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RESEARCH ARTICLE

Evaluation of respiratory function in physically active elderly males in comparison to males having sedentary lifestyle

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ABSTRACT

Background: Various studies showed that physically active geriatric population remain more physically fit than their sedentary peers. Various respiratory functional changes occur as the age progresses. Benefits of regular exercise in lowering risk of early death, stroke, coronary artery disease, and incidences of hypertension have been proven. **Aims and Objective:** To study the effect of ageing on respiratory system in elderly persons. **Material and Methods:** Subjects were divided into two groups according their physical activity level into test group and control group. The test group consist of subjects having higher physical activity, whereas sedentary subjects were included in the control group. Various respiratory parameters were measured by spirometry. **Result:** The study found that physically active elderly had significantly higher pulmonary function compared to their sedentary peers: Forced vital capacity (FVC) in liters (2.58 ± 1.03 vs. 1.99 ± 0.81; $P < 0.01$), forced expiratory volume (FEV1) in liters (1.79 ± 0.68 vs. 1.26 ± 0.53; $P < 0.0007$), peak expiratory and inspiratory flow rates (PEFR) in liters per second (5.51 ± 1.64 vs. 3.35 ± 1.27; $P < 0.0001$), maximum voluntary ventilation in liters (89.69 ± 33.81 vs. 50.36 ± 28.69; $P < 0.0001$), 40 mm endurance test in seconds (23.73 ± 9.42 vs. 16.36 ± 13.60; $P < 0.0083$), and maximum expiratory pressure in mmHg (85.57 ± 22.67 vs. 57.43 ± 24.65; $P < 0.0001$). However, the results of FEV1/FVC ratio in % (70.06 ± 12.67 vs. 66.25 ± 17.89; $P = 0.29$), forced expiratory flow 25-75 in % (1.63 ± 1.22 vs. 1.16 ± 0.78; $P = 0.068$), and breath holding time in seconds (27.66 ± 9.85 vs. 24.33 ± 9.01; $P = 0.147$) were not found significant. **Conclusion:** A regular physical activity is beneficial for the elderly in all aspects, particularly in maintaining their better pulmonary function and preventing debility and mortality from respiratory diseases.

KEY WORDS: Pulmonary Function; Exercise; Sedentary Lifestyle; Ageing

INTRODUCTION

Ageing is the lifelong process involving biological changes which starts even before we born. Commonly persons aged above 60 are considered as elderly.[1]

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One of the main features of the world population in the 20th century has been a considerable increase in absolute and relative number of older population in both developed and developing countries. This phenomenon is referred as "population ageing." Population ageing is occurring more rapidly because of rapid fertility decline and increasing life expectancy due to a medical intervention based on the use of advance technology and drugs. These interventions have provided effective means to treat and prevent many diseases that used to kill people prematurely. Also of importance is the fact that the population ageing in the developing world is accompanied by persistent poverty.[2]

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Various studies showed that physically active geriatric population remain more physically fit than their sedentary peers. Active old age population are vibrant and essential contributors to the development and stability of society and lessen the social burden.

Various respiratory functional changes occur as the age progresses. The elderly have increased residual lung volume as compared to adults, vital capacity gradually declines while total lung volume and tidal volume remain relatively unchanged. Maximum available oxygen concentration starts falling in the elderly. Forced expiratory volume at 1 s (FEV1) and forced vital capacity (FVC) decreases as the age progresses.[3] As the age progresses, gas diffusing capacity decreases leading to mismatch ventilation perfusion and ultimately high alveolar-arterial oxygen gradient. There is decrease in gas diffusing capabilities with age resulting in mismatch ventilation perfusion leading to higher alveolar-arterial oxygen gradient.[4] Peak expiratory flow also decreases with age.[5]

Primary aim of the exercise is to improve the health by planned, structured, repetitive physical activity. Regular exercise helps to improve cardiorespiratory and muscular fitness in the elderly. Benefits of regular exercise in lowering risk of early death, stroke, coronary artery disease, and incidences of hypertension have been proven.[6]

Evidence suggested usefulness of controlled exercise in improving peak expiratory and inspiratory flow rates (PEFR) in geriatric age group.[7] It was proven that the sedentary lifestyle could be associated with less efficient pulmonary function. Involvement in certain physical activity or sports could help in respiratory muscle strengthening and improvement in pulmonary function.[8]

Based on these findings, this study was planned to study the effect of ageing on respiratory system in the elderly persons.

