CLINICAL STUDY

Pulmonary Function Parameters in Healthy People in Urban Central Anatolia

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Abstract

The evaluation of pulmonary function tests, normal value need to be taken into consideration. The pulmonary functions values arranged by Kamburoff's are generally used in our clinic. The aim of this is to determine normal values of our region, evaluating the pulmonary function of healthy people in Kayseri, Türkiye in 1998. The peak expiratory flow, vital capacities and forced expiratory volume in one second of 510 healthy males and 812 healthy females using a dry spirometer were measured and analyzed. The subjects were classified according to their age and sex. The values we found in this study were compared with the values we use at present. We determined statistically significant differences in some values.

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Introduction

Pulmonary function tests (PFT) are used in clinics to assess the extent of the deterioration in lung functions, to predict the prognosis, to decide on treatment and to evaluate the response to treatment. These tests are also used in evaluating lung function in the preoperative period and in health research.

The normal reference values are needed for evaluation of lung function. The pulmonary function tests (PFT) values arranged by Kamburoff's are still being used in our hospital. There are various factors that influence the PFT, the most important ones being sex, age, race and height. Furthermore, individual factors such as enviromental factors, socioeconomic status, nutritional habits and technical factors cause a change in PFT values (1).

The aim of this study was to determine PFT values in a healthy urban population residing in Kayseri, a town in Central Anatolia, Turkey, and to compare our results with the currently used reference values. The study also aimed to

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evaluate the effects of smoking and low income on PFT results.

Materials and Methods

The study was carried out in Kayseri, which is a large city in Central Anatolia, Turkey. 1500 adults were selected by randomized sampling, using the local electoral roll call lists. These individuals were invited to the hospital and asked if they were willing to participate in the study. Of the sample of 1500 people, 1395 participated in the study, a response rate of 93.0%. Of those 1395, 842 were female (60.4%) and 553 were male (40.6%). We used the standardized British Medical Council questionnaire which includes variables of potential etiological relevance such as demography, respiratory symptoms, smoking, housing and life style (2). The subjects were classified as smokers, if they had smoked at any time of their life for at least one year (3). The questionnaire was applied by face-to-face interview. Individuals who had a history of asthma, pulmonary tuberculosis, chronic cough and sputum or thoracic surgery and also those in whom any pathology pertaining to the pulmonary and/or cardiovascular systems were detected in the physical examination, were excluded from the study. The analysis was based on 1322 subjects. All subjects were subjected to a detailed clinical assessment which included anthropometric measurements taken by trained observers. Standard equipment and methods were used for the measurements and the subjects were allowed to be measured in their light underwear.

PFT was measured using dry spirometer (PFT II Vitalography). Forced expiratory volume in one second (FEV_1) and vital capacity (FVC) were calculated according to volume time curve (4). The test was applied at least three times and the highest value was recorded.

Individuals with monthly income levels under US $ 150 were accepted as of low socioeconomic level, those with incomes between US $ 151-300 as of middle and those above US $ 301 as of high level. Mean values within each gender and age group were compared using Student *t* test. Any p value <0.05 was considered significant.

Results

This study was carried on 510 healthy males and 812 healthy females. The age and sex distribution of the subjects are given in Table 1. Mean height was 169.8±6.8 cm in males and 156.9±5.9 cm in females.

Table 1. Standard and measured values of PEFR according to the age group and gender.

	MALE		FEMALE	
Age Groups	Predicted median value L/min	Measured value X ± SD L/min	Predicted median value L/min	Measured value X ± SD L/min
20-29	610	519.9 ± 96.1*	470	379.8 ± 53.1*
30-39	627	500.6 ± 100.9*	473	378.2 ± 65.6*
40-49	607	493.5 ± 95.5*	462	357.07± 66.8*
50-59	572	452.4 ± 88.6*	440	337.97± 63.9*
60 +	553	410.0 ± 89.5*	413	304.71 ± 64.1*

*p<0.01

Predicted and measured PEFR (peak expiratory flow rate) values for all age groups are also given in Table 1. Predicted values are based on the currently used reference values. Observed PEFR values were significantly low relative to the reference values in both sexes and in all age groups.

While observed FEV_1 (forced expiratory volume) values were almost identical to predicted values in males in almost all age groups, these values were found to be significantly low in females 20 to 29 years and >60 years of age ($p<0.01$ and $p<0.05$), as shown in Table 2.

