GAZİANTEP ÜNİVERSİTESİ
Spor Bilimleri Dergisi

Cilt / Vol: 7, Sayı / Issue: 4
December / Aralık, 2022
ISSN: 2536-5339

The Effects of Different Body Positions on Pulmonary Functions in Adolescent Football Players

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DOI: 10.31680/gaunjss.1206029

Orijinal Makale / Original Article

Geliş Tarihi / Received: 11.10.2022 **Kabul Tarihi / Accepted:** 29.11.2022 **Yayın Tarihi / Published:** 23.12.2022

Abstract

The present study aims to examine the effects of different body positions on pulmonary functions in adolescent football players. Twenty-three healthy male football players who did not have any diseases and who did not smoke participated in the study voluntarily. Pulmonary function tests (PFT) were determined by using a spirometer. Measurements were performed in sitting, standing and supine positions to determine the effect of body positions on pulmonary functions. One-way analysis of variance in repeated measurements was used to compare the mean differences in respiratory function variables in three different body positions, and Bonferroni correction test was used to determine in which position the difference existed. All statistics were performed in SPSS 26.0 package program. As a result of the applications, FVC, FEV1, FEV1/FVC, FEF_{max} and MVV parameters measured while sitting and standing were found to be statistically significantly higher than the supine position ($p<0.05$). No significant difference was found between all applications in SVC and IC parameters ($p>0.05$). Highest mean values were reached in FVC, FEV1, FEV1/FVC, FEF_{max}, SVC parameters while sitting, in IC capacity in supine position and in MVV capacity in standing position. As a result, it was found that different body positions affect pulmonary function parameters significantly. It is thought that the preferred position should be taken into account when interpreting the PFT measurement results.

Key Words: Football Player, Body Position, Pulmonary Function

Adölesan Futbolcularda Farklı Vücut Pozisyonlarının Pulmoner Fonksiyonlara Etkisi

Öz

Araştırmanın amacı, adölesan futbolcularda farklı vücut pozisyonlarının pulmoner fonksiyonlar üzerine etkilerini incelemektir. Araştırmaya herhangi bir hastalığı olmayan ve sigara kullanmayan 23 sağlıklı erkek futbolcu gönüllü olarak katılmıştır. Pulmoner fonksiyon testleri (PFT) spirometre kullanılarak belirlenmiştir. Vücut pozisyonlarının pulmoner fonksiyonlara etkisini belirlemek için ölçümler oturarak, ayakta ve sırt üstü pozisyonda uygulanmıştır. Üç farklı vücut pozisyonunda solunum fonksiyonu parametrelerindeki ortalama farklılıkları karşılaştırmak için tekrarlı ölçümlerde tek yönlü varyans analizi ve farklılığın hangi pozisyonda olduğunun belirlenmesi için Bonferroni düzeltme testi kullanılmıştır. Tüm istatistikler SPSS 26.0 paket programında yapılmıştır. Uygulamalar sonrası oturarak ve ayakta ölçülen FVC, FEV1, FEV1/FVC, FEF_{max} ve MVV parametrelerinin sırt üstü pozisyondan istatistiksel olarak daha yüksek olduğu görülmüştür ($p<0,05$). SVC ve IC parametrelerinde ise tüm uygulamalar arasında anlamlı farklılık bulunamamıştır ($p>0,05$). FVC, FEV1, FEV1/FVC, $FEF_{max,}$ SVC parametrelerinde oturarak, IC kapasitesinde sırt üstü ve MVV kapasitesinde ise ayakta pozisyonunda en yüksek ortalama değerlere ulaşılmıştır. Sonuç olarak adölesan futbolcularda farklı vücut pozisyonlarının pulmoner fonksiyon parametrelerini önemli ölçüde etkilediği saptanmıştır. PFT ölçüm sonuçları yorumlanırken tercih edilen pozisyonun dikkate alınması gerektiği düşünülmektedir.

Anahtar Kelimeler: Futbolcu, Vücut Pozisyonu, Pulmoner Fonksiyon

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Introduction

Pulmonary function test (PFT) is a combination of studies conducted in clinical practice to determine lung capacities (Katz et al., 2018; Patel and Thakar, 2015). It is useful to confirm the possible presence and severity of lung diseases (Wanger and Culver, 2016).

