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COMPARATIVE EVALUATION OF SPIROMETRY PARAMETERS IN HEALTHY YOUNG AND ELDERLY ADULTS POPULATION IN PUNJAB, INDIA

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ABSTRACT **INTRODUCTION:** Spirometry is a vital tool for the assessment of pulmonary function status. Spirometry can be used to demonstrate the age-related decline in pulmonary function. The spirometry values can be used as reference values for a particular age group. The aims of our study was to compare spirometry values between the young and elderly groups and evaluate age-related changes in both groups.

MATERIAL AND METHODS: A cross-sectional study was conducted on 600 adults, which divided into two healthy groups: one was of young adults (18-35 years), and other was of elderly adults (>60 years) of 300 persons, each taken over a period of one year, in the Department of pulmonary medicine, a tertiary care hospital, Punjab. We conducted spirometry in both age group. Spirometry values were measured FVC, FEV1, FVC/FEV1, PEFR, and FEF25- 75 % of each groups.The subjects were selected based on random sampling

RESULT: Spirometry values compared between young and elderly adults. Mean BMI in young and elderly groups was 25.09±2.87 and 25.82±2.45, respectively. Spirometry values in FVC , FEV1, FEV1/FVC , PEFR and FEF25-75% in young was 4.31± 0.18 , 3.84,± 0.88± 0.02, 9.87± 0.38 and 3.75 ±0.26 and elderly age group 3.01±, 2.60 ±0.85± 0.02, 7.70± 0.30 and 2.82 ± 0.26. On statistical analysis, p value <0.001 in all spirometry parameters.

CONCLUSION: The study shows that there was a decline in spirometry parameters of healthy adults with the increase in age. This decline was significant in all spirometric parameters (FVC, FEV1, FEV1/FVC, PEFR, FEF25–75%) measured in the present study.

KEYWORDS : Spirometry, Pulmonary fuction test, Forced vital capacity, Forces expiratory volume

INTRODUCTION

Ageing is the process of developing and maintaining the functional ability that permits well being in older age.[1] Ageing is not restricted to the organism's single cells but affects different cell types to a variable extent and with varying impacts for the organism.[2] The foremost important physiological changes associated with ageing are of a pulmonary system depicting the decrease in static elastic recoil of the lung, respiratory muscle performance, and compliance of the chest wall and leading to increased work of breathing.[3] Lung functions decline with age, even in a healthy person; cross-sectional analysis has suggested that the decline with age leads to changes in pulmonary mechanics, respiratory muscle strength, gas exchange, and ventilatory control.[4] During the first 20 years of life, the lungs undergo a phase of growth and maturation. The maximal number of alveoli is reached at about 10±12 years of age, and, after that, the lungs' development accelerates until the maximal function is called, at approximately the age of 25 years for males and 20 years for females. Throughout the entire life, ageing causes a progressive decrease in lung performance; however, unless affected by the disease, the lungs remain capable of maintaining adequate gas exchange during the whole lifespan.[5-6] Age-related changes to the respiratory tract ultimately end in reduced delivery of oxygen to the blood and a decrease in oxygen saturation. The structural changes lead to changes in lung function. Some of these can be recorded by spirometry and other technique[7] Spirometry is a physiological test that measures the maximal volume of air that person can inspire and expire with maximal effort. The original signal measured in spirometry is either volume or flow as a function of time. Spirometry is a basic test in the assessment of general respiratory health. Spirometry provides essential information regarding the large and small airways, the pulmonary parenchyma. Spirometry helps measure a disease's effect on lung function, assessing airway responsiveness, monitoring disease course, indicating therapeutic interventions, assessing pre-operative risk, and determining a prognosis for several pulmonary conditions.[8] In our study,criteria were adhered to while performing spirometry, which complies with ATS/ERS criteria.[8] In the present study, a comparative evaluation of spirometry value between young and elderly adults was done. The study has been so designed,considering that young adults in India constitute most of the population to the tune of 65% being <35 years of age. Simultaneously, with increasing life expectancy elderly population is also growing; accordingly, the present study covered the region's broad age group population. As few studies are done comparing spirometry values in younger and elderly adults, this study helped give clues about reference value in both age groups and describe changes that occur with ageing in lung function performance.

