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An analysis of the relationship between pulmonary-aerobic capacity variables defined via pulmonary function tests and anthropometric measurements of different somatotypes

Solunum fonksiyon testleri kullanılarak belirlenen akciğer aerobik kapasite değişkenleri ile farklı somatotiplerin antropometrik ölçümleri arasındaki ilişkinin incelenmesi

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Abstract

Objectives: The aim of this study is (i) to detect pulmonary-aerobic capacity in different somatotypes by using body morphometry in sedentary subjects, and (ii) to show that pulmonary-aerobic capacity an be enhanced.

Materials and Methods: This study was carried out at Inonu University Medical Faculty between the dates of May 1-30 in 2016. The study included 120 voluntary sedentary subjects, aged 20 to 26 years. Each subject was exposed to pulmonary function tests (PFT) three times through an acceptable technique. Such anthropometric measurements were taken to generate somatotypes by using method of Carter and Heath.

Results: Six distinct somatotypes were defined. Pulmonary function test (PFT) performed on different somatotypes in accordance with Kruskal-Wallis test revealed that FVC, FEV_1, FEV_1/FVC, PEF and FEF_{25-75} values are not affected by somatotype ($p>0.05$). Such anthropometric measurements as biacromial diameter, chest depth, chest breadth, neck circumference, chest circumference and waist circumference are considered to be significant in measuring lung capacity. Besides, a statistically significant relation between these measurements and somatotype differences was apparent ($p<0.05$). Correlation analysis revealed that biacromial diameter, chest breadth, chest circumference and waist circumference had a positive relation with FVC, FEV_1, PEF and FEF_{25-75}; and that neck circumference had a positive relation with all the respiratory parameters.

Conclusion: This study, we believe, will not only serve as a clinical resource for specialists in the area in terms of diagnosis and treatment, but also as an academic resource in the relevant literature.

Keywords: PFT; Lungs; Somatotype; Anthropometry; Aerobic Capacity.

Öz

Amaç: Bu çalışmanın amacı (i) sedanterlerde vücut morfometrisi kullanılarak farklı somatotiplerde akciğerlerin aerobic kapasitesinin belirlenmesi (ii) solunum kapasitelerinin geliştirilebileceğinin ortaya konulmasıdır.

Gereç ve Yöntemler: Bu çalışma 1-30 Mayıs 2016 tarihleri arasında İnönü Üniversitesi Tıp Fakülte'sinde yapıldı. Bu çalışma 20-26 yaşları arasında 120 gönüllü sedanter ile gerçekleştirildi. Gönüllülere kabul edilen teknik ile solunum fonksiyon testi (SFT) uygulandı. Carter ve Heath metodu ile somatotipi belirlemek için bazı antropometrik ölçümler alındı.

Bulgular: Altı farklı somatotip belirlendi. Kruskal Wallis analizine göre farklı somatotiplere uygulanan SFT sonucunda FVC, FEV_1, FEV_1/FVC, PEF ve FEF_{25-75} değerlerinin vücut tipinden etkilenmediği belirlendi ($p>0,05$). Akciğer kapasitesini değerlendirmek için önemli kabul edilen antropometrik ölçümler olan biacromial çap, göğüs derinliği, göğüs genişliği, boyun çevresi, göğüs çevresi ve bel çevresi ile somatotip farklılıklar arasında istatiksel olarak anlamlı ilişkisi olduğu tespit edildi ($p<0,05$). Korelasyon analizi sonucuna göre; biacromial çapın, göğüs genişliğinin, göğüs çevresinin ve bel çevresinin FVC, FEV_1, PEF ve FEF_{25-75} ile pozitif yönlü, boyun çevresinin tüm solunum parametreleriyle pozitif yönlü ilişkisinin olduğu belirlendi.

Sonuç: Bu çalışmanın klinik olarak teşhis ve tedavi açısından konu ile ilgili hekimlere ve literatür yönünden akademik çalışmalara kaynak teşkil edeceğini düşünmekteyiz.

