CORRELATION OF ANTHROPOMETRIC PARAMETERS WITH PULMONARY FUNCTION IN HEALTHY ADULTS

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ABSTRACT

Background: The most known cause of deaths globally is primary respiratory diseases which usually include pneumonitis, pulmonary hypertension, asthma, chronic bronchitis and other disorders related to respiration in which lungs are affected in multi system diseases. SLE is the most common multi system disease in which many internal organs are affected altogether.

Objective: To determine the correlation of anthropometric Parameters with Pulmonary Function in healthy adults.

Methodology: Data was collected by using convenient sampling. The healthy adults were selected and then divided into two groups depending upon gender then each group was subdivided into sub-groups depending upon the BMI and Waist circumference. The data analysis was done by using SPSS version 25. Shapiro Wilks test were used to assess the normality of data. In order to find out within and across the group difference non-Parametric test was applied. The correlation was analyzed by using Pearson correlation and Mann Whitney U test was applied to analysis across the group difference.

Results: FEV_1 and FEV_1/FVC showed a significant correlation with the anthropometric measurements of our study. Body mass index has a significant negative correlation with FEV_1 and FEV_1/FVC with $P<0.05$ and $p<0.01$ respectively whereas waist circumference has a significant negative correlation with FEV_1 and FEV_1/FVC in males ($p<0.001$) but only with FEV_1/FVC in females ($p<0.001$). Though waist circumference in females is positively correlated with FVC, the correlation was not significant ($p=0.49$).

Conclusion: FEV_1 and FEV_1/FVC showed significant correlation with the anthropometric measurements of our study.

Indexed Terms_ Anthropometric values, BMI, Pulmonary functions test.

I. INTRODUCTION

The most known cause of deaths globally is primary respiratory diseases which usually include pneumonitis, pulmonary hypertension, asthma, chronic bronchitis and other disorders related to respiration in which lungs are affected in multi system diseases. SLE is the most common multi system disease in which many internal organs are affected altogether.(1) PFTs are used to diagnose lung illnesses, check cognitive impairments, and determine progress in prognosis. They've become commonplace in respiratory, occupational, and sports medicine tests, as well as public health screenings. These tests help doctors to assess their patients' respiratory functioning. (2) These tests are used to assess the efficacy of therapies for respiratory disorders. Baseline Spirometry is the most common lung function test. A range of variables, including technical, biological, and clinical variances, might alter spirometry lung function values.(3) They give a high-resolution picture of airway blockage and disease severity. A person's sickness status, age, gender, body weight, and environment all have an effect on their respiratory function and lung capacity.(4) The endurance and tension of respiratory muscles, gas exchange in the lungs, breathing control, and exercise capacity, as well as many other health-related issues, are all affected by body mass. Obesity, especially extreme central obesity (tissues surrounding central abdomen and chest cavity), has an impact on the mechanisms of the respiratory system, upper airway mechanical performance, and VCO_2.(5) Even the severely obese may preserve encaenia by enhanced respiratory drive, despite the increased work of breathing imposed by their large weight. Awake hypercapnia develops when the adaptive strategies that ordinarily help do this are weakened or overloaded. These circumstances show the effect of weight gain on respiration.(6) Obesity can lead to dyspnea, higher cardiac stress, greater burden on the diaphragm and thoracic wall respiratory muscles, and reduced gas exchange and exercise capacity in the lungs. As a response, the area in which diaphragm moves during breathing shrinks thus causing the lung space to be underused.(7) Obesity causes greater resistance in the airway, this is due, at primarily, to fat people's usual lower lung volumes, which causes the smaller airways to constrict. In obese patients, the respiratory diseases like asthma, trigger the cytokines production which activate inflammatory response. This inflammatory response results in an increased resistance. (8) Studies reveal that there is no clear relationship yet found between anthropometric obesity measures and respiratory functions. More research is needed to find how adiposity measures affect obese subjects. Moreover, there is no decisive proof with regards to whether of the body weight, BMI, muscle versus fat tissue, midsection perimeter, abdomen/hip proportion, neck outline, and midriff/stature proportion is a solid sign in assessing respiratory capacity discoveries.(9) Many studies have been connected to a decrease in lung work in a few examinations, albeit the connection to shortcoming is muddled and need justifications and analysis of the correlations.(10) Recent researches from ATS and ECCS propose that PFT findings be evaluated in accordance to normal-range reference values (ECCS). In healthy people, ethnicity, physical work, environment, age and sex along with history of smoking and socio – economic value can all affect respiratory function. (11) The enormous variety of shifting climatic and geographical variables in a large country like India may be connected to regional variations in pulmonary function in normal subjects. There are numerous things that effect the normal lung functions.(12) Coughing can be caused by a variety of illnesses that affect different parts of the body. Chronic cough creates significant functional limitations in a large number of patients, necessitating comprehensive assessment. The decline phase and steady phase of disease of disease are studied by various individual parameters irrespective of sex, height, and age.(13) Some new factors impacting the functional condition of the lung have been established in last decade. The field of interest is the relationship of hyperglycemic state of diabetes mellitus with and lung function. (14) This is a valid relationship as various studies have been carried out and it is found that diabetic microangiopathy can affect the respiratory system, much like any other organ. Insulin's glycaemia- dependent and glycaemia-independent actions are both involved in the pathophysiology. Lung functions can be affected by diabetes in various conditions.(15)