MATERIAL AND METHOD

A cross-sectional study was conducted on 600 adults, which divided into two healthy groups: one was of young adults (18-35 years), and the other was of elderly adults (>60 years) of 300 persons, each taken over a period of one year. The subjects taken in the study were healthy nonsmokers attendants/relatives of the patients admitted in Department of pulmonary medicine, a tertiary care hospital, Punjab. Spirometry was performed on the subjects considering standard guidelines. Spirometry values measures include FVC, FEV1, FEV1/FVC, and FEF 25%- 75%, PEFR. Spirometry data were compared between the two groups.The study was performed as per the institute's ethical committee considerations, and the consent of all the participants is taken prior to the study. The subjects were selected based on random sampling.

INCLUSION CRITERIA:
- Both males and females of young age group (18-35 years) and elderly age group adults (>60 years).

EXCLUSION CRITERIA:
- Persons with any cardio-pulmonary morbidity, neurological impairment, recent musculoskeletal injury and vocal cord dysfunction
- Pregnant and lactating female
- A person on bronchodilator medication.

Tools used in the study as follows:
1.A spirometer: ISO certified HELIOS 702 portable spirometry system was used, giving thorough consideration to the factors enhancing the accuracy of spirometric analysis and minimizing the sources of error and providing accurate reading.
2.A stethoscope: An ISO certified stethoscope was used for the auscultation of respiratory sounds.
3.A weighing machine: A weighing machine with ± 100 grams accuracy was used to measure subjects' weight in the present study.
4. A measuring tape: for anthropometric measurement.

STATISTICS:
The data obtained was put in tables and then statistically analyzed. The p-value of <0.05 was be considered statistically significant, and p<0.01 was considered highly significant.

RESULTS
A total of 600 subjects, divided into two age groups; each age group contained 300 adults. There were 300 adults in the young age group, in which 104 (34.67 %) are from age 19 – 25, and 196 (65.33 %) are from 25 – 35 years. In the elderly age group total of 300 persons, 269 (89.67%) are from 60- 65 years, and 31(10.33 %) were from >66 years.The mean age in the young age group was 26.83±3.22 years, and the mean age in the elderly age group was 58.11±2.26 years. (Table 1) Mean FVC value in younger and elderly age group was 4.31 and 3.06, respectively (p. value < 0.001). Mean FEV1 in the younger and elderly age group was 3.76 and 2.60, respectively. On statically analysis, p value < 0.001. Mean FEV1/FVC in the younger and elderly age group was 0.88 and 0.85, which was statistically significant. Mean PEFR in the younger and elderly age group was 9.87 and 7.70, which was statistically significant. Mean FEF25-75% in the younger and elderly age group was 3.75 and 2.82, statistically highly significant. (Table 2) The mean height in both young and elderly age group was 162.05. (Table 3)

Table1: Age-wise distribution of both young and elderly age group

Age Group	Young Age		Elderly Age	
	Patients	Percentage	Patients	Percentage
18- 25	104	34.67 %	0	0%
26-35	196	65.33 %	0	0%
60-65	0	0%	269	89.67%
>66	0	0%	31	10.33%
Total	300	100%	300	100%
Mean ±SD	26.83±3.22		58.11±2.26	

Table 2:Distribution of spirometry values in the younger and elderly age group

	Young	Elderly	Statistically
FVC (Litre)	4.31 0.14	3.06 0.09	p. value <0.0001
FEV1(Litre)	3.760.26	2.60	p. value <0.0001
FEV1/FVC %	0.88 0.02	0.850.02	p. value <0.0001
PEFR (Litre/sec)	9.870.38	7.70 0.30	p. value <0.0001
FEF25-75%(Litre/sec)	3.75 0.26	2.82 0.26	p. value <0.0001

Table 3: Distribution of Height in the younger and elderly age groups

Gender	N	Mean in height (cm)	Std. deviation
Male	135	159.24	7.29
Female	465	162.86	7.52
Total	600	162.05	7.61

DISCUSSION
Age is an important influencing factor for pulmonary function. Evidence showed that the decline of pulmonary function was related to reducing neural respiratory drive, but it is more associated with structural changes in the respiratory system associated with ageing[9–12].In the present study, all spirometry parameters FEV1, FVC, FEV1/FVC, PEFR, and FEF25- 75% were measured, decrease in elderly adults as compared to younger adults. FEV1 mean value was higher in younger adults in comparison to elderly adults,(p <0.001) this was statistically significant. These finding was concordance with the study done by Ren WT[12] and Pruthi et al.[13] In general, the annual decrease in FEV1 is approximately 20 mL in aged 25±39 years, an increase to 38 mL in subjects aged > 65 years.[14]. FVC mean value in the present study was higher in younger adults as compared to elderly adults.(p. < 0.001) The finding was consistent with the study done by Ren WT[12] and Pruthi[13]. FEV1 and FVC increase up to 20 years of age in females and 27 years of age in males, then diminish at advanced ages. [15,16]