MATERIAL AND METHODS

All subjects participating in the study were apparently healthy males between the ages of 60 and 80. They were non-smokers without any history of pulmonary disease such as asthma or emphysema. Subjects were assigned to two different groups - test group and control group. Subjects who were either going for swimming or walking regularly at least for 150 min a weak were enrolled in test group. The control subjects were males having a sedentary lifestyle and were selected from old age homes in the city. The sedentary lifestyle was defined as per center for disease control and prevention, as no leisure-time physical activity, or activities done for <20 min or fewer than 3 times/week.

The test subjects were called studied at institute between 9 A.M and 12 A.M. For the control group, the spirometer was taken to the old age home and the examination was carried out between 9 A.M and 12 A.M. Assessment of the general health and activity level were measured. Anthropometric measurements were taken and recorded followed by a thorough systemic examination.

The subjects were explained the purpose and importance of the study. Only those who consented and appeared to be motivated were selected for the study. All the parameters were recorded throughout by the same instruments to avoid the instrumental errors.

For measurement of height and weight, Detecto-Scales Inc., Brooklyn, NY., USA, model No. 239 of capacity 140 kg was used. MEDI:: SPIRO digital spirometry system was used to measure the respiratory functions.

Standard Anthropometric measurements, weight (kg), Height (cm), Hip, and waist circumference (cms) were measured. From these measurements, body surface area (BSA) in square meter and waist/hip ratio were calculated. Subjects were made to rest for 10 min and pulse rate and blood pressure systolic and diastolic were noted.

Name, age, sex, height, and weight were filled in the computer. These data were used for obtaining age and height corrected predicted values. Smoking status and nationality data were also filled in the computer.

Each pulmonary function test was fully explained and demonstrated to each subject. Once the subject acknowledged understanding of the procedure, they were allowed to rehearse before recording of test results began. Spirometry was done in erect sitting posture and by applying a nose clip. The mouthpiece was held tightly between lips.

For FVC manoeuvre, subjects were instructed to breath quietly for two tidal breaths and then take a deep maximal inspiration followed by breathing out forcefully as fast and as complete as possible. Graphic record and values of FVC and its components were obtained.

For maximum voluntary ventilation (MVV) manoeuvre, the subject performed inspiration and expiration as fast as and as deep as possible for 10 s and computed values for MVV/min were obtained.

The data were obtained through the computer printer. All the spirometric values were automatically corrected to BTPS. The subject performed the above manoeuvre three times and the best result among the three was selected.

Computerized spirometric records showed following results: FVC, FEV in 0.5 and 1 s (FEV0.5 and FEV1), FEV1/FVC%, PEFR and PIFR; forced expiratory flow (FEF) at 25%, 50%

and 75% of expired volume, FEF 25-75%, i.e., maximum flow rate during 25-75% of expired volume. (Earlier termed 4 as maximum mid expiratory flow rate), MVV and flow 5 volume curves. Predicted values were also obtained along with observed values. Remarks whether, flow volume and flow rates were normal or suggestive of restrictive or obstructive defects were also printed.

The subject was then instructed to sit comfortably on stool. He was asked to take deep inspiration and hold the breath as long as possible. The stopwatch was started as soon as the subject held his breath and stopped when the subject released his breath. The time was recorded. The procedure was repeated twice and the average of the two recordings was taken as the breath holding time in seconds.

For 40 mm Hg Endurance test and maximum expiratory pressure test (MEPT), a mercury manometer without pressure cuff was used. The subject was made to sit comfortably on stool and the nose clip was applied. He was instructed to take deep inspiration and to blow continuously into the mercury manometer through a rubber tube to maintain a constant pressure at 40 mm Hg. The maximum duration for which the subject could maintain the mercury column at 40 mm Hg was noted in seconds. The duration was considered as 0 s when the subject could not raise the mercury column to 40 mm Hg. The subject was given rest for 2 min. The subject was again instructed to take deep inspiration and blow into the mercury manometer tube to raise the mercury column as high as possible. The highest level at which the subject could raise the mercury column was recorded in mm Hg. This value corresponds to MEP.

The data collected from both the groups were fed into MedCalc computer software. The inbuilt unpaired *t*-test software was used to find any significant difference between the two groups.