Anahtar Kelimeler: SFT; Akciğer; Somatotip; Antropometri; Aerobik Kapasite.

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INTRODUCTION

Pulmonary function tests (PFT) are valuable investigations in the diagnosis and monitoring of pulmonary diseases. Relative contraindications for PFT include hemoptysis, pneumothorax, nausea and vomiting, unstable cardiovascular status, recent myocardial infarction or pulmonary embolism; aortic or cerebral (brain) aneurysms, recent thoracic, abdominal or ophthalmic surgery (1). Thanks to PFT, functional status and capacity of lungs in patients of asthma or Chronic Obstructive Pulmonary Disease (COPD) (chronic bronchitis, emphysema) can be evaluated objectively (2).

FVC is forced vital capacity and is the maximum amount of air an individual can expel from the lungs through complete and forced expiration after deep inspiration. FVC decrease depends on parenchymal tissue loss in emphysema, while it is dependent on mucus plugs and bronchial construction in bronchitis, asthma, bronchiectasis and cystic fibrosis (3,4).

FEV_1 is defined to be the volume exhaled during the 1^{st} second of forced expiration. Normally, 80% of the volume is expelled during the 1^{st} second. It reflects large airways and falls considerably in the presence of airway obstruction. It depends on patient cooperation and effort (3, 4).

FEV_1/FVC allows one to distinguish between restrictive and obstructive pathologies. Except for diseases related only to small airways, the best indicator of obstructive pattern is a reduction in FEV_1/FVC value. It is over 75% in young adults, and decreases with age. Airways obstruction is <70%. It either rises or is maintained in restrictive pathologies (3,4).

PEF, also called peak expiratory flow, reflects the caliber of large airways and the activity of expiratory muscles. Different models of flow-volume curves are diagnostic in intrathoracic obstruction (asthma, COPD etc.), restrictive lung diseases (parenchyma, respiratory muscle diseases, thoracic wall diseases, pulmonary edema, congestive heart failure) and extrathoracic shortness of breath (tracheal obstruction, vocal cord paralysis) (3-6).

FEF_{25-75} is the flow rate achieved during the middle of maximal expiration. It is the average flow rate during forced expiration when 25-75% of the volume is exhaled. It reflects the flow from small and medium airways. It falls in the early phases of obstructive diseases (3-6).

Somatotype is a convenient shorthand description of overall body physique in terms of shape and composition independent of body size (3-6). To generate somatotypes, two steps are followed. First, anthropometric variables are measured. And then, by using anthropometric somatotyping method of Carter and Heath (7), somatotypes are calculated by means of anthropometric variables. Somatotype evaluation involves three digits with the first digit referring to endomorphy, the second to mesomorphy and the third to ectomorphy. These three digits make up a combination to enable the appraisal of the physical components of the body. Endomorphy represents relative fatness. Mesomorphy relates to musculoskeletal robustness and ectomorphy relates to slenderness (7-9).

This study aims to understand how and in which body types, pulmonary function test results differ in healthy individuals. In doing so, aerobic capacity variables of various somatotypes are presented.

MATERIAL and METHODS

This research was undertaken under the approval no. 2016/46 of Malatya Clinical Research Ethics Committee. This cross sectional study was carried out at Inonu University Medical Faculty between the dates of May 1-30 in 2016. The study population included 120 voluntary sedentary subjects (N), aged 20 to 26 years, with no history of surgery and no evidence of pulmonary diseases. These were non-smoker, nondrinker individuals who performed no exercise.

PFT is a group of physiological tests that measure how well a person moves air in and out of their lungs in relation to time i.e. it is a test that provides a numerical measure of lung functions. A MIR device (Model: Minispir) was used for PFT. Before the test, volunteers were first given information about the process and what they were supposed to do. Then they were given PFT under constant supervision. By use of the acceptability standards that were outlined by the American Thoracic Society (ATS), pulmonary function testing was carried out with subjects who were in a standing position and had nose clips on them. Each subject was exposed to pulmonary function tests three times through an acceptable technique. In each subject, PFT measurements were conducted three times, and only a small variation was detected among these measurements (3). The following were taken independently of the three curves: the highest level for forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), FEV_1/FVC ratio (Tiffeneau – Pinelli Index), peak expiratory flow (PEF), and maximal expiratory flow at 75% and 25% of the FVC (FEF_{25-75}) (5,6,10,11).

