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ORIGINAL ARTICLE

Pulmonary Function Test Among University Students-A Cross Sectional Survey

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ABSTRACT
Objectives: To identify the lung functioning parameters i.e. FVC, FEV1, FEV1/FVC%, MVV of healthy individuals with normal pulmonary function.
Study Design: It was a cross-sectional study.
Study Setting: Study was conducted at Institute of Physical and Medical Rehabilitation (IPM&R), Dow University of Health Sciences (DUHS), Karachi, Pakistan from August 2022 to January 2023.
Methods: Total 60 students giving the male to female ratio of 1:1 with age ranging of 15-30 years were enrolled and studied for respiratory functions by spirometry. Subjects were divided in two groups depending on their gender. The Measured parameters comprised: Vital capacity (VC), forced vital capacity (FVC), forced expiratory volume first second (FEV1), FEV1/FVC%, and maximum voluntary ventilation (MVV).
Result: Our results show that all indices, including FVC, FEV1, FVC/FEV1%, and MVV, were statistically significantly (p0.01) greater in males compared to females. Women have a much lower FEV1/FVC ratio than men do ($p< 0.05$). Out of a total of 60 students, 57.3% (n=34) were classified as having normal spirometry; 15.3% (n=9) were classified as having mild restrictions; 11.7% (n=7) were classified as having moderate restrictions; 1.7% (n=1) were classified as having moderate severe restrictions; 10% (n=6) were classified as having mild obstruction; and 5.3% (n=3) were classified as having moderate obstruction.
Practical Implication: Little data exist on whether and how PFT parameters change depending on a person's gender. As a result, we set out to learn more about the differences between the sexes in PFT variables and the connection between BMI and the tests.
Conclusion: Our study revealed that males had greater values of FVC, FEV1, FVC/FEV1, and MVV when compared to females, which was statistically significant ($p<0.01$). Females have a significantly (p0.05) lower FEV1/FVC ratio than males. Our findings demonstrate that healthy male and female subjects breathe in different ways, which may be related to gender's effect on lung function.
Keywords: Gender, Spirometer, FVC, FEV1, FEV1 /FVC%, MVV, Medical Rehabilitation, Pulmonary Function

INTRODUCTION
Pulmonary Function Tests are a series of tests that are aimed to determine how well the lungs are operating.[1] A vital screening tool for respiratory health, spirometry is a respiratory test that measures the inhalation and exhalation air volumes as a function of time.[2] The study's primary spirometric indicators included measuring forced expiratory volume per second (FEV1), forced vital capacity (FVC), and the ratio of FEV1 to FVC (FEV1/FVC).[3] Over the past few decades the pulmonary function tests are not only confined to the physiological studies of the respiratory system but it has evolved throughout and is applied extensively in the assessment of the respiratory levels as a clinical tool.[4]

Spirometry has also become one of the utmost frequently used analysis methods for public health screening and other than their application in the management of just the clinical cases, it is also well taken advantage of, for the surveillance of the treatment outcomes as well as in the assessment of the surgical risk factors of a patient.[5] For the identification of the levels of severity in any impairment of the respiratory functions, airway obstruction, reactivity to bronchodilators therapy and levels of impairment of gaseous exchange, all these vital information can be attained through the use of spirometric approach.[6] European adults are said to have greater spirometric ranges than in normal Pakistani adults as reported by few previous researches.[6,7]

Lung function is affected by a number of factors, including age, gender, and overall size. Males often have greater lung volume and capacity than females. When height and weight are considered, men still have wider lungs than women. This disparity in lung size between the sexes necessitates using a separate normal table for men and women.[8] Until puberty, there is little difference in lung function among boys and girls of the same size, while boys have a slightly greater vital capacity (VC) on average, and VC-related indices also differ by this amount. The adolescent size gap widens mostly because boys experience faster thoracic growth than girls do. Brody and others have demonstrated that fluctuations in blood growth hormone levels affect lung size.[9] Muscle strength, particularly in the chest area, increases in boys as they mature. This discovery is supported by information provided by Pierce and coauthors showing that mature male lungs have less collagen tissue than female lungs. These alterations may help to explain why men, in relation to their body size, have larger lungs since they increase the force which makes for lung expansion without correspondingly increasing the elastic rebound.[10]