In clinical practice, interpretation of pulmonary function has been based on anthropometric factors such as weight, height, gender and age (Mottram, 2012). In addition, other factors have taken on particular importance as knowledge in this area has increased. These are circadian rhythms (Hwang et al., 2014), trachea size (Barone-Adesi et al., 2015), social and health-related issues (Lange et al., 2014; Löfstedt et al., 2017; Tabak et al., 2009), environmental factors (Bowatte et al., 2017; Dane et al., 2016; Kobayashi et al., 2013), race or ethnic group (Mehari et al., 2015), nutrition (Shan et al., 2015), physical activity level (Lazovic et al., 2015), smoking (Bostanci et al., 2019), and diseases (Ostrowski et al., 2006).

While there is a quite extensive bibliography on how each of the above factors influence lung function, there are not enough studies on the position to be applied on athletes in pulmonary function tests. Positions to be applied in pulmonary function tests are standing, sitting and supine positions (Mohammed et al., 2017).

In addition, respiratory muscles activity varies in different positions. (Segizbaeva et al., 2013). Different body positions affect lung volume and relationship between muscle length and tension. These factors have an impact on mean expiratory pressure and peak expiratory flow (Bhat et al., 2003). The effects of body positions on pulmonary functions of normal individuals have previously been reported to vary (Jones and Dean, 2004; Badr et al., 2002). However, no studies have been found on football players. The aim of the present study is to determine the body position that provides the best lung volume by examining the effects of different body positions on pulmonary functions in adolescent football players.

Method

Subjects

Twenty three healthy male football players who continued their amateur football life actively in 2021-2022 football season, who did not have any diseases (chronic and acute respiratory diseases, cardiovascular diseases and neuromuscular diseases) and who did not smoke participated voluntarily in study (Table 1). The study was done in

accordance with the Helsinki Declaration Criteria and 26/10/2022 dated and 2022/6 numbered permission was obtained from the Ethics Committee of Gümüşhane University prior to the study.

Pulmonary function test and study design

PFTs were performed by a spirometer (CPFS/D USB Spirometer, MGC Diagnostics) according to the guidelines of the ATS/ERS (2002). Forced vital capacity (FVC), forced expiratory volume in one second (FEV1), FEV1/FVC ratio, maximal voluntary ventilation (MVV), slow vital capacity (SVC), and inspiratory capacity (IC) were recorded with pulmonary function testing (Bostanci et al., 2019). All measurements were repeated 3 times and FVC, FEV1, FEF_{max}, SVC, IC and MVV values of the best result were recorded. Measurements were made respectively in sitting (football player in sitting position with trunk upright, hip joint 90° flexed with trunk), standing position (with body standing upright and legs parallel to each other facing forward) and supine position (football player in supine position with his face pointing upwards in supine position) and with their noses closed with clips. The participants were asked not to eat at least 2 hours before the tests and not to exercise on the day of the test. A 15-minute rest period was observed between individual positions. The test was terminated if the volunteer withdrew consent, if he was short of breath, too tired to continue, if he could not tolerate the position, or could not perform the test correctly in this position.

Statistical analyzis

SPSS 26.0 program was used. After statistical procedures, the results were presented as mean and standard deviation. Repeated Measures ANOVA was used to compare the mean differences in respiratory function variables in three different body positions and Bonferroni correction test was used to determine in which position the difference existed. The results obtained were evaluated according to $p<0.05$.

Results

Table 1. Descriptive information of the subjects

Variables	n	Mean	S.D.
Age (years)	23	15.56	0.51
Height (cm)	23	178.65	4.49
Weight (kg)	23	64.35	8.36
BMI (kg/m^2)	23	20.09	2.05

SD: standard deviation, BMI: body mass index

Descriptive information of the football players who participated in the study is presented in Table 1.

Table 2. Comparison of respiratory test results according to body positions (n=23)