In order to define the somatotypes; height and weight, triceps, subscapular, supraspinale, calf skinfold, knee and elbow breadth as well as arm and calf girths of the subjects were measured in accordance with the techniques recommended by International Biological Programme (IBP)" and "International Society for the Advancement of Kinanthropometry (ISAK)" (8,12).

In addition to the above, such anthropometric measurements as biacromial diameter, chest depth, chest breadth, neck circumference, chest circumference and waist circumference were taken, as well. Anthropometric measurements were taken with Holtain Anthropometric Set (8,13).

Somatotype calculations were performed using the "Somatotype for Windows 1.2.6 Trial Version" program. Kruskal-Wallis variance analysis was carried out in order to investigate the relation between anthropometric measurements taken to assess lung capacity and the

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influence of somatotype differences on respiratory parameters. Correlation analysis was applied to the data so as to assess the relation between anthropometric measurements and the respiratory parameters. Kruskal-Wallis variance and correlation analyses were conducted using the package program IBM SPSS Statistics 22.0 for Windows. The data were analyzed via Conover pairwise comparison test using Medcalc statistical software (16.4.3 Trial Version) in order to detect among which somatotypes anthropometric measurements differ.

RESULTS

The mean age of the study population was 20.65±2.31. Endomorphy component for all participants was calculated to be 4.95±1.61, mesomorphy component was 4.49±2.34 and ectomorphy component was 2.52±1.4. Average height was 171.25±8.02 cm while average weight was 67.32±13.47 kg. Other values used to define somatotypes were measured as follows: triceps SF was 16.06±7.48 mm, subscapular SF was 16.56±6.79 mm, supraspinale SF was 18.57±8.75 mm, calf SF was 14.12±6.58 mm, arm girth was 28.44±4.34 cm, calf girth was 34.88±4.54 cm, elbow breadth was 7.34±0.86 cm and knee breadth was 9.46±1.26 cm.

As a result of the somatotype analysis, 6 somatotypes were detected among the volunteers participating in the study. These were balanced ectomorph (N. = 20), central (N. = 20), ectomorphic endomorph (N. = 20), endomorphic mesomorph (N. = 20), mesomorph-endomorph (N. = 20) and finally mesomorphic endomorph (N. = 20). Mean somatotype was defined to be mesomorph-endomorph. Endomorphy, mesomorphy, ectomorphy components corresponding to the resultant somatotypes as well as height (cm), mass (kg), triceps sf, subscapular sf, supraspinale sf, calf sf, arm girth, calf girth, elbow breadth and knee breadth values are given in Table 1.

Somatoplot representations of the somatotype characteristics of the 120 voluntary participants are presented in Figure 1.