The rational of this study is to coincide and access the factors which effect the pulmonary function in healthy adults. As we've seen, there are some people who don't have any disease or aren't on any medications but yet have a lung condition or disease. As a result, the author of this study will investigate if there are any additional variables that influence pulmonary function.

II. MATERIAL & METHODS

The study design was cross-sectional correlational study. Data was collected from District Head Quarter Hospital Mianwali, Obaid Noor Hospital Mianwali. Study was completed within 10 months after approval of synopsis. Sampling technique was Non-Probability Convenience Sampling **Inclusion criteria:** Non-smoking history (current or former), age between 20 to 45 years. (16), both Male and Female, cognitively stable patients MMS>24 and all healthy adults. (17) **Exclusion criteria:** Any other known medical illness e.g. cardiovascular disease, respiratory disease (18), limited patient's ability to complete questionnaire and concomitant enrollment in any other clinical trial.(19) A sample of 355 healthy adults was recruited using EPITOOL. (https://epitools.ausvet.com.au/samplesize)

Study Tool: Spirometer for respiratory health parameters, forced expiratory volume in 1 s (FEV1), Forced vital capacity (FVC), FEV1/FVC ratio, Vital capacity (VC), Peak expiratory flow (PEF) and waist circumference.

Visit selected hospital setting with questionnaire and Consent form. Consent form was signed from patient prior to questionnaire. The healthy adults were selected and then divided into two groups depending upon gender then each group was sub-divided into sub- groups depending upon the BMI and Waist circumference. The data was analyzed using SPSS v 25. The normality of the data was assed Shapiro-Wills test of normality and uniformity, based on which parametric or non-parametric test was applied to determine within the group and across the group difference in two groups. Mann-Whitney U test was applied to determine any significant difference across subjects. Pearson Correlation were applied to determine the correlation between anthropometric parameters and pulmonary function test.

III. RESULTS:

The Normality distribution tested by Shapiro -Wilk test revealed a significant departure from normality among all the study variables ($p<0.001$). To evaluate the effect of BMI and Waist circumference on respiratory parameters, we applied Mann-Whitney U test as shown in Table 3. The test shows a significant ($p<0.05$) difference in PEF in obese (BMI ≥ 25.0) and Non-obese Groups ($BMI \leq 24.9$). To evaluate the effect of BMI and Waist circumference on respiratory parameters, we applied Mann-Whitney U test as shown in Table 4 results for all the respiratory parameters showed no significant difference in participant belonging to Normal Waist Circumference subgroup (WC ≤ 34 $inches\ in\ females, WC \leq 39$ $inches\ in\ males$) and Increased Waist Circumference subgroup (WC ≥ 35 inches $in\ females, WC \geq 40$ inches in males). Only FEV1 and FEV1/FVC showed significant correlation with the anthropometric measurements of our study. Body mass index have a significant negative correlation with FEV1 and FEV1/FVC with $P<0.05$ and $p<0.01$ respectively whereas waist circumference has a significant negative correlation with FEV1 and FEV1/FVC in males ($p<0.001$) but only with FEV1/FVC in females ($p<0.001$). Though waist circumference in females is positively correlated with FVC, the correlation was not significant ($p=0.49$).