FEV1/FVC mean value in the present study was higher in younger adults than elderly age groups. This finding was statically significant (p. <0.001). FEV1/FVC is about 85% in young adults and then decreases to 70%–75% at about 70 years. But the actual changes in aged people are unclear. The decline may accelerate over 60 years or remain stable throughout the 60–90 years old.[12] FEF25 -75% and PEFR mean in the present study were higher in the young group than the elderly. These findings were statistically significant (p. <0.001). This finding was concordance with the study done by Ren WT [12] and pruthi.[13] In our study, all spirometry parameters (FEV1, FVC, FEV1/FVC, PEFR, and FEF25- 75%) were higher in males compared with females except FEV1/FVC in both younger and elderly age groups. These results are comparable to a study done by Chabra et al[17]. Mean Height in their study in male and female was 169 ± 6.79 and 155.97 ± 5.72 respectively, in comparison to present study mean height in male and female was 162.86 ± 7.52 and 159.24 ± 7.29 respectively. FVC in their study was 4.06±0.62 and 2.77±0.43 in males and females respectively , as compared to our study was 3.69±0.66 and 3.66±0.69 in males and females respectively. FEV1 in their study was 3.26±0.52 in males and 2.33±0.44 in females compared to our study was 3.18±0.61 and 3.18±0.62 in males and females respectively.A study done by Desaiet et al[18] on western India population healthy subjects. Their findings in comparsion to present study mean height in their study was 166.14± 7.02 cm in comparison to our study mean height in both age group was 162.05 ±7.61. Spirometry parameter were higher in men as compared to women which were the concordance to our study. FVC (Lt) in their study was 3.68 ±0.68and 2.54±0.50 in males and females respectively compared to our study was 3.69±0.66 and 3.66±0.69 in males and females. FEV1 (Lt) in their study was 3.03±0.57and 2.13±0.47 in males and females respectively compared to our study was 3.18±0.61 and 3.18±0.62 in males and females respectively. In our study, spirometry values were higher than in comparison to their study. Difference in values may be due to racial changes and anthropometric parameters in the study taken [18]. Sawane et al.[19] in their study on central India population. Mean Height in male and female was 168.62± 7.49 cm and 153.79 ± 6.28 cm, in comparison present study Mean height in male and female was 162.86± 7.52 and 159.24 ± 7.29 cm respectively. In their study spirometer parameter - FVC was 3.10±0.48 (males), 2.07±0.29 (females) and FEV1 was 2.60±0.42 (males) &1.73±0.28 (females), PEFR was 6.97±1.13 (males) &4.94±0.95 (females). FEF25-75% - 3.23±0.85 (males) & 2.31±0.53 (females). In their study, there was an age-related decline and values were higher in males in all the pulmonary function parameters which was in concordance with present study.[19] The present study's finding could be explained based on two significant changes to the respiratory system associated with an increase in age. These changes are stiffening of the chest wall and decreased elastic recoil. Minimal evidence suggests that the connective tissue structure may be the primary mechanism for age-associated difference in elastic recoil. Chest wall stiffness is accompanied by costal cartilage calcification, narrowing of the inter-vertebral disks, increased chest anterior-posterior diameter, and change in rib to vertebrae articulations.[20] In addition to this, decreases occur in the alveolar-capillary surface area, the alveolar septal surface area, and the lung parenchyma's total surface area,[21] Results reduce gas exchange area and increase the amount of physiological dead space.[20] This study showed a decline in spirometry value with increasing age due to a decrease in the lung's elastic recoil, reduced compliance of the chest wall, and reduced respiratory muscles' strength.