Table 1. Values Corresponding to the Resultant Somatotypes

Variable	*Balanced ectomorph*	*Central*	*Ectomorphic endomorph*	*Endomorphic mesomorph*	*Mesomorph endomorph*	*Mesomorphic endomorph*
Endomorphy	2.94±1.26	3.32±0.54	4.78±0.62	5.42±1.7	5.57±0.77	6.28±1.01
Mesomorphy	2.3±1.31	3.30±0.5	1.81±0.33	6.85±2.28	5.77±0.81	4.19±1.39
Ectomorphy	5.28±2.23	3.29±0.52	3.22±0.52	0.82±0.63	2.18±1.29	1.72±0.79
Height (cm)	1.74±0.07	1.75±0.06	1.64±0.06	1.69±0.05	1.71±0.1	1.73±0.07
Mass (kg)	59±7.72	65.92±8.53	54.12±6.93	78±11.69	71.11±18.95	75.23±12.93
Triceps SF	9.72±6.45	9.92±3.4	18.62±5.06	14±6.95	17.22±4.73	20.45±8.63
Subscapular SF	10.27±3.1	11.84±2.99	13±3.96	20.14±6.71	20.55±7.92	20.7±6.57
Supraspinale SF	10.09±2.7	11.84±4.16	14.75±5.99	22.14±10.73	19.77±4.84	26.6±7.84
Calf SF	9±4.33	9.92±4.46	16.37±5.26	14.71±8.19	17.11±6.09	17.85±6.43
Arm Girth	25.09±2.78	26.76±3.47	22.81±2.15	31.57±4.43	30.22±3.88	29.8±2.78
Calf Girth	31.27±2.41	32.92±2.49	29.75±1.83	37.64±4.24	37.77±3.6	35.15±3.68
Elbow Breadth	6.81±0.4	7.53±0.82	6.32±0.41	7.92±0.74	7.73±0.91	7.18±0.88
Knee Breadth	8.93±0.6	8.89±0.6	8.16±0.7	10.32±1.74	9.94±1.07	9.25±1.02

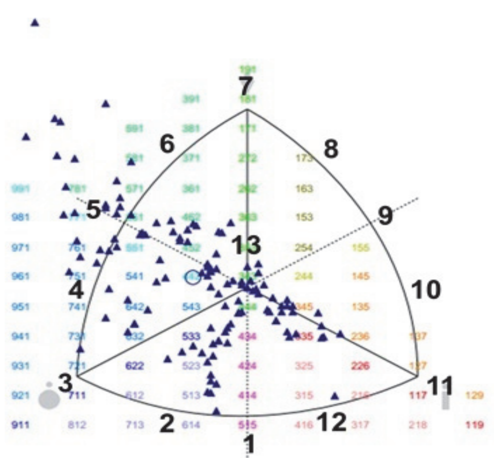

Figure 1. Somatoplot representations of the somatotype characteristics. **1**;endomorph ectomorph, **2**;ectomorphic endomorph, **3**;balanced endomorph, **4**;mesomorphic endomorph, **5**;mesomorph endomorph, **6**;endomorphic mesomorph, **7**;balanced mesomorph, **8**;ectomophic mesomorph, **9**;mesomorph ectomorph, **10**;mesomorphic ectomorph, **11**;balanced ectomorph, **12**;endomorphic ectomorph, **13**; central, O; mean somatotype.

In PFTs, observed FVC value for the averages of all somatotypes was 3.48±1.01 L, while predicted value was 4.4±0.73 L. Observed value for FEV_1 was 3.13±0.96 L/sec and predicted value was 3.81±0.62 L/sec. For FEV_1/FVC, observed value was 90.07%±11.17 and predicted value was 86.63%±2.48. For PEF, observed value and predicted value for all somatotypes were 4.83±2.08 L/sec and 8.02±1.21 L/sec, respectively. In all somatotypes, FEF_{25-75} observed value was calculated to be 3.94±1.61 L/sec and predicted value was 4.39±0.57 L/sec. Observed values for FVC, FEV_1, FEV_1/FVC, PEF and FEF_{25-75} of somatotypes are given in Table 2 and Table 3. The volunteers were administered spirometry, considered to be normal, and the corresponding measurement graphs are provided in Figure 2.

Kruskal-Wallis variance analysis results have revealed no significant relation between balanced ectomorph, central, ectomorphic endomorph, endomorphic mesomorph, mesomorph-endomorph, mesomorphic endomorph somatotypes and the observed FVC, FEV_1, FEV_1/FVC, PEF, FEF_{25-75} respiratory parameters ($p>0.05$). Table 4.