Parameters	Sitting	Standing	Supine	f	λ p	η_p^2
FVC (L)	4.34±0.98[a]	4.33±0.98[a]	4.09±0.89[b]	5.005	0.017	0.323
FEV1 (L)	3.71±0.80[a]	3.58±0.76[a]	3.25±0.65[b]	6.640	0.006	0.387
FEV1/FVC (%)	86±7.51[a]	83.26±8.74[a]	80.48±9.89[b]	5.307	0.014	0.336
MVV (L/min)	147.26±41.18[a]	154.48±39.14[a]	146.61±36.62[b]	7.337	0.004	0.411
FEF_{max} (L/s)	7.27±1.74[a]	7.26±1.69[a]	6.45±1.52[b]	7.490	0.004	0.416
SVC (L)	3.74±1.03	3.55±0.94	3.64±0.90	1.186	0.325	0.101
IC (L)	2.52±0.89	2.51±0.77	2.77±0.70	1.568	0.232	0.130

a-b: significant difference in groups, FVC: forced vital capacity, FEV1: forced expiratory volume in one second, MVV: maximal voluntary ventilation, FEF_{max}: forced expiratory flow, SVC: slow vital capacity, IC: inspiratory capacity

As a result, it was found that the parameters of FVC, FEV1, FEV1/FVC, FEF_{max} and MVV measured while sitting and standing were significantly higher than the supine position ($p<0.05$). No significant difference was found between all applications in SVC and IC parameters ($p>0.05$). Mean impact power values of the measured positions were calculated as FVC 32.3%, FEV1 38.7%, FEV1/FVC 33.6%, FEF_{max} 41.6% and MVV 41.1%. Highest values were reached in FVC, FEV1, FEV1/FVC, FEF_{max}, SVC parameters in sitting position, in IC capacity in supine position and in standing position in MVV capacity.

Discussion

PFT provides an objective determination of lung function. It has been measured in different positions in the literature (Baghery and Esmaeilzadeh, 2011; Lee, 2012; Melam et al., 2014; Tsubaki et al., 2009). However, no such study was found on football players. In the study, it was hypothesized that respiratory function test parameters would change according to body position in adolescent football players. The main finding of this study is that changes in the subject's body position affect the results significantly. The results show that the highest measurement of pulmonary function was found when the subject was sitting, while the lowest was found when the subject was in the supine position. According to the measurement results taken from the football players who participated in this study, mean impact power values of the positions were calculated as FVC 32.3%, FEV1 38.7%, FEV1/FVC 33.6%, FEF_{max} 41.6% and MVV 41.1% and the highest values were reached in FVC, FEV1, FEV1/FVC, FEF_{max}, SVC parameters in sitting position, in IC capacity in supine position and in standing position in MVV capacity.

Different studies have been conducted on the effect of body position on respiratory mechanics and function (Katz et al., 2018; Patel and Thakar, 2015; Poussel et al., 2014). Tsubaki et al. (2009) reported that the highest pulmonary function test results in women were in the sitting position, while respiratory muscle strength did not change in sitting, supine, and 45-degree rotation prone positions (Tsubaki et al., 2009). In another study conducted on fourty five healthy individuals, the FVC, FEV1 and PEF measurements were found to be significantly higher in the sitting position than in the standing position, while there was no significant change in the FEF parameter, and there was a 10% decrease in all respiratory parameters in the supine position compared to the sitting position (Patel and Thakar, 2015). These results are similar to the results of the present study.

According to ATS/ERS guidelines, PFT can be performed sitting or standing. Sitting is preferred more for safety measures such as preventing fainting and falling (Miller et al., 2005). In a study they conducted on asthma patients, Razi and Mousavi (2007) found the FVC value as 3.04±0.93 while sitting, as 3.03±0.96 while standing, FEV1 value as 2.38±0.75 while sitting, as 2.40±0.81 while standing, and FEV1/FVC value as 79.10±9.02 while sitting and as 78.63±8.53 while standing (Razi and Mousavi, 2007). Poussel et al. (2014) examined the effects of supine and sitting positions on respiratory function and stated that supine performance was significantly lower than sitting performance (Poussel et al., 2014). In another study, it was stated that there was no difference between PFT parameters obtained in sitting and standing positions (Domingos-Benício et al., 2004).

In a study by Baghery and Esmaeilzadeh (2011) conducted with 20 participants between the ages of 12-15, the participants reported that the best VC, FEV1, PEF values were in standing position, followed by normal posture and kyphotic sitting posture (Baghery and Esmaeilzadeh, 2011). Melam et al. (2014) reported that standing is the best position to measure the FEV1 and FVC of asthmatic subjects, and the more upright the individual, the higher the FEV1 and FVC values will be (Melam et al., 2014).

In the supine position, while the dorsal side of the chest wall limits its mobility with the weight, strength and balance are provided against gravity with a certain force in the standing position. The pressure caused by the intra-abdominal organ to the diaphragm is higher than in the supine position and standing. On the other hand, it is thought that in sitting position, the body is more free and spends less energy.