Gender differences in the modification of PFT parameters are poorly known. Hence, knowing the differences between the sexes in PFTPs may help in diagnosing and treating chronic respiratory problems. Consequently, the purpose of this research was to assess and contrast PFTPs by sex among male and female student of institute of physical and medical rehabilitation (IPM&R), Dow University of Health Sciences (DUHS), Karachi. There hasn't been a research like this done on medical students in the Karachi before, but it would be helpful to compare the pulmonary function of male and female gender across the country and beyond. The study's scope will encompass geographical variations and the impact of gender on pulmonary function.

MATERIAL AND METHODS
Study Design: The study design was cross sectional.
Study Setting: Study was conducted at Institute of Physical and Medical Rehabilitation (IPM&R), Dow University of Health Sciences (DUHS), Karachi, Pakistan from August 2022 to January 2023.
Inclusive Criteria: Both of the male and female students with age ranging from 15 – 30 years were included. Individuals who, according to their medical records, had normal heart and pulmonary functioning were included in study. Members who did not exhibit acute illness symptoms, such as those associated with

an upper or lower respiratory infection. Those who did not smoke and those who did smoked were presented.

Exclusive Criteria: The members who showed signs and symptoms or diagnosed with respiratory conditions such as TB, Post-Tuberculosis Lung Disease, Bronchial Asthma, COPD, etc. Valvular heart disease was the official diagnosis for the participants. All students who have recently been unwell, had stomach surgery.

Sample Size: By using OpenEpi software sample size of 60 students was calculated with Power of test=90%, Confidence interval=95%, Mean and standard deviation of FEF (25-75%) in males=4.35+1.11, Mean and standard deviation of FEF(25-75%) in females=3.45+0.91.

Study Tools: Maximum voluntary ventilation (MVC), forced vital capacity (FVC), and forced expiratory volume in 1 second (FEVI-I) (MVV), the ratio between the two volumes (FVC/FEV1) was measured using computerized spirometer (Mir Winspiro PRO ver4.1.4) Computerized spirometer (MIR Winspiro PRO ver4.1.4) was used to measure the pulmonary function of students. This apparatus is able to give very exact and good outcomes.

Procedure: The apparatus reserves and quantify all obligatory flow and volume variables. Pulmonary Function Test results needed to be derived from a combination of Forced Vital Capacity and Maximum Voluntary Ventilation (MVV). The test of lung capacity was conducted while the patient was seated.. Students were shown display of the test before initiation of it. Three measurements were noted down for each test for every student for having consistent and sustainability of recorded test, best of three measurements were selected.

After explaining the overall technique to the students, FVC icon was clicked. Students were request to start relaxed tidal breathing along the mouthpiece (firm above the transducer) and then to take deep breathe inside. Instantly, students were request to breathe out as forcefully and quickly as feasible and continue to breathe out until no air can be exhaled. After instructing the students to breathe deeply in through the mouthpiece until their lungs were full, the FVC screen simultaneously displayed flow/volume and volume/time visuals and critical factors like FVC, FEV1, FEV1/FVC, and PEFR.

To perform MVV test, spirometer was turned to MVV test mode, with the display of MVV test screen. During 15 seconds, with their nostrils closed, students were instructed to breathe in and out as swiftly and deeply as possible into the mouthpiece of a spirometer. The estimated variable and real variable of executed test were shown. Two accurate maneuvers were achieved and best variable of MVV was noted.