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Table 2. Observed and Predicted Values for the Respiratory Function Parameters belonging to the Balanced Ectomorph, Central, and Ectomorphic Endomorph Somatotypes

Parameter	*Balanced ectomorph*		*Central*		*Ectomorphic endomorph*	
	Observed	*Predicted*	*Observed*	*Predicted*	*Observed*	*Predicted*
FVC	3.63±0.93	4.67±0.69	3.85±1.12	4.96±0.47	2.76±1.13	3.61±0.28
FEV_1	3.32±0.92	4.04±0.58	3.48±1	4.27±0.41	2.32±1.14	3.09±0.23
FEV_1/FVC	91.51±9.71	86.16±1.24	90.7±9.01	85.68±0.74	82.75±13.89	86.35±2.15
PEF	5.38±2.37	8.43±1.12	5.06±1.68	8.94±0.8	3.65±2.61	6.6±0.33
FEF_{25-75}	4.18±.1.64	4.58±0.53	4.11±.1.36	4.79±0.37	2.86±.1.94	3.66±0.28

Table 3. Observed and Predicted Values for the Respiratory Function Parameters belonging to the Endomorphic Mesomorph, Mesomorph-endomorph, Mesomorphic Endomorph Somatotypes

Parameter	*Endomorphic mesomorph*		*Mesomorph endomorph*		*Mesomorphic endomorph*	
	Observed	*Predicted*	*Observed*	*Predicted*	*Observed*	*Predicted*
FVC	3.25±0.94	4.11±0.53	3.69±1.02	4.45±0.95	3.59±0.9	4.51±0.77
FEV_1	2.92±0.93	3.58±0.43	3.33±1.1	3.85±0.81	3.23±0.71	3.89±0.68
FEV_1/FVC	90.84±13.61	88.11±2.64	89.66±9.98	86.7±3.11	91.23±10.01	85.75±2.52
PEF	4.77±2.23	7.64±0.94	4.73±2.11	8.05±1.53	4.97±1.83	8.13±1.29
FEF_{25-75}	3.97±.1.76	4.23±0.34	3.92±.1.71	4.46±0.75	4.10±.1.43	4.43±0.66

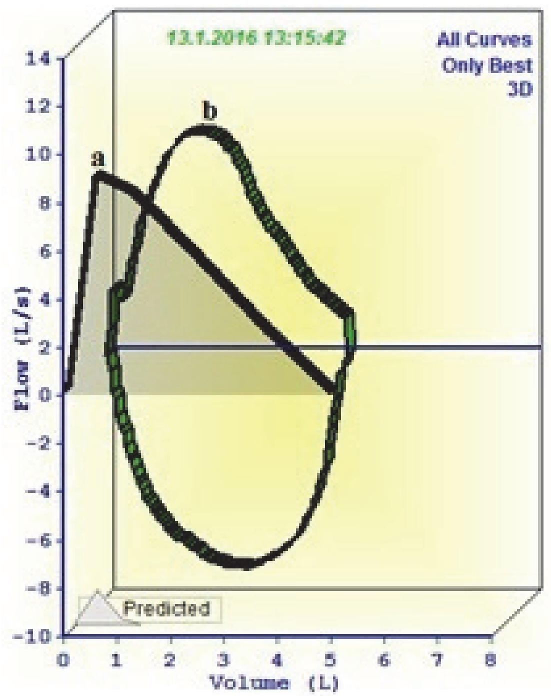

Figure 2. A 3D Representation of the Normal Spirometry Measurement Graphs (a: predicted value, b: observed value)

Table 4. Results of the Kruskal-Wallis Variance Analysis of the Somatotypes and the Respiratory Parameters

Test Statistic	FVC	FEV_1	FEV_1/FVC	PEF	FEF_{25-75}
p value	,241	,155	,482	,506	,395

Some anthropometric measurements, considered to be important in understanding lung capacity, were computed. Of them, biacromial diameter was found to be 39.85±2.82 cm for all somatotypes, chest depth was 18.98±2.36 cm, chest breadth was 26.15±2.25 cm, neck circumference was 33.14±3.63 cm, chest circumference was 84.32±10.47 cm and waist circumference was 78.98±11.24 cm.