As a result, it was found in the study that different body positions affect pulmonary function parameters significantly. Considering this result, it was concluded that the preferred position should be considered while interpreting the PFT measurement results. It was also found that pulmonary function tests give better results when seated. The highest results were obtained in FVC, FEV1, FEV1/FVC, FEF_{max}, SVC parameters while sitting, in IC parameter in supine position and in MVV parameter in standing position.

References

American Thoracic Society/European Respiratory Society (2002). ATS/ERS Statement on respiratory muscle testing. *American Journal of Respiratory and Critical Care Medicine*, *166*(4), 518-624.

Badr, C., Elkins, M. R., & Ellis, E. R. (2002). The effect of body position on maximal expiratory pressure and flow. *Australian Journal of Physiotherapy*, *48*(2), 95-102.

Baghery, H., & Esmaeilzadeh, M. (2011). Effect of different sitting posture on pulmonary function in students. *Journal of Physiology and Pathophysiology*, *2*(3), 29-33.

Barone-Adesi, F., Dent, J. E., Dajnak, D., Beevers, S., Anderson, H. R., Kelly, F. J., & Whincup, P. H. (2015). Long-term exposure to primary traffic pollutants and lung function in children: Cross-sectional study and meta-analysis. *PloS One*, *10*(11), e0142565.

Bhat, R. Y., Leipala, J. A., Singh, N. R. P., Rafferty, G. F., Hannam, S., & Greenough, A. (2003). Effect of posture on oxygenation, lung volume, and respiratory mechanics in premature infants studied before discharge. *Pediatrics*, *112*(1), 29-32.

Bostanci, Ö., Mayda, H., Yılmaz, C., Kabadayı, M., Yılmaz, A. K., & Özdal, M. (2019). Inspiratory muscle training improves pulmonary functions and respiratory muscle strength in healthy male smokers. *Respiratory Physiology & Neurobiology*, *264*, 28-32.

Bowatte, G., Lodge, C. J., Knibbs, L. D., Lowe, A. J., Erbas, B., Dennekamp, M., & Dharmage, S. C. (2017). Traffic-related air pollution exposure is associated with allergic sensitization, asthma, and poor lung function in middle age. *Journal of Allergy and Clinical Immunology*, *139*(1), 122-129.

Dane, D. M., Lu, H., Dolan, J., Thaler, C. D., Ravikumar, P., Hammond, K. A., & Hsia, C. C. (2016). Lung function and maximal oxygen uptake in deer mice (peromyscus maniculatus) bred at low altitude and re-acclimatized to high altitude. *The FASEB Journal*, *30*, 1297-5.

Domingos-Benício, N. C., Gastaldi, A. C., Perecin, J. C., Avena, K. D. M., Guimarães, R. C., Sologuren, M. J., & Lopes-Filho, J. D. (2004). Spirometric values of obese and non-obese subjects on orthostatic, sitting and supine positions. *Revista da Associacao Medica Brasileira, 50*(2), 142-147.

Hwang, J. W., Sundar, I. K., Yao, H., Sellix, M. T., & Rahman, I. (2014). Circadian clock function is disrupted by environmental tobacco/cigarette smoke, leading to lung inflammation and injury via a SIRT1-BMAL1 pathway. *The FASEB Journal*, *28*(1), 176-194.

Jones, A. Y., & Dean, E. (2004). Body position change and its effect on hemodynamic and metabolic status. *Heart & Lung*, *33*(5), 281-290.

Katz, S., Arish, N., Rokach, A., Zaltzman, Y., & Marcus, E. L. (2018). The effect of body position on pulmonary function: A systematic review. *BMC Pulmonary Medicine*, *18*(1), 1-16.

Kobayashi, S., Hanagama, M., Yamanda, S., Satoh, H., Tokuda, S., Kobayashi, M., & Yanai, M. (2013). The impact of a large-scale natural disaster on patients with chronic obstructive pulmonary disease: The aftermath of the 2011 Great East Japan Earthquake. *Respiratory Investigation*, *51*(1), 17-23.

Lange, P., Marott, J. L., Vestbo, J., Ingebrigtsen, T. S., & Nordestgaard, B. G. (2014). Socioeconomic status and prognosis of COPD in Denmark. *COPD Journal of Chronic Obstructive Pulmonary Disease*, *11*(4), 431-437.