Data Analysis: Descriptive statistics including mean, standard deviation, frequencies, and percentages were conducted using SPSS 19.0 statistical software. Frequencies and percentages were calculated for qualitative variables i-e gender, Smoking status and spirometry interpretations. Qualitative data works best when represented with a pie chart. Quantitative variables like body mass index, forced vital capacity, forced vital capacity to height ratio, and forced vital capacity to body weight ratio were given means and standard deviations. Mean differences between the sexes are tested using a T-test for independent samples. If the p-value is less than 0.05, the result is significant.

RESULTS

Results showed that the frequency of gender were 50% for males and 50% for females. Frequency of smoking status is described, 13% (n=08) out of N=60 students were smokers. 86.7% (n=52) out of N=60 students were non-smokers. The interpretation of spirometry is described as, Out of N=60, 56.7%(n=34) students had Normal Spirometry,15%(n=9) students had Mild Restrictions,11.7%(n=7) students had Moderate Restriction,1.7%(n=1) students had Moderate Severe Restriction,10%(n=6) students had Mild Obstruction,5%(n=3) students had moderate Obstruction as shown in Table 1. Results showed the categories of body mass index as 6.4%9(n=4) students were underweight, 73.3 %(n=44) students were normal, 18.3 %(n=11) students were overweight and 1.7% (n=1) student was obese (class I). Mean BMI = 1.15 and SD= .547 as shown in table 2. Results shown are described for mean and standard deviation for quantitative variables such as FEV1, FVC, FEV1/FVC ratio, and MVV. Out of N=60, FEV1 had (M= 81.85 and SD= 11.929). FVC had (M=74.22 and SD= 12.695). FEV1/FVC had (M= 112.70 and SD=5.634). MVV had (M=68.33 and SD=19.735). An independent T-test was analyzed to evaluate that the maximal voluntary ventilation has an association with the male and female students.

Table 1: Demographics details of enrolled patient's study

Parameters	Variables	Frequency(%)
Gender	Male	30(50.0%)
	Female	30(50.0%
Smoking	Smoker	8(13.3%)
	Non-smoker	52(86.7%)
Spirometry Interpretation	Normal Spirometry	34(56.7%)
	Mild Restriction	9(15.0%)
	Moderate Restriction	7(11.7%)
	Moderate Severe Restriction	1(1.7%)
	Mild Obstruction	6(10.0%)
	Moderate Obstruction	3(5.0%)
Total	60	100.0%

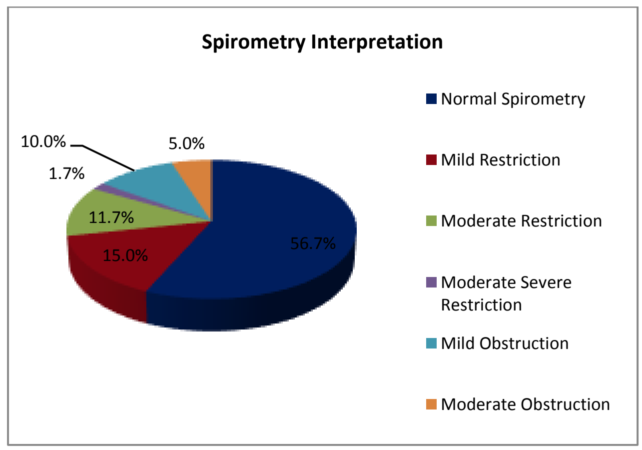

Figure 1: Spirometry Interpretation classification of enrolled patients

Table 2: Mean values of BMI & Sub-Classification of BMI Classes

Parameter	Variable	Mean±SD
BMI	Value of BMI	1.15±5.47
Classes of BMI	<18.5, under weight	4(6.7%)
	18.5-24.9, Normal weight	44(73.3%)
	25.0-29.9, over weight	11(18.3%)
	30.0-34.9, Class I Obesity	1(1.7%)
Total	60	100.0%

Table 3: showing the mean and Sd values of lung function of study participants

Parameters	Mean	±SD
FEV1	81.85	11.92
FVC	74.22	12.69
FEV1/FVC	112.70	5.634
MVV	68.33	19.73

