ORIGINAL ARTICLE

Correlation of Hemoglobin with Lung Function Tests

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ABSTRACT

Objective: Purpose of this study was to know any existing correlation between haemoglobin and lung function tests for respiratory status evaluation in young healthy individuals.

Study Design: Cross sectional study.

Place and Duration of Study: Physiology Laboratory of Yusra Medical and Dental College, Islamabad from January 2012 to January 2013.

Materials and Methods: One hundred and sixty students of Yusra Medical and dental college were included in the study. Blood samples of the subjects were collected for haemoglobin (Hb) estimation by Sahli method and measurement of the lung function tests was done by Spirometry using volume Spirometer. Lung function tests included tidal volume (TV), Inspiratory reserve volume (IRV), expiratory reserve volume (ERV) and vital capacity (VC).Data was analysed using SPSS 15and correlation was calculated using Pearson's correlation co-efficient between haemoglobin and the lung functions tests.

Results: The p value indicates significant positive relation exist between haemoglobin and Inspiratory reserve volume($r = 0.39$, $p < 0.0001$), expiratory reserve volume($r = 0.43$, $p < 0.0001$) however, no significant relation exists between vital capacity and haemoglobin ($p=0.242$).

Conclusion: There is positive correlation between haemoglobin and Lung Function Tests.

Key Words: *Spirometry, Haemoglobin, Vital Capacity, Lung Function Tests.*

Introduction

Various studies have shown that restrictive[1] and obstructive lung pathologies [2] are accountable for 3 million deaths every year world widely with estimated mortality rate of 71 deaths per 100,000 in Pakistan.[3] Respiratory status of patient is evaluated using lung function tests,[4] that are non-invasive diagnostic tests and helps in monitoring of functioning of lung and also gives an overall idea of prognosis for diseases. Though there are several different kinds of lung function tests, recent data suggests spirometry,[5,6] is first and most commonly used method. Spirometer[7] monitors lung function by measuring amount of gas inhaled and exhaled that shows how effectively gas travels from the lungs[2,4] into the blood which allows to estimate how well the lungs move oxygen that is carried by haemoglobin[8] from the air into the blood stream. Different studies have shown that due to decrease haemoglobin concentration poor delivery of oxygen to lungs makes, anaemic[9] patients usually lethargic[10] and breathless,[11] thus, they are more prone to have abnormal lung functions[1,2,3] so in this study we chose hemoglobin[4]as second entity for direct comparison with IRV, ERV and VC. In a developing country like Pakistan, where lung functions tests[12] are too costly[13] for an average person and according to study[14] conducted in urban areas of Pakistan anemia is quite common, our study was carried out with an aim to find any co-relation that exists between haemoglobin and lung function tests so in future by knowing Hb[15]level of a person indirect assessment of functioning of lung could be made.

Materials and Methods

The study was conducted at Physiology Laboratory of Yusra Medical and Dental College, Islamabad from January 2012 to January 2013. It was an analytical (Cross sectional) study. A total of 160 healthy young adults of both sexes between ages 18 to 24 selected through purposive sampling, were included in the study. Patients with existing lung diseases of asthma, dyspnoea, pneumonia were excluded from study. Before starting the study, formal approval from YMDC medical ethics committee was obtained. Data for haemoglobin (Hb) and lung function tests was analysed using Pearson co-relation co-efficient that give numeral values between two variables that are measured on same interval and results were calculated using SPSS 15. We approached potentially healthy students regularly attending classes in YMDC. Participants provided signed informed

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consent, predesigned questionnaire Performa and underwent blood sample collection for haemoglobin (G/dl),blood group, bleeding time, red blood cell count, white blood count cell count, and lung function tests that is spirometer testing includes Tidal volume, Inspiratory reserve volume, Expiratory reserve volume and Total lung capacity. Erythrocyte sedimentation rate (mm at end of first hour) was measured using Westergren Method. Haemoglobin of participants was estimated using Sahli Method[16] due to its simplicity and cost effectiveness. Haemometer kit of Sahli method included in it a Comparator tube, Hb pipette and acid. Sahli Haemometer method utilizes the conversion of haemoglobin into acid haematin which has a brown colour in solution. The intensity of the colour is related to the amount of haemoglobin in the blood sample. Water is added to dilute the brown solution until it matches that of a standard. The more haemoglobin, the more water required to obtain a colour match[17]. Haemoglobin values are read at the meniscus of the brown solution. Hence, Haemoglobin levels of individuals were taken and estimated. Lung function test[17] swere measured using Spirometer[18] with its accessories that included a mouth piece, soda lime container, floating drum and the results were obtained on Kymograph. Data was noted from the recorded Spirogram for Inspiratory reserve volume, tidal volume and expiratory reserve volume were recorded where as Vital capacity values were calculated. Analysis of covariance was performed to compare the levels of different pulmonary function parameters in relation to haemoglobin. Data for haemoglobin (Hb) and lung function tests was analysed using Pearson co-relation co-efficient which give numeral values between two variables that are measured on same interval and results were calculated using SPSS 15. Though, our approach of using Pearson co-efficient is quite novel in biomedical field, however, in other fields such as statistics, Pearson method is well known for tackling co-relation financial phenomena.

Results

The lung function tests and haemoglobin are compared by taking lung function tests (IRV, ERV,VC) on Y axis whereas, Haemoglobin is taken on X axis and results were calculated using Pearson Correlation co-efficient as shown in table II. For Inspiratory reserve volume and haemoglobin comparison variance is 3.9001, standard deviation of 0.1623, whereas, co-relation co-efficient 'r' was evaluated as 0.3862 which showed significance level p<0.0001 and 95% confidence interval for 'r' calculated as 0.2398 to 0.5154 hence the p value indicated the significant positive relation exist between Inspiratory reserve volume and haemoglobin as shown in table II and figure 1. The 95% confidence interval for mean is 12.8995 to 13.5411.