Lazovic, B., Mazic, S., Suzic-Lazic, J., Djelic, M., Djordjevic-Saranovic, S., Durmic, T., & Zugic, V. (2015). Respiratory adaptations in different types of sport. *Eur Rev Med Pharmacol Sci*, *19*(12), 2269-74.

Lee, B. K. (2012). The effect of the forced pulmonary function of young female, by changes in lung function related to postures and by transverse abdominis activation in standing position. *Journal of the Korean Society of Physical Medicine*, *7*(3), 267-274.

Löfstedt, H., Hagström, K., Bryngelsson, I. L., Holmström, M., & Rask-Andersen, A. (2017). Respiratory symptoms and lung function in relation to wood dust and

monoterpene exposure in the wood pellet industry. *Upsala Journal of Medical Sciences*, *122*(2), 78-84.

Mehari, A., Afreen, S., Ngwa, J., Setse, R., Thomas, A. N., Poddar, V., & Thomas, A. V. (2015). Obesity and pulmonary function in African Americans. *PLoS One*, *10*(10), e0140610.

Melam, G. R., Buragadda, S., Alhusaini, A., Alghamdi, M. A., Alghamdi, M. S., & Kaushal, P. (2014). Effect of different positions on FVC and FEV1 measurements of asthmatic patients. *Journal of Physical Therapy Science*, *26*(4), 591-593.

Miller, M. R., Crapo, R., Hankinson, J., Brusasco, V., Burgos, F., Casaburi, R., & Wanger, J. (2005). General considerations for lung function testing. *European Respiratory Journal*, *26*(1), 153-161.

Miller, M. R., Hankinson, J., Brusasco, V., Burgos, F., Casaburi, R., Coates, A., & Wanger, J. (2005). Standardisation of spirometry. *European Respiratory Journal*, *26*(2), 319-338.

Mohammed, J., Abdulateef, A., Shittu, A., & Sumaila, F. G. (2017). Effect of different body positioning on lung function variables among patients with bronchial asthma. *Archives of Physiotherapy & Global Researches*, *21*(3), 7-12.

Mottram, C. (2012). Ruppel's manual of pulmonary function testing, Mosby, Maryland Heights, Missouri.

Ostrowski, S., & Barud, W. (2006). Factors influencing lung function: are the predicted values for spirometry reliable enough?. *Journal of Physiology and Pharmacology: An Official Journal of the Polish Physiological Society*, *57*, 263-271.

Patel, A. K., & Thakar, H. M. (2015). Spirometric values in sitting, standing and supine position. *J Lung Pulm Respir Res*, *2*(1), 1-3.

Poussel, M., Kaminsky, P., Renaud, P., Laroppe, J., Pruna, L.,&Chenuel, B. (2014). Supine changes in lung function correlate with chronic respiratory failure in myotonic dystrophy patients. *Respiratory Physiology&Neurobiology,* 193, 43, 51.

Razi, E., & Mousavi, S. G. A. (2007). The effect of positions on spirometric values in obese asthmatic patients. *Iran J Allergy Asthma Immunol,* 6(3), 151-154.

Segizbaeva, M. O., Pogodin, M. A., & Aleksandrova, N. P. (2013). Effects of body positions on respiratory muscle activation during maximal inspiratory maneuvers. *In Respiratory Regulation-The Molecular Approach,* 355-363.

Shan, X., Liu, J., Luo, Y., Xu, X., Han, Z., & Li, H. (2015). Relationship between nutritional risk and exercise capacity in severe chronic obstructive pulmonary disease in male patients. *International Journal of Chronic Obstructive Pulmonary Disease*, *10*, 1207.

Tabak, C., Spijkerman, A. M. W., Verschuren, W. M. M., & Smit, H. A. (2009). Does educational level influence lung function decline (Doetinchem Cohort Study)?. *European Respiratory Journal*, *34*(4), 940-947.

Tsubaki, A., Deguchi, S., & Yoneda, Y. (2009). Influence of posture on respiratory function and respiratory muscle strength in normal subjects. *Journal of Physical Therapy Science*, *21*(1), 71-74.

Wanger, J. S., & Culver, B. H. (2016). Quality standards in pulmonary function testing: past, present, future. *Annals of the American Thoracic Society*, *13*(9), 1435-1436.