Table 3: Showing comparison between present study and study done by Ren WT et al. (2012) Pruthi et al. (2012)

	Age group	Gender	FEV1 (Litre)	FVC (Litre)	FEV1 /FVC	PEFR (Litre/S)

Present study	Young age group	Male	3.83	4.39	0.87	10.2
		Female	3.53	4.11	0.88	9.49
	Elderly age group	Male	2.62	3.10	0.85	7.75
		Female	2.48	2.89	0.86	7.42
Ren WT et al[12] (2012)	Younger group	Male	3.97	4.71	0.84	9.77
		Female	2.88	3.28	0.86	6.42
	Elderly group	Male	2.80	3.47	79.97	8.16
		Female	2.00	2.43	82.26	5.63
Pruthi et al[13](2012)	25 – 35 yrs. group	Both gender	3.75	4.44	88.82	10.18
	56 – 65 yrs.	Both gender	2.54	3.07	81.49	7.11

Table 4: Showing the comparison between the present study and other relevant studies

	Gender	FEV1 (Litre)	FVC Litre)	FEV1 /FVC	PEFR (Litre/S)	FEF 25% - 75%(Litre/S)
Present study	Male	3.18±0.61	3.69±0.66	86.00±0.03	8.80±1.17	3.33± 0.52
	Female	3.18±0.62	3.66±0.60	87.00±0.02	8.73±1.02	3.11±0.54
Chhabra Et.[17] al (2014) (North India)	Males	3.26±0.52	4.06±0.62	80.37±6.07	8.01±1.05	3.34±1.11
	Female	2.89±0.44	2.77±0.43	82.46±7.28	5.42±1.24	2.48±0.91
Desai et. al[18] (Western India) 2016	Males	3.03±0.57	3.68±0.68	82.23±5.95	8.30±1.35	3.28±1.02
	Female	2.13±0.47	2.54±0.50	83.92±7.62	5.71±1.02	2.52±0.99
Manish Sawane et. al[19] (Central India) 2019	Males	2.60±0.42	3.10±0.48	---	6.97±1.13	3.23±0.85
	Female	1.73±0.28	2.17±0.29	---	4.94±0.95	2.31±0.53

CONCLUSION:

The study shows that there was a decline in healthy adults' spirometry parameters with the increase in age. This decline was significant in all spirometric parameters (FVC, FEV1, FEV1/FVC, PEFR, FEF25–75%) measured in the present study. These findings explain the age-related changes in pulmonary reserve, anatomical, physiological, and immunological changes over aging in normal healthy individuals.