Table 2. Standard and measured values of FEV_1 according to the age group and gender.

	MALE		FEMALE	
Age Groups	Predicted median value ml	Measured value X ± SD ml	Predicted median value ml	Measured value X ± SD ml
20-29	4250	3975.5 ± 880.6	3040	2732.6 ± 541.3**
30-39	3950	3891.0 ± 744.4	2760	2775.0 ± 528.3
40-49	3600	3594.3 ± 653.1	2440	2439.4 ± 491.4
50-59	3100	3066.7 ± 653.9	2090	2062.6 ± 496.7
60 +	2600	2520.9 ± 662.2	1780	1777.0 ± 458.0*

*p<0.05 **p<0.01

Observed FVC values were low both in males and females compared to predicted and measured values (Table 3).

Table 3. Standard and measured values of VC in relation to age group and sex.

Age Groups	MALE Predicted median value ml	MALE Measured value X ± SD ml	FEMALE Predicted median value ml	FEMALE Measured value X ± SD ml
20-29	4910	4563.8± 976.3*	3550	3132.2± 495.0**
30-39	4740	4507.9±732.0**	3300	3188.7± 564.8**
40-49	4480	4216.1±704.6**	3000	2783.9± 503.9**
50-59	3990	3661.4± 706.5**	2680	2404.0 ±525.5**
60 +	3590	3017.1± 652.3**	2480	2073.4 ±458.1**

*p<0.05 **p<0.01

PFT results of 356 individuals (118 male, 238 female) with low incomes and who were classified as of low socioeconomic (SE) level were compared with 966 individals (571 female, 395 male) who were classified as of high SE level (Table 4). FEV_1 and FVC values were statistically lower in the group with low SE ($p<0.05$).

Table 4. Measured value of PFT in both of sex by age group and socioeconomic (SE) level

	PEFR(L/min)				FEV_1(ml)				FVC(ml)			
	HIGH		LOW		HIGH		LOW		HIGH		LOW	
Age groups	Male X± SD	Female X± SD	Male X± SD	Female X±SD	Male X±SD	Female X±SD	Male X±SD	Female X±SD	Male X±SD	Female X±SD	Male X±SD	Female X±SD
20-39	506 ± 20,5	380,2 ±5,6	475 ± 20,5	369 ±5,6	3974 ± 148,5	2858 ±58,1	3536* ±148,5	2418* ±58,1	4584 ± 163,7	3254 ±59,1	4183* ± 163,7	2907* ±59,1
40-49	497 ± 110	359,3 ±8,9	455 ±110	350 ±8,9	3660 ± 274,7	2507 ±66,2	2879* ±274,7	2240* ±66,2	4286 ± 270,1	2830 ±71,5	3453* ± 270,1	2649* ±71,5
50-59	456 ± 19,1	343,7 ±9,6	437 ± 19,1	320 ±9,6	3166 ±163	2102 ±73,2	2688* ±163	1943* ±73,2	3759 ± 163,3	2461 ±83,1	3288* ±163,3	2233* ±83,1
60+	413 ± 14,3	306,4 ±7,9	397 ± 14,3	303 ±7,9	2574 ±120,8	1844 ±59,4	2367 ±120,8	1676* ±59,4	3039 ± 126,7	2118 ±62,0	2931 ±126,7	2006 ±62,0

*P<0.05

Table 5. Measured value of PFT in both of sex by age group and socioeconomic (SE) level

	PEFR				FEV_1				FVC			
	smoker		nonsmoker		smoker		nonsmoker		smoker		nonsmoker	
Age groups	Male X±SD	Female X±SD	Male X±SD	Female X±SD	Male X±SD	Female X±SD	Male X±SD	Female X±SD	Male X±SD	Female X±SD	Male X±SD	Female X±SD
20-29	503 ±84,8	387 ± 10,3	538 ±107,1	375 ±49,4	3940 ±854,5	2848 ±447,5	4015 ±935,6	2672 ± 580,3	4533 ±961,8	3267 ± 454,5	4597 ±1022	3062 ±506
30-39	498 ±102,9	386 ±56,4	495 ±103,5	375 ±68,2	3884 ±777,3	2899 ±521,7	3907 ±759,6	2740 ±524,9	4513 ±758,3	3278 ± 585,3	4482 ±766,7	3161 ±558
40-49	496 ±92,2	367 ±68,2	475 ±100,5	375 ±68,2	3612 ±568,3	2526 ±534,2	3494 ±710,6	2413 ± 480,4	4216 ±611,8	2824 ±507,4	4131 ±812,8	2772 ±506
50-59	438 ±93,3	337 ±86	458 ±89,3	337 ±62,4	2987 ±724	2185 ±269,4	3079 ±596,2	2040 ± 492,4	3660 ±822,8	2581 ± 316,8	3641 ±648	2371 ±500
60+	394 ±98	– –	420 ±85	305 ±64	2430 ±600,6	– –	2585 ±692,8	1778 ±460.4	3000 ±671	– –	3043 ±648	2072 ±462