Mean and ± standard deviation values for such anthropometric measurements as biacromial diameter, chest depth, chest breadth, neck circumference, chest circumference and waist circumference for balanced ectomorph, central, ectomorphic endomorph, endomorphic mesomorph, mesomorph-endomorph and mesomorphic endomorph somatotypes are provided in Table 5.

Kruskal-Wallis variance analysis results revealed that there exists a significant relation between such anthropometric measurements as biacromial diameter, chest depth, chest breadth, neck circumference, chest circumference and waist circumference taken in order to assess the lung capacities of balanced ectomorph, central, ectomorphic endomorph, endomorphic mesomorph, mesomorph endomorph, mesomorphic endomorph somatotypes ($p<0.05$) (Table 6).

Correlation analysis has revealed that biacromial diameter, chest breadth, chest circumference and waist circumference have a positive relation with FVC, FEV1, PEF and FEF25-75. Besides, it revealed that neck circumference has a positive relation with all the respiratory parameters, while chest depth has no relation with the respiratory parameters ($p>0.05$) (Table 7).

In the present study, such anthropometric measurements as biacromial diameter, chest depth, chest breadth, neck circumference, chest circumference and waist circumference were taken in order to assess lung capacities. Conover pairwise comparison test, on the other hand, was administered in order to detect among which somatotypes these cited anthropometric measurements differed, and the results of the test are presented in Table 8.

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Table 5. Values of Anthropometric Measurements Taken to Assess the Lung Capacity

Parameter	*Balanced ectomorph*	*Central*	*Ectomorphic endomorph*	*Endomorphic mesomorph*	*Mesomorph endomorph*	*Mesomorphic endomorph*
Biacromial diameter	38.5±1.68	40.5±1.9	37.05±2.35	39.64±3.21	40.1±3.3	41.51±2.11
Chest depth	16.85±1.76	18.53±1.58	17.51±1.54	19.03±1.89	19.96±2.36	20.95±2.39
Chest breadth	25.27±1.65	25.98±1.27	24.31±1.61	26.02±2.85	27.32±2.71	27.44±1.54
Neck circumference	32.45±2.85	33.76±2.48	28.75±2.49	34.4±3.33	32.83±3.7	33.87±4.2
Chest circumference	79.63±7.55	85.73±8.11	73±10.33	84.35±9.6	86.77±11.77	90.8±9.48
Waist circumference	72.54±5.68	75.73±6.83	67.37±8.97	84.4±10.52	79.5±13.83	86.52±9.84

Table 6. Results of the Kruskal-Wallis Variance Analysis of the Somatotypes and Anthropometric Measurements taken to Assess Lung Capacity

Test Statistic	Biacromial diameter	Chest depth	Chest breadth	Neck circumference	Chest circumference	Waist circumference
p value	,000	,000	,001	,009	,001	,000

Table 7. Results of the Correlation Analysis of the Anthropometric Measurements and the Respiratory Parameters

Parameter	Test statistics	FVC	FEV_1	FEV_1/FVC	PEF	FEF_{25-75}
Biacromial diameter	r	,424	,452	,146	,390	,417
	p	,000	,000	,199	,000	,000
Chest depth	r	,162	,119	-,020	,079	,121
	p	,154	,296	,863	,488	,289
Chest breadth	r	,501	,508	,198	,463	,463
	p	,000	,000	,081	,000	,000
Neck circumference	r	,595	,530	,058	,359	,409
	p	,000	,000	,000	,001	,000
Chest circumference	r	,632	,644	,214	,565	,604
	p	,000	,000	,055	,000	,000
Waist circumference	r	,448	,466	,187	,432	,463
	p	,000	,000	,094	,000	,000