Conflict of interest

The authors have none to declare

REFERENCES

1. Dey, A. (2017). World report on ageing and health. *Indian Journal of Medical Research*, *145*(1), 150. https://doi.org/10.4103/0971-5916.207249
2. Spirduso, W., Francis, K., & MacRae, P. (1995). *Physical dimensions of aging*.
3. Miller, M. R., Hankinson, J., Brusasco, V., Burgos, F., Casaburi, R., Coates, A., Crapo, R., Enright, P., van der Grinten, C. P. M., Gustafsson, P., Jensen, R., Johnson, D. C., MacIntrye, N., McKay, R., Navajas, D., Pedersen, O. F., Pellegrino, R., Viegi, G., & Wagner, J. (2005). Standardisation of spirometry. In *European Respiratory Journal* (Vol. 26, Issue 2, pp. 319–338). Eur Respir J. https://doi.org/10.1183/09031936.05.00034805
4. Cardús, J., Burgos, F., Diaz, O., Roca, J., Barberà, J. A., Marrades, R. M., Rodriguez-Roisin, R., & Wagner, P. D. (1997). Increase in pulmonary ventilation-perfusion inequality with age in healthy individuals. *American Journal of Respiratory and Critical Care Medicine*, *156*(2 I), 648–653. https:// doi. org/ 10. 1164/ ajrccm. 156. 2. 9606016
5. JF, M. (1986). *The Normal Lung. Philadelphia, PA, WB Saunders 1986* (1986th ed.).
6. Krumpe, P. E., Knudson, R. J., Parsons, G., & Reiser, K. (1985). The aging respiratory system. In *Clinics in Geriatric Medicine* (Vol. 1, Issue 1, pp. 143–175). https://doi.org/10.1016/s0749-0690(18)30963-7
7. Niewoehner, D. E., & Kleinerman, J. (1974). Morphologic basis of pulmonary resistance in the human lung and effects of aging. *Journal of Applied Physiology*, *36*(4), 412–418. https:// doi. org/ 10. 1152/ jappl. 1974.36.4.412
8. Graham, B. L., Steenbruggen, I., Barjaktarevic, I. Z., Cooper, B. G., Hall, G. L., Hallstrand, T. S., Kaminsky, D. A., McCarthy, K., McCormack, M. C., Miller, M. R., Oropez, C. E., Rosenfeld, M., Stanojevic, S., Swanney, M. P., & Thompson, B. R. (2019). Standardization of spirometry 2019 update an official American Thoracic Society and European Respiratory Society technical statement. *American Journal of Respiratory and Critical Care Medicine*, *200*(8), E70–E88. https:// doi. org/ 10. 1164/ rccm. 201908- 1590ST
9. Rodriguez-Roisin, R., Burgos, F., Roca, J., Barbera, J. A., Marrades, R. M., Wagner, P. D., Teramoto, S., Matsuse, T., Ouchi, Y., Jansens, J. P., Pache, J. C., & Nicod, L. P. (1999). Physiological changes in respiratory function associated with ageing [1] (multiple letters). *European Respiratory Journal*, *14*(6), 1454–1456. https://doi.org/10.1183/09031936.99.14614549
10. Marek, W., Marek, E. M., Mückenhoff, K., Smith, H. J., Kotschy-Lang, N., & Kohlhäufl, M. (2011). Lung function in our aging population. *European Journal of Medical Research*, *16*(3), 108–114. https://doi.org/10.1186/2047-783x-16-3-108
11. Ostrowski, S., Grzywa-Celińska, A., Mieczkowska, J., Rychlik, M., Lachowska-Kotowska, P., & Łopatyński, J. (2005). Pulmonary function between 40 and 80 years of age. *Journal of Physiology and Pharmacology*, *56*(SUPPL. 4), 127–133.
12. Ren, W. ying, Li, L., Zhao, R. ya, & Zhu Dr., L. (2012). Age-associated changes in pulmonary function: A comparison of pulmonary function parameters in healthy young adults and the elderly living in shanghai. *Chinese Medical Journal*, *125*(17), 3064–3068. https://doi.org/10.3760/cma.j.issn.0366-6999.2012.17.018
13. Pruthi, N., & Multani, N. K. (2012). Influence of Age on Lung Function Tests. *Journal of Exercise Science and Physiotherapy*, *8*(1), 1. https://doi.org/10.18376//2012/v8i1/67598
14. Yang, T. S., Peat, J., Keena, V., Donnelly, P., Unger, W., & Woolcock, A. (1991). A review of the racial differences in the lung function of normal Caucasian, Chinese and Indian subjects. In *European Respiratory Journal* (Vol. 4, Issue 7, pp. 872–880). Eur Respir J.
15. Hurwitz, S., Allen, J., Liben, A., & Becklake, M. R. (1980). Lung function in young adults: Evidence for differences in the chronological age at which various functions start to decline. *Thorax*, *35*(8), 615–619. https://doi.org/10.1136/thx.35.8.615
16. Rossi, A., Fantin, F., Di Francesco, V., Guariento, S., Giuliano, K., Fontana, G., Micciolo, R., Solerte, S. B., Bosello, O., & Zamboni, M. (2008). Body composition and pulmonary function in the elderly: A 7-year longitudinal study. *International Journal of Obesity*, *32*(9), 1423–1430. https://doi.org/10.1038/ijo.2008.103
17. Chabra SK, Kumar R, Gupta U, Rahman M, D. D. (2014). Prediction equations for spirometry in adults from northern India. *Indian J Chest Dis Allied Sci*, *55*(4), 221–229.
18. Desai, U., Joshi, J. M., Chhabra, S. K., & Rahman, M. ur. (2016). Prediction equations for spirometry in adults in western India. *Indian Journal of Tuberculosis*, *63*(3), 176–182. https://doi.org/10.1016/j.ijtb.2016.08.005
19. Sawane, Manish & Ansari, T. (2019). (2019). Prediction Equations for Pulmonary Function Parameters in Central Indian Adult Population. *Indian Journal of Physiology and Pharmacology.*, *63*, 160–167.
20. Zaugg, M., & Lucchinetti, E. (2000). Respiratory function in the elderly. *Anesthesiology Clinics of North America*, *18*(1), 47–58. https://doi.org/10.1016/S0889-8537(05)70148-6
21. Brody, J. S. and Thurlbeck, W. M. (1985). *In Fishman, A.P. (Ed). Handbook of Physiology* (3(2)).