Original Article

Assessment of Pulmonary Functions and Effect of Co Morbid Conditions in Community Dwelling Elderly

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Abstract

Background: Aging is associated with significant changes in lung parenchyma and functions. Pulmonary function is an important independent predictor of morbidity and mortality in elderly. The present study was undertaken to find out age associated changes and influence of co morbid conditions on pulmonary function in rural elderly population.

Material and Methods: The present study was a cross-sectional community based study in a rural population aged 60 years and above. Using structured questionnaire socio-demographic determinants (age, sex, place, marital status, occupation, monthly income), personal habits (smoking, alcohol, gutkha, opium), and history of co-morbid diseases was recorded. Anthropometric measurements, clinical examination, routine blood and urine investigations along with spirometry were performed.

Results: Impaired pulmonary function (FEV $_1$ / FVC % <80%) was observed in 40.3% of elderly population. Pulmonary dysfunction was more in male population. Age associated decline ($p<0.05$) in FEV $_1$ / FVC was observed in both sexes. BMI, hand grip strength, smoking, ischemic heart disease, hypertension and diabetes mellitus had effect on pulmonary function.

Conclusion: There is a decline in pulmonary function with increasing age. This physiological phenomenon is aggravated by co morbid conditions.

(Journal of The Indian Academy of Geriatrics, 2006; 3:101-106)

Introduction

Among the aged individuals, progressive decrease in physiological capacity of respiratory functions and reduced ability to respond to environ-mental stresses lead to increased susceptibility to chronic respiratory diseases, significantly affecting the quality of life. Pulmonary function is an important independent predictor of morbidity and mortality in elderly persons. Impairment of pulmonary function is associated with increased mortality. [1-6] Cigarette smoking has been clearly documented as a primary cause of impaired pulmonary function. [7] However the role of factors other than smoking is less clear. Factors such as obesity, body fat distribution, alcohol consumption, diabetes mellitus, dietary composition, physical activity and several other cardiovascular risk factors have been associated with altered pulmonary function in some studies.[8-12]

The investigations of factors associated with pulmonary function have been infrequently performed among the elderly. Due to demographic changes in developing countries, selective survival and potential changes in the strength of associations between risk factors and pulmonary function with increasing age, identification of factors associated with pulmonary function in older populations have both clinical and public health significance.

Material and Methods

The present study was a cross-sectional community based study among rural population aged 60 years and above. Population of less than 60 years of age, bed ridden/terminally ill persons, those who could not perform spirometry and those who had COPD, asthma, tuberculosis, dyspnea, cough, expectoration, and

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hemoptysis were excluded from the study. Balarwa village of Jodhpur district was selected for study, which has a sub center and a population of about 7000 people.

A house to house survey was carried out in village to select elderly persons. Temporary clinics were set up at sub center with participation of local social organizations. A structured questionnaire was used to get information from selected population in the study. Socio-demographic determinants (age, sex, place, marital status, occupation, and monthly income), personal habits (smoking, alcohol, gutkha, opium), co-morbid diseases, physical examination, and anthropometric measurements were recorded. Blood samples were taken for biochemical investigations and hemoglobin estimation. The urine sample was taken for protein and sugar examination. Handgrip was judged by dynamometer. Spirometry was performed with fully automated spirometer "Spirolab-2". The largest FEV_1 and the largest FVC from the three best acceptable FVC maneuvers were reported.

Results

The data obtained from the study is presented in table 1-8. Three hundred subjects were included in the study with forty six controls.

Discussion

Pulmonary functions are dependent on various factors. Age-associated physiological decline in respiratory functions is related to progressive decrease in chest wall compliance, alteration in respiratory skeletal muscle functions and decrease in static elastic recoil pressure of the lung. Our study also reaffirms the gradual decline of lung function with age.

Analysis suggests that there is progressive significant decline ($p<0.05$) in FEV_1/FVC till 80 years among female elderly as also reported by Milne and Williamson, there after decline is insignificant.[13]

There was a significant decline ($p<0.05$) observed in FEV_1/FVC % when BMI was >30kg/m^2.and a significant improvement ($p<0.05$) with increase in BMI

Table 1: Age and sex distribution of study population

Age group (yrs)	Male (%)	Female (%)	Total (%)
< 60 (Controls)	34 (73.9)	12 (26.1)	46 (100)
60-70	110 (36.6)	108 (36.0)	218 (72.6)
71-80	40 (13.3)	31 (10.3)	71 (23.6)
> 80	5 (1.66)	6 (2.0)	11 (3.6)
Total	155 (51.7)	145 (48.3)	300 (100)