IV. DISCUSSION

This study when correlated to previous literature it explains the fact that the chronic cough creates significant functional limitations in a large number of patients, necessitating comprehensive assessment. The decline phase and steady phase of disease of disease are studied by various individual parameters irrespective of sex, height, and age. Some new factors impacting the functional condition of the lung have been established in last decade. The field of interest is the relationship of hyperglycemic state of diabetes mellitus with and lung function. This is a valid relationship as various studies have been carried out and it is found that diabetic microangiopathy can affect the respiratory system, much like any other organ. (20) Insulin's glycaemia-dependent and glycaemia-independent actions are both involved in the pathophysiology. Lung functions can be affected by diabetes in various conditions. (21) In this study FEV1 and FEV1/FVC showed significant correlation with the anthropometric measurements of our study. Body mass index have a significant negative correlation with FEV1 and FEV1/FVC with $P<0.05$ and $p<0.01$ respectively whereas waist circumference has a significant negative correlation with FEV1 and FEV1/FVC in males ($p<0.001$) but only with FEV1/FVC in females ($p<0.001$). Though waist circumference in females is positively correlated with FVC, the correlation was not significant ($p=0.49$). When compared with the parent article it is shown that in males, the following variables exhibited inverse correlation: expiratory reserve volume (ERV), forced vital capacity (FVC), maximum ventilatory volume (MVV), peak expiratory flow rate (PEFR), and forced expiratory volume at the end of the first second (FEV1). Female body fat percent was found to have a negative connection with ERV, FVC, and MVV. These data imply that a higher body fat percentage and a more central fat regional distribution may affect pulmonary function tests. Expiratory reserve volume and functional residual capacity are both reduced in obese people. Except in extreme central obesity, total lung capacity, residual volume, and spirometry are unaffected by obesity and are normally within acceptable limits.(22) Obesity is linked to a number of comorbidities, including respiratory diseases. BMI, on the other hand, does not account for fat deposits or muscle mass and is unable to discriminate between abdominal obesity and fat-free mass (FFM), which is muscular mass. In this study the comparison of respiratory functional parameters within BMI subgroups (IA, IB, IC, and ID) of both male sand females were observed. Group IA has significantly lower mean value for FEV1 than IB ($p<0.001$) among female participants whereas FEV1/FVC was significantly ($p<0.001$) lower in IA and IB and IA and ID.(23) In comparison with previous literature, it has been postulated in recent years that various variables may have different impacts on respiratory function. Human body proportions in terms of structure and lipid profile, as well as the efficacy of the human lungs for exchange of gases, have been widely recorded. The pulmonary system's functioning is influenced by intrinsic non- modifiable characteristics such as age and gender.(24) For instance, Body fat percentage, a reliable indicator of obesity, had a considerable impact on pulmonary function, which differed across males and females. The link between BMI and lung function tests, as well as the distribution of variances between men and women, appear to be intricate. The composition of body is changed as the age increases.(25) There are not too many studies on how fat mass redistribution affects pulmonary function tests in lesser obese or not obese population.(26) It is evident from researches that mechanical compression is produced in lung, diaphragm and chest cavity due to adiposity that may lead to restrictive pulmonary disease. Excessive fat also results in lower lung compliance, weakens respiratory muscles by reducing strength and raises pulmonary resistance.(24)

V. CONCLUSION

FEV1 and FEV1/FVC showed significant correlation with the anthropometric measurements of our study.

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All the authors have been informed of their inclusion and have approved this.

Disclaimer:

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Conflict of interest:

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Table 1: **Baseline Characteristics of Participants**

Variable	Male	Female
N	200	155
Height	169.1±15.9	166.0±18.7*
Weight	76.0±26.9	73.2±29.7
BMI	23.1±5.4	22.9±5.8
Waist Circumference	32.2±3.0	31.7±3.4*
FEV1	2.2±0.8	2.2±0.8
FVC	2.7±0.9	2.7±0.9
FEV1/FVC	78.0±12.4	79.1±14.2
PEF	7.6±45.1	4.5±1.6
*p<0.05		

Table 2: Pearson's' Correlation between Anthropometric measurements and Respiratory Parameters in Males and Females

Anthropometric Indices	FEV1	FVC	FEV1/FVC	PEF
BMI	Negative*	Negative	Negative**	Negative
WC (males)	Negative**	Negative	Negative**	Negative
WC(Females)	Negative	Positive	Negative**	Positive
P<0.05*, p<0.01**				

References:

