players. These findings may be related to core stabilization, which increases the efficiency of respiratory muscles and improves thoracoabdominal mobility. Lee and Park [10] reported that core exercises positively affected respiratory function by increasing the activity of the diaphragm and intercostal muscles. These results demonstrate the contribution of core stability contributes to increased respiratory capacity. Strengthening the core muscles allows the diaphragm muscle to work more efficiently and create stronger expiratory movements, thereby increasing FVC and FEV1 values. In their study, Güler and Yıldırım [14] reported that core exercises significantly improved the respiratory function FVC and FEV1 values in trained football players. They emphasized that core training strengthens abdominal and diaphragm muscles, thereby improving respiratory functions by increasing the capacity of the respiratory muscles. Şahin and Kocahan [15] investigated the effects of an 8-week core strengthening program applied to professional football players on FVC and FEV1 values. At the end of the study, core exercises significantly increased FVC and FEV1 values. The researchers stated that this improvement may be due to the stabilization of the core muscles and the more effective functioning of respiratory muscles by increasing postural control. Mills et al., [16] reported that core exercises significantly increased FVC and FEV1 in athletes. Strengthening the core muscles can improve respiratory capacity by increasing the functional capacity of the respiratory muscles (especially the diaphragm and intercostal muscles). These results can be associated with the strengthening of respiratory muscles and increasing rib cage mobility. In a study conducted by Kilding et al., [17], significant improvements in FEV1 values were observed after core exercises and core stabilization led to more efficient breathing patterns [18]. The findings of this study indicated that core exercises increased respiratory performance in athletes. Hibbs et al., [1] reported that respiratory muscle strength and functions were positively affected by regular core exercises. In another study, Beneke and Leithäuser [19] stated that strong core muscles optimize the oxygen consumption of athletes by improving running economy. Therefore, the authors stated that core exercises play a critical role not only for general fitness but also for respiratory system performance.

Kim et al., [20] reported that the PEF is an important parameter that reflects airway patency and respiratory muscle strength. The effects of core exercises on PEF were also investigated, and the results indicated that core exercises significantly improved PEF. Chang et al., [21]. Strong core muscles provide better postural control during breathing, allowing respiratory muscles to work more efficiently. The findings of this study indicate that core stabilization increases respiratory efficiency and can significantly improve PEF values in athletes. Hoshikawa et al., [22] reported that core exercises can also indirectly affect the general respiratory capacity. Core exercises can increase abdominal muscle strength, increase the pressure created during expiration, and thus improve PEF values. Especially in high-intensity sports such as football, these improvements can directly affect the performance of athletes. However, the effects on PEF may vary depending on individual differences and exercise protocols. Some studies have reported significant improvements in PEF with core exercises, while others have noted that this effect may be minimal [23]. These differences may be attributable to factors such as the duration and intensity of the exercise and the participants' baseline respiratory function.

In conclusion, it is seen that core exercises have positive effects on respiratory parameters of football players. These findings show that core exercises should be included in athlete training programs in order to optimize sports performance and prevent injuries.

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