Table 2: Pulmonary function (FEV1/FCV %) in study population

	Male (%)				Female (%)				Total (%)			
Age Group(yrs)	30-49	50-79	>80	Total	30-49	50-79	>80	Total	30-49	50-79	>80	Grand Total
< 60 (controls)	0 (0)	10 (29.4)	24 (70.6)	34 (100)	0 (0)	5 (41.7)	7 (58.3)	12 (100)	0 (0)	15 (35.7)	31 (64.3)	46 (100)
60-70	4 (3.6)	42 (38.2)	64 (58.2)	110 (100)	1 (0.9)	29 (26.9)	78 (72.2)*	108 (100)	5 (2.3)	71 (32.6)	142 (65.1)*	218 (100)
71-80*	0 (0)	20 (50)	20 (50)	40 (100)	0 (0)	19 (61)	12 (38.7)*	31 (100)	0 (0)	39 (54.9)	32 (45.1)*	71 (100)
>80*	0 (0)	2 (40)	3 (60)	5 (100)	0 (0)	4 (66.7)	2 (33.3)	6 (100)	0 (0)	6 (54.5)	5 (45.5)	11 (100)
Total cases	4	64	87	155	1	52	92	145	5	116	179	300

*$p<0.05$

Table 3: Age and sex wise distribution of Pulmonary function (FEV1/FVC%) according to BMI

	Male (%)				Female (%)				Total (%)			
Age Group(yrs)	30-49	50-79	>80	Total	30-49	50-79	>80	Total	30-49	50-79	>80	Grand Total
<20*	2	21	23	46	0	19	18	37	2	40	41	83
	(4.3)	(45.7)	(50.0)	(100)	(0)	(51.4)	(48.6)	(100)	(2.4)	(48.2)	(49.4)	(100)
>=20-24	2	30	35	67	0	15	32	47	2	45	67	114
	(3.0)	(44.8)	(52.2)	(100)	(0)	(31.9)	(68.1)	(100)	(1.8)	(39.5)	(58.8)	(100)
>=25-29	0	8	19	27	1	10	27	38	1	18	46	65
	(0)	(29.7)	(70.3)	(100)	(2.6)	(26.3)	(71.1)	(100)	(1.5)	(27.7)	(70.8)	(100)
>=30*	0	5	10	15	0	8	15	23	0	13	25	38
	(0)	(33.3)	(66.7)	(100)	(0)	(34.8)	(65.2)	(100)	(0)	(34.2)	(65.8)	(100)
Total	4	64	87	155	1	52	92	145	5	116	179	300

*p<0.05

Table 4: Pulmonary Function (FEV1/FVC %) in relation to Handgrip strength

	Male (%)				Female (%)				Total (%)			
Handgrip strength (kg)	30-49	50-79	>80	Total	30-49	50-79	>80	Total	30-49	50-79	>80	Grand Total
<15*	1	1	2	4	0	16	22	38	1	17	24	42
	(25)	(25)	(50)	(100)	(0)	(42.1)	(57.9)	(100)	(2.4)	(40.5)	(57.1)	(100)
16-30	1	42	49	92	1	32	60	93	2	74	109	185
	(1.1)	(45.6)	(53.3)	(100)	(1.1)	(34.4)	(64.5)	(100)	(1.1)	(40)	(58.9)	(100)
>30*	2	18	33	53	0	2	2	4	2	20	35	57
	(3.8)	(34)	(62.2)	(100)	(0)	(50)	(50)	(100)	(3.5)	(35.1)	(61.4)	(100)
CNP@	0	3	3	6	0	2	8	10	0	5	11	16
	(0.0)	(50)	(50)	(100)	(0)	(20)	(80)	(100)	(0)	(31.3)	(68.8)	(100)
Total	4	64	87	155	1	52	92	145	5	116	179	300

@- Could not be performed. *(p<0.05)

till 30. This relation was found to be applicable for both male and female elderly. Bottai M et al and Amara CE et al reported that BMI < 20 and > 30 are negatively associated with lung functions.[14,15] BMI is an indicator of nutritional status. Low BMI is found in malnutrition, malignancy, chronic illnesses and advanced age. Respiratory muscle mass and strength also decrease with decrease in BMI and cause impaired lung functions. Obesity (high BMI) also causes decline in pulmonary functions. Peripheral airway obstruction, increased pulmonary vascular resistance and increased respiratory muscle workload are the suggested mechanisms.

There was significantly better FEV$_1$/FVC % observed in males with increased handgrip strength in our study (p<0.05). Kronmal RA et al also reported similar association between handgrip strength and pulmonary function.[16] Handgrip strength is considered as indicator of muscle strength and functional ability which are also the factors determining the respiratory functions.