Table 8. Results of the Conover Pairwise Comparison Test

Somatotype	Biacromial diameter	Chest depth	Chest breadth	Neck circumference	Chest circumference	Waist circumference
(1) *Balanced ectomorph*	(2)(6)	(2)(4)(5)(6)	(5)(6)	(3)	(6)	(4)(6)
(2) *Central*	(1)(3)	(1)(6)	(3)(6)	(3)	(3)	(3)(6)
(3) *Ectomorphic endomorph*	(2)(4)(5)(6)	(4)(5)(6)	(2)(4)(5)(6)	(1)(2)(4)(5)(6)	(2)(4)(5)(6)	(2)(4)(5)(6)
(4) *Endomorphic mesomorph*	(3)(6)	(1)(3)(6)	(3)(6)	(3)	(3)(6)	(1)(3)
(5) *Mesomorph endomorph*	(3)	(1)(3)	(1)(3)	(3)	(3)	(3)
(6) *Mesomorphic endomorph*	(1)(3)(4)	(1)(2)(3)(4)	(1)(2)(3)(4)	(3)	(1)(3)(4)	(1)(2)(3)

DISCUSSIONS

Functional status of the respiratory system can classically be determined by measuring lung volume and capacity. This study has investigated the relation between aerobic capacity variables defined by pulmonary function tests and somatotypes; and it, using necessary measures for lung capacity, has revealed important data for future researches.

Both around the world and in our country, researches have shown that various types of sports activities have an impact on lung functions. Research about the effects of exercise on respiratory parameters in children and young individuals has generated different views regarding the issue. Some researchers claim that rigorous physical activity impacts respiratory parameters upwards (14,15). On the other hand, a group of researchers emphasize the fact that this increase is actually part of the normal developmental process of that age group and is in parallel with normal growth process (16, 17). Another group of researchers, however, suggest that exercise does not increase respiratory parameters, but it makes respiration more productive and economical (18). Volunteers of the study are healthy individuals. This study shows that individuals with sedentary lifestyles use only a small portion of their lung capacity. When their lung capacities are measured, predicted and observed values for the subjects turn out to be quite different. This is because they do not engage in any sports activity to enhance their lung capacities.

Kurkcu et al., reported that in an 8-week long training program, participants' endomorphy component declined from 3.11±1.11 to 2.35±0.84; while mesomorphy component rose from 6.78±1.15 to 7.07±1.11; and ectomorphy component rose from

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2.29±0.93 to 2.40±0.94 (19). Lundy et al., found out that endomorphy component was 2.5±0.6, mesomorphy component was 6.9±1.2, and ectomorphy component was 0.9±0.5 (20). In our study, endomorphy and ectomorphy components are higher than the cited values, while mesomorphy component is lower than those in the cited works, because participants of this study are sedentary individuals.

Chaouachi et al., carried out research on the effects of dominant somatotype on aerobic capacity trainability with forty one subjects aged 21.4±1.3 years (21). As a result, four distinct somatotypes emerged with nine endomorph-mesomorph, 11 mesomorph, 12 mesomorph-ectomorph, and nine ectomorph subjects.

Uzun et al., in their study on wrestlers found FVC to be 4.77±0.83 L (13). Atan et al., measured FVC values to be 4.34±1.69 L for athletes of judo, 4.15±1.09 L for track and field athletes, 4.91±1.19 L for wrestlers, 5.13±1.36 L for swimmers, 4.62±1.63 L for taekwondo athletes, 4.17±1.42 L for table tennis players and finally 3.92±1.06 L for sedentary males (22). Erdil et al., in a study on the respiratory parameters of elite table tennis players, reported that FVC values were different in sedentary people (23). Pastre et al., conducted research on patients with idiopathic pulmonary fibrosis (IPF, the prototype for fibrotic pulmonary diseases predominantly affecting the lower lobes), stage IV sarcoidosis (predominantly affecting the upper lobes) and connective tissue disease- associated interstitial lung diseases (CTD-ILDs, which are usually characterized by diffuse, inflammatory lesions rather than fibrotic damage) (24). As a result, they specified FVC to be 2.65±0.68 in IPF, 2.66±0.81 in sarcoidosis and 2.65±0.89 in CTD-ILD. FVC values in our study, however, are lower than those of athletes, and higher than those of patients. If sedentary individuals in the present study are compared to the studies conducted on athletes, it is seen that FVC values are higher in our study. This can be explained by the fact that respiratory muscles gain strength through sports activities. Furthermore, if diaphragm muscles are weak, FVC values might turn out to be low (25).