1. Sonnappa S, Lum S, Kirkby J, Bonner R, Wade A, Subramanya V, et al. Disparities in pulmonary function in healthy children across the Indian urban–rural continuum. American journal of respiratory and critical care medicine. 2015;191(1):79-86.
2. Kuppusamy M, Dilara K, Ravishankar P, Julius A. Effect of Bhrāmarī prāṇāyāma practice on pulmonary function in healthy adolescents: a randomized control study. Ancient science of life. 2017;36(4):196.
3. Heraganahally SS, Howarth T, White E, Sorger L, Biancardi E, Ben Saad H. Lung function parameters among Australian Aboriginal 'apparently healthy'adults: an Australian Caucasian and Global Lung Function Initiative (GLI-2012) various ethnic norms comparative study. Expert Review of Respiratory Medicine. 2021;15(6):833-43.
4. Strippoli M-PF, Kuehni CE, Dogaru CM, Spycher BD, McNally T, Silverman M, et al. Etiology of ethnic differences in childhood spirometry. Pediatrics. 2013;131(6):e1842-e9.
5. Lum S, Bountziouka V, Quanjer P, Sonnappa S, Wade A, Beardsmore C, et al. Challenges in collating spirometry reference data for South-Asian children: an observational study. PloS one. 2016;11(4):e0154336.
6. Rosenzweig JRC, Edwards L, Lincourt W, Dorinsky P, ZuWallack RL. The relationship between health-related quality of life, lung function and daily symptoms in patients with persistent asthma. Respiratory medicine. 2004;98(12):1157-65.
7. Schweitzer L, Geisler C, Johannsen M, Glüer C, Müller M. Associations between body composition, physical capabilities and pulmonary function in healthy older adults. European journal of clinical nutrition. 2017;71(3):389-94.
8. Lum S, Bountziouka V, Sonnappa S, Wade A, Cole TJ, Harding S, et al. Lung function in children in relation to ethnicity, physique and socioeconomic factors. European Respiratory Journal. 2015;46(6):1662-71.
9. Chhabra SK, Kumar R, Mittal V. Prediction equations for spirometry for children from northern India. Indian pediatrics. 2016;53(9):781-5.
10. Smith HE, Jones CJ, Hankins M, Field A, Theadom A, Bowskill R, et al. The effects of expressive writing on lung function, quality of life, medication use, and symptoms in adults with asthma: a randomized controlled trial. Psychosomatic medicine. 2015;77(4):429-37.
11. Sorkness R. Nature, Nurture, and Lung Volumes. American Thoracic Society; 2015. p. 11-2.
12. Howarth T, Saad HB, Perez AJ, Atos CB, White E, Heraganahally SS. Comparison of diffusing capacity of carbon monoxide (DLCO) and total lung capacity (TLC) between Indigenous Australians and Australian Caucasian adults. Plos one. 2021;16(4):e0248900.
13. Weiner DJ, Graham B, Stanojevic S. Ethnically Diverse Normative Data for Diffusing Capacity and Lung Volumes: Another Research Priority. Annals of the American Thoracic Society. 2020;17(1):128-.
14. Blake TL, Chang AB, Chatfield MD, Marchant JM, McElrea MS. Global Lung Function Initiative-2012 'other/mixed'spirometry reference equation provides the best overall fit for Australian Aboriginal and/or Torres Strait Islander children and young adults. Respirology. 2020;25(3):281-8.
15. Hall GL, Pearson G. Reduced forced vital capacity in A boriginal A ustralians: Biology or missing evidence? : Wiley Online Library; 2015. p. 693-4.
16. Holland AE, Mahal A, Hill CJ, Lee AL, Burge AT, Moore R, et al. Benefits and costs of home-based pulmonary rehabilitation in chronic obstructive pulmonary disease-a multi-centre randomised controlled equivalence trial. BMC pulmonary medicine. 2013;13(1):1-7.
17. Zhang Y, Wang L, Mutlu GM, Cai H. More to Explore: Further Definition of Risk Factors for COPD–Differential Gender Difference, Modest Elevation in PM2. 5, and e-Cigarette Use. Frontiers in Physiology. 2021;12:423.
18. Morgan AD, Zakeri R, Quint JK. Defining the relationship between COPD and CVD: what are the implications for clinical practice? Therapeutic advances in respiratory disease. 2018;12:1753465817750524.
19. Mihaltan F, Adir Y, Antczak A, Porpodis K, Radulovic V, Pires N, et al. Importance of the relationship between symptoms and self-reported physical activity level in stable COPD based on the results from the SPACE study. Respiratory research. 2019;20(1):89-.

20. Bahat G, Tufan A, Ozkaya H, Tufan F, Akpinar TS, Akin S, et al. Relation between hand grip strength, respiratory muscle strength and spirometric measures in male nursing home residents. The Aging Male. 2014;17(3):136-40.
21. Chen X-F, Yan L-J, Lecube A, Tang X. Diabetes and obesity effects on lung function. Frontiers in Endocrinology. 2020;11:462.
22. Dixon AE, Peters U. The effect of obesity on lung function. Expert review of respiratory medicine. 2018;12(9):755-67.
23. Forno E, Han Y-Y, Mullen J, Celedón JC. Overweight, obesity, and lung function in children and adults—a meta-analysis. The Journal of Allergy and Clinical Immunology: In Practice. 2018;6(2):570-81. e10.
24. Xing X, Hu L, Guo Y, Bloom MS, Li S, Chen G, et al. Interactions between ambient air pollution and obesity on lung function in children: The Seven Northeastern Chinese Cities (SNEC) Study. Science of The Total Environment. 2020;699:134397.
25. Klepaker G, Svendsen MV, Hertel JK, Holla ØL, Henneberger PK, Kongerud J, et al. Influence of Obesity on work ability, respiratory symptoms, and lung function in adults with asthma. Respiration. 2019;98(6):473-81.
26. Hsu Y-E, Chen S-C, Geng J-H, Wu D-W, Wu P-Y, Huang J-C. Obesity-Related Indices Are Associated with Longitudinal Changes in Lung Function: A Large Taiwanese Population Follow-Up Study. Nutrients. 2021;13(11):4055.