Table 5: Pulmonary function (FEV1/FVC %) according to smoking habits

	Male (%)				Female (%)				Total (%)			
Smoking	30-49	50-79	>80	Total	30-49	50-79	>80	Total	30-49	50-79	>80	Grand Total
Yes*	3 (4.5)	28 (42.4)	35 (53.1)	66 (100)	1 (4.5)	10 (45.5)	11 (50)	22 (100)	4 (4.5)	38 (43.2)	46 (52.3)	88 (100)
No	1 (1.1)	36 (40.5)	52 (58.4)	89 (100)	0 (0)	42 (34.1)	81 (65.9)	123 (100)	1 (0.5)	78 (36.8)	133 (62.7)	212 (100)
Total	4	64	87	155	1	52	92	145	5	116	179	300

* $p < 0.05$

Table 6: Lung Functions (FEV1/FVC %) in Coronary Artery Disease

	Male (%)				Female (%)				Total (%)			
IHD	30-49	50-79	>80	Total	30-49	50-79	>80	Total	30-49	50-79	>80	Grand Total
Yes	2 (6.4)	15 (48.4)	14 (45.2)	31 (100)	0 (0)	7 (29.1)	17 (70.9)	24 (100)	2 (3.6)	22 (40)	31 (56.4)	55 (100)
No	2 (1.6)	49 (39.5)	73 (58.9)	124 (100)	1 (0.8)	45 (37.2)	75 (62.0)	121 (100)	3 (1.2)	94 (38.4)	148 (60.4)	245 (100)
Total	4	64	87	155	1	52	92	145	5	116	179	300

* $p < 0.05$

Table 7: Pulmonary function (FEV1/FVC %) in Hypertension

	Male (%)				Female (%)				Total (%)			
HTN	30-49	50-79	>80	Total	30-49	50-79	>80	Total	30-49	50-79	>80	Grand Total
Yes*	1 (1.3)	35 (44.3)	43 (54.4)	79 (100)	0 (0)	31 (37.3)	52 (62.7)	83 (100)	1 (0.6)	66 (40.7)	95 (58.6)	162 (100)
No	3 (3.9)	29 (38.2)	44 (57.9)	76 (100)	1 (1.6)	21 (33.9)	40 (64.5)	62 (100)	4 (2.9)	50 (36.2)	84 (60.9)	138 (100)
Total	4	64	87	155	1	52	92	145	5	116	179	300

* $p < 0.05$

There was significantly better FEV_1/FVC% observed in nonsmokers ($p<0.05$). Impairment in pulmonary functions with smoking is a well-known fact reported in literature.[6, 15, 17,18]

Mean FEV_1/FVC % was lower in elderly with Ischaemic Heart Disease (IHD). Among male elderly with IHD 54.8 % had poor pulmonary function in comparison to non IHD population (41.1%) which was

Table 8: Pulmonary function (FEV1/FVC %) in Diabetes Mellitus

	Male (%)				Female (%)				Total (%)			
DM	30-49	50-79	>80	Total	30-49	50-79	>80	Total	30-49	50-79	>80	Grand Total
Yes*	1 (4.3)	6 (26.1)	16 (69.6)	23 (100)	0 (0)	10 (71.4)	4 (28.6)*	14 (100)	1 (2.7)	16 (43.2)	20 (54.1)	37 (100)
No	3 (2.3)	58 (43.9)	71 (53.8)	132 (100)	1 (0.7)	42 (32.1)	88 (67.2)	131 (100)	4 (1.5)	100 (38)	159 (60.5)	263 (100)
Total	4	64	87	155	1	52	92	145	5	116	179	300

* $p < 0.05$

significant ($p<0.05$). However our study failed to prove the same in female elderly. Higgins M et al, Enright et al, and Davis TM et al, reported impairment of pulmonary function in population with IHD. [9,12,19,20] IHD associated congestive heart failure and elevated pulmonary pressure may cause impairment in pulmonary function.[12]

Mean FEV_1/FVC% was significantly lower in hypertensive elderly as compared to normotensives ($p<0.05$). The association of hypertension and altered pulmonary function has already been observed in past. [12, 20, 21] Though the cause remains obscure, the possible mechanisms suggested are increased left ventricular hypertrophy, congestive heart failure and increased pulmonary and systemic vascular resistance as well as stiffness.

Mean FEV_1/FVC% was significantly lower in diabetic elderly as compared to nondiabetics ($p<0.05$). Lange P et al and Meo SA et al had the similar observations of declined pulmonary function in diabetes mellitus.[22,23] Diabetes associated vascular changes and other co morbidities appear to be the cause.

Conclusion

Thus present study proves age associated significant decline in pulmonary function. This impairment is more with co morbidities like hypertension, diabetes mellitus, coronary artery disease, and smoking. BMI and hand grip strength also influence the lung functions.

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