Pastre et al., defined FEV_1 to be 2.17±0.69 L/sec in IPF, 1.87±0.65 L/sec in sarcoidosis, and 2.18±0.66 L/sec in CTD-ILD (24). Atan et al., defined FEV_1 to be 4.14±1.72 L/sec for athletes of judo, 3.94±1.09 L/sec for track and field athletes, 4.60±1.15L/sec for wrestlers. On the other hand, they calculated FEV_1 as 4.94 ±1.54L/sec in swimmers, as 4.39 ±1.58 L/sec in taekwondo athletes, as 4.29±2.51L/sec in table tennis players and finally as 3.61±1.05 L/sec in sedentary individuals (22). Kubiak and Janczaruk conducted a 6-month long research on 310 elite swimmers between the ages of 12 and 14. As a result, they detected a statistically meaningful difference between the preliminary and final test values of FVC and FEV_1 parameters (26). Kurkcu et al., reported that 8-week-long training program increased the FVC value from 3.98±0.80 L/sec to 4.26±0.77L/sec, and decreased FEV_1 the value from 3.67±0.83 L/sec to 3.71±0.85 L/sec (19). Uzun et al., in their study on wrestlers, measured FEV_1 as 4.48±0.57 L/sec (13). Gunaydın et al., conducted a study to determine the physical and physiological profiles of Turkish Female National Team wrestlers. 18 female wrestlers participated in their study voluntarily and the mean age was 19.6. Consequently, they defined pulmonary functions of those female wrestlers in which FVC was 3.74±0.50 L, and FEV1 was 3.34±0.39 L/sec (27). In our study, mean FEV_1 value for all groups was found to be 3.13±0.96 L/sec. The fact that this value is higher than those of patients and lower than those of athletes was an predicted outcome.

Uzun et al., in a study on wrestlers, defined FEV_1/FVC as 91.89%±4.93 (13). Pastre et al., computed FEV_1/FVC to be 83%±0.07 in IPF, 71%±0.14 in sarcoidosis, 84%±0.07 in CTD-ILD. FEV_1/FVC ratios fall due to illnesses, but increase with sports activities; accordingly the value in our study is somewhere between those of patients and athletes (24).

Cakmakci et al., established that 4-week technical and tactical training program increased the FVC and PEF values of taekwondo athletes. According to them, this training program strengthened respiratory muscles which, in turn, increased maximal respiratory capacity leading also flow rates to change (28). In our study, there is a considerable discrepancy between the predicted and observed values of PEF. This is, to our opinion, because sedentary study population in our study does not fully use their lung capacity.

Marseglia et al., defined FEF_{25-75} to be below 80% in patients of allergic rhinitis (29). In our study, FEF_{25-75} was approximately 90%. This ratio turned out to be above that of patients, a result we predicted to arrive at.

Uzun et al., in their study on wrestlers, measured biacromial diameter as 41.20±26.69 cm, chest depth as 21.26±2.28 cm, chest breadth as 30.13±3.11 cm, neck circumference as 39.98±2.71 cm, chest circumference as 101.23±8.22 cm, and waist circumference as 81.98±8.05 cm (13). In our study, on the other hand, anthropometric measurements of the sedentary individuals were found to be lower than those of the athletes.

In conclusion, in our study, the respiratory parameters did not differ among somatotypes, because air inhalation and exhalation needs of individuals in relation to body types are thought to be directly proportionate to their lung capacity. Furthermore, that participants of the study were all sedentary individuals and that they did not engage in any sports activity suggest lung capacities do not lead significant differences among body types. Apart from these, PFT values turned out to be lower than predicted. This, accordingly, implies that individuals in our study do not fully use their lung capacities. This study, we believe, will not only serve as a clinical resource for specialists in the area in terms of diagnosis and treatment, but also as an academic resource in the relevant literature.

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