Table 4: Male participants' body mass index and lung function measurements

Parameters	Male			
	BMI<25	BMI>25		
	R	P	R	P
FEV1	0.389	0.063	−0.135	0.445
FVC	0.323	0.088	−0.161	0.265
MVV	0.192	0.365	−0.007	0.965
FEV1/FVC	−0.049	0.691	−0.069	0.619

A significance level of 0.05 was used. R: Pearson correlation coefficient

Table 5: Female participants' body mass index and lung function measurements

Parameters	Female			
	BMI<25	BMI>25		
	R	P	R	P
FEV1	0.083	0.061	−0.482	0.071
FVC	0.028	0.872	−0.275	0.189
MVV	0.234	0.019	−0.321	0.416
FEV1/FVC	−0.194	0.07	−0.625	0.047

A significance level of 0.05 was used. R: Pearson correlation coefficient

DISCUSSION

The developed relationship depends on size, capacity of lungs, chest expansion, muscle strength, exercise, hormonal effect, and life patterns. Dissimilarities and miscalculations in the present results may be due to the circumstance that the individual either be unsuccessful to cooperate fully for the reason that of non-respiratory elements like self-consciousness, communication problems, or nervousness because of suffocation due to the mouth piece used by the students.[11]

Our study's sample included a broad spectrum of society. A long-term study might have been preferable, but it's not easy to pull off. Most studies assessing the worth of a passing mention are cross-sectional since prolonged studies of performance are difficult to conduct.[12] In the present study, we compared our findings to those of other racial and ethnic groups and impacted a relation to an inducement for spirometric parameters for healthy students residing in Karachi, Pakistan. Our foresight conditions resulted from adding age, sex, height, and weight as independent variables to the measurements of respiratory capacity (VC, FVC, FEV1, FEV1/FVC%, and MVV). Spirometry tests of 60 healthy students (30 male and 30 female) yielded these findings. Most pulmonary function test values were significantly impacted by gender. Variations in fat-free mass, ribcage size, and breathing muscle power may help explain the sex disparities in risk variables.[13]

We intended to make a comprehensive analysis of how each individual performed on spirometry. The test's agent (the subject's training, the quality of direction during timed motions, the critical evaluation of the value of individual actions, and the test's reproducibility) affects how the test is carried out. We wanted to make sure that the correlation was as strong as possible, so we had all of the rehearsing members use the same spirometer and verify their readings at the same three-minute intervals. [14]

Our examination of the median values of PFT variables by gender revealed significant variations in FVC% predicted, FEV1% anticipated, and PEF between the sexes, even though there was no difference in their BMI. Our findings corroborate those of recent studies that revealed that men, on average, have higher scores on PFT variables than women.[15,16] Yet, a different study found that females actually had better PFT readings than males. Numerous other studies did not find substantial differences in spirometry patterns between the sexes among the populations studied. 17 Possible factors in the differences between the sexes include differences in lung morphology; on average, women can be expected to have narrower airways and smaller lungs than men. Changes in hormone levels could also play a role.[16,17]

FVC, FEV, and PEFR were all shown to be statistically significant in both sexes in Gujarat, according to research by Doctor et al.[18] The best predictor of FVC and FEV in females was age, while in males it was height. Age and height were found to have a negative link with FEV% in both sexes, while surface area was found to have a positive correlation. PEFR correlated most strongly with body area in both sexes. Children living in India had considerably lower FEV1 and FVC than UK-Indian children, according to research by Sonappa et al.[19]

The current study had problems with its methodology. It was a cross-sectional study conducted by a modest team at a single research facility. A long-term, multi-center investigation with a sizable sample size is required.

CONCLUSION

According to the results of our study, the values of FVC, FEV1, FVC/FEV1, and MVV were shown to be statistically significantly greater in men than in women (p 0.01). Females have a lower FEV1/FVC ratio than males, which is statistically significant (p 0.05). Our findings demonstrate that healthy male and female subjects' respiratory patterns differ, indicating that gender influences lung function.

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