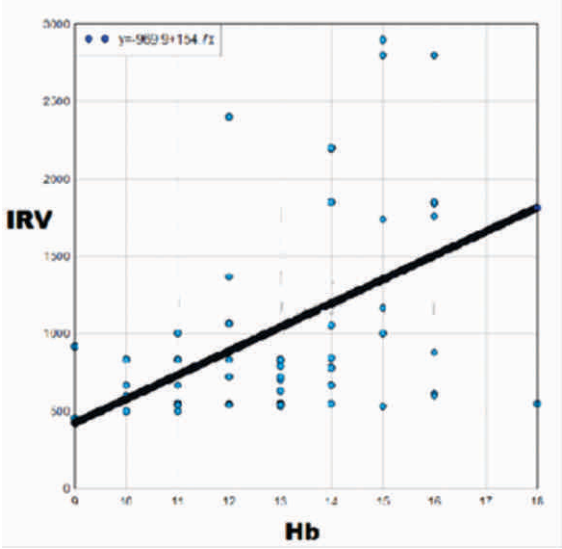

Fig 1: Scatter plot showing significant positive correlation between the HB & IRV

On comparing expiratory reserve volume and haemoglobin, variance is 3.8515, standard deviation of 1.9625, whereas, the co-relation co-efficient r value is 0.4321 ,significance level of p<0.0001 and 95%confidence interval for r calculated as 0.2910 to 0.5547 therefore, a positive relation co-exist among haemoglobin and expiratory reserve volume. The confidence interval for mean is 12.8828 to 13.5226.Results are shown in table II. When vital capacity was compared with haemoglobin, it showed variance of 3.8710, standard deviation of 1.9675, whereas, co-relation co-efficient calculated to be 0.2110, significance level of p=0.242 and the confidence interval for 'r' calculated as 0.02816 to 0.3801. Hence results showed no significant relation exists between VC and haemoglobin, shown in table II. The 95% confidence interval for the mean is 12.8852 to 13.5201. The positive relation of haemoglobin with Inspiratory reserve volume and

expiratory reserve volume indicates that by knowing one parameter either haemoglobin or lung function test one can predict about working of other.
The statistical summary is given in table I.

Table I: Statistical analysis of HB and lung function tests

Variables	95% CI	Variance	SD
HB	12.885 - 13.520	3.8710	1.9675
ERV	833.416 - 973.043	184700.4555	429.7679
IRV	949.614 - 1165.843	442948.8475	665.5440
VC	581.983 - 801.939	455199.4667	674.6847

95% CI: 95% confidence interval. **SD:** standard deviation

Discussion

When the co-relation of haemoglobin with lung function test parameters (Inspiratory reserve volume, expiratory reserve volume and vital capacity) is done using Pearson co-relation co-efficient method, there exists positive relation of haemoglobin[19] with Inspiratory reserve volume (p value<0.0001) and expiratory reserve volume (p value<0.0001). Haemoglobin and lung function test are separate parameters and usually evaluated out separately however, it is found by our study results that with having just haemoglobin values of an individual one can predict about his lung function. Decrease haemoglobin concentration results in poor delivery of oxygen to lungs disturbing breathing mechanism, thus, anaemic patients[9,10,11] are lethargic and dyspnoeic being more prone to have abnormal lung function tests. As in poor countries, it is difficult for people to go for lung function tests due to expenses, hence by taking blood samples for haemoglobin, fair prediction about functioning of lung could be done and if any doubt still persists regarding poor functioning of lung, then for confirmation, lung function tests such as Spirometry[20] could be prescribed for such patients. In accordance to best of our knowledge, no direct national or international study has yet been carried out on comparison of haemoglobin with lung function test, however, there is evidence of matching of our study results with that, conducted in year 2012 by J.N. Oko-Ose et al. in University Of Benin Teaching hospital,[21] which compared lung function test in sickle cell patient.[22] Though the sample size was less than half of that what we chose for our study(160) ,as they chose 60 subjects, however the analysis of data was done using T test and Pearson co-relation that we have also utilized for results. In that study, other parameters such as forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) were also included, though they have not been utilized in our study, but we have future plans of exploring these areas also.

According to the study, the lung function indices were lower in females than males in sickle cell patient, that[23] differs greatly with our results as they were same for both genders in regards, that low haemoglobin values for both genders will predict equally for poor lung functioning, however, this area needs further extensive exploration and the difference in gender result may be due to different geographical areas and different races being examined in both studies.

Further recommendation regarding our study is that haemoglobin estimation by Drapkin method, Forced expiratory volume, forced vital capacity and diseased individuals should also be included.

Conclusion

Haemoglobin level in future can serve as good indicator for assessing lung function of the patients without history of any lung disease especially in poor socioeconomic conditions and environment where anaemia is more prevalent, patients are prone to have abnormal lung function tests.

Table II: Correlation between HB & lung function tests

	Haemoglobin	
IRV	Correlation coefficient r value p value	0.3862* <0.0001
ERV	Correlation coefficient r value p value	0.4321** <0.0001
VC	Correlation coefficient r value p value	0.2110*** 0.0242

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*For Haemoglobin and Inspiratory reserve volume, the "r" value is 0.38 so there exists fair co-relation among them.
**For Haemoglobin and Expiratory reserve volume, the "r'' value 0.43 depicts a good significant relation between the two.
***For Haemoglobin and Vital capacity, the "r" value of 0.2 shows a weak co-relation among them.
IRV: Inspiratory reserve volume. **ERV:** Expiratory reserve volume
VC: vital capacity

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