Thirty-two percent of the study population (425/1322) were smokers. The rate of male smokers was 53,5% (273/510). The frequency of smoking among females was much lower and only 18, 8% (152/812) (Table 5). There were no significant differences in PFT results between the smokers and nonsmoker ($p>0.05$).

Discussion

As for other biological variables, selection and interpretation of reference values are important in epidemiological studies on PFTs. Errors due to biological differences and technical factors should be eliminated as much as possible (1). Factors such as the individual's circadian rhythm, genetic and biological characteristics, his/her body size, age, physical activity, sex, muscle structure, race, seasonal influences can influence the PFT results. Present or past health events, smoking and environmental factors such as profession, place of residence (rural or urban), indoor pollution, socioeconomic level are some of the other factors which may influence PFT results.

Of technical factors which may lead to erroneous PFT results, the most important aspect is the selection of the tools. The tools should measure sensitively and accurately. To give an example, the tube of the spirometer will change its resolution.

In this study, in attempt to minimize the errors caused by biological factors, we limited our subject group to include only healthy individuals living in our region. We also tried to determine the scope of errors due to smoking (5) and to this end, we included both smokers and non-smokers in our study group and compared the PFTs of these two subgroups. Some factors, which includes body and head position, effort capacity for proving maximal flow and circadian rhythm has to be considered during the measurements of PFTs (1). Particularly body position affects FVC and FVC. A difference of 1-2% in favor of the standing position is reported when the tests are applied when the subjects are measured in the standing or sitting positions (6, 7). Standing position should be preferred especially in overweight subjects (8). Our tests were performed in the sitting position, following a period during which we tried to make the subjects comfortable, thus facilitating their adaptation to the test. It is known that flexion of the neck increases airway resistance and decreases PEFR (9). Differences as high as 100-200 ml in FEV_1 were reported as a result of lower expiratory effort (10). Flushing and venous strain were taken as the criteria for maximal expiratory effort. To obtain a maximum expiratory flow of highest degree, the measurements were made with the necks in a hyperextended position. Circadian rhythm causes some changes in PFT (11, 12). Maximal expiratory flow is at its lowest level. during the early hours of the morning (4.00-6.00 am) and it was demonstrated that the level reaches its peak in the afternoon (11). This effect reflects predominately on PEF (12, 13, 14, 15). Our tests were performed at midday, between the hours 11.00-14.00.

Sex and body measurements, age and race are important factors which may lead to differences among individuals and groups. When PFT values in the Caucasian population were compared with the Black population in the U.S.A., lower values were found in static and dynamic lung volume and forced expiratory flow. It was also found that the rate of FEV_1 and FVC were higher or similar and that the diffusing capacity was slightly lower (16). The most important environmental factors causing some deviation in PFT, are environmental and industrial pollution. A low socioeconomic level was shown to have an adverse effect on PFT (17), but socioeconomic level is also related to environmental factors. Living in towns and in industrial regions, being exposed to occupational, environmental or indoor pollution, having frequent respiratory illnesses, difficulties in reaching medical centers may all cause changes in PFT (1). In our study some PFT parameters were found to be significantly low in the low income group.

In conclusion, this study also shows that socioeconomic level has adverse effect on PFT. On the other hand, possibly due to the limitations of this study which led to the exclusion of any subject who had any symptoms, no significant difference in PFT values were found between the non-smokers and asymptomatic smokers. Our results also showed significant differences from the reference standards used in our clinic. We believe that further studies are needed for establishment of local reference norms for PFTs in different regions and in different study groups in Turkey.

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