RESULTS

In the case of anthropometric measurement, all the parameters were expressed as a mean ± standard deviation. Age of test subject was 68.27 ± 5.26 years, while in the case of control group it was 70.935 ± 5.03 years. Height was 164.76 ± 7.36 cm in test group, while in the case of control group; it was 161.61 ± 7.55 cm. Weight was 71.50 ± 12.42 kg while in the case of control group it was 66.32 ± 16.03 kg. Waist circumference in cm for test subject was 99.73 ± 10.63, while in the case of control group, it was 98.96 ± 13.79. Hip circumference in cm in test group was 99.07 ± 8.05, while in the case of control group it was 96.58 ± 8.88.

Waist to hip ratio was 0.97 ± 0.07 in control group; in the case of control group, it was 1.02 ± 0.07. BSA calculated was 1.80 ± 0.17 square meter; in test group, while it was 1.85 ± 0.80 square meter in control group. Body mass index was 26.31 ± 4.19 kg/m^2 in test subjects, while it was 25.32 ± 5.61 kg/m^2 in control group.

Systolic blood pressure was 134.04 ± 13.48 mm of Hg in control group, while it was 131.87 ± 18.42 in control group. Diastolic blood pressure was 79.61 ± 9.22 in test group, while it was 7.16 ± 8.91 mm of Hg in control group. Pulse rate was 70.95 ± 10.90/min in test group while that was 76.12 ± 11.12/min in control group.

Various respiratory function test parameters obtained by spirometry are shown in Table 1.

DISCUSSION

It is believed that people with higher level of physical activity have higher levels of fitness, which leads to improvement in cardiorespiratory fitness. Physical inactivity and low cardiorespiratory fitness are important causes of morbidity and mortality.[9,10] Pulmonary function declines as the age progresses. Declines in pulmonary function can be associated with loss of elastic recoil of the lungs.[11]

There are contradictory findings in various studies. In 1988, it was concluded that improvement in pulmonary function in older endurance athletes might be attributed to enhanced respiratory muscle function.[12] It was opposed in 2004, finding that respiratory muscle strength has no significant difference in athletes and non-athletes.[13]

FVC of the test group (2.58 ± 1.03) was found to be statistically significant in comparison to sedentary group (1.99 ± 0.81). This finding is consistent with other studies.[14] FEV1 in the physically active group (1.79 ± 0.68) was statistically highly significant ($P < 0.0007$) than that of the sedentary group (1.26 ± 0.53). Physical activity provides a small but significant contribution in FEV1 in active individuals.[15]

PEFR was higher in test group (5.51 ± 1.64) in comparison to control group (3.35 ± 1.27) which was statistically highly significant ($P < 0.0001$). It was proved that swimmers have higher PEFR in comparison to non-swimmers.[16] It was also proved that there is improvement in PEFR as the physical activity increases in elderly.[7] Comparison of FVC, FEV1 and PEFR is shown in Figure 1.

The results of FEV1/FVC ratio in % (70.06 ± 12.67 vs. 66.25 ± 17.89; $P = 0.29$), FEF 25-75 in % (1.63 ± 1.22 vs. 1.16 ± 0.78; $P = 0.068$), and breath-holding time in seconds (27.66 ± 9.85 vs. 24.33 ± 9.01; $P = 0.147$) were not found significant. Perhaps a larger sample size would have cleared the picture in a better way.

MVV was significantly higher in our study group was statistically significantly higher in comparison to sedentary

Table 1: Respiratory function test by spirometry

Parameter	UNIT	Test (physically active) group		Control (sedentary) group		*T*	*P*
		Number of subject	Mean±SD	Number of subject	Mean±SD		
FVC	L	42	2.58±1.03	31	1.99±0.81	−2.61	0.001*
FEV-05	L	42	1.16±0.57	31	0.66±0.41	−4.13	0.0001*
FEV1	L	42	1.79±0.68	31	1.26±0.53	−3.56	0.0007*
FEV3	L	36	2.31±0.99	23	1.94±0.51	−1.63	0.107
FEV1/FVC	%	42	70.06±12.67	31	66.25±17.89	−1.06	0.29
FEV-3/FVC	%	36	86.47±7.93	23	86.49±8.54	0.01	0.99
FEF25-75	%	42	1.63±1.22	31	1.16±0.78	−1.85	0.068
PEF	L/S	42	5.51±1.64	31	3.35±1.27	−6.09	0.0001*
FEF-25	L/S	42	4.57±1.93	31	2.70±1.22	−4.73	0.0001*
FEF-50	L/S	42	2.31±1.37	31	1.59±1.02	−2.43	0.017*
FEF-75	L/S	42	0.61±0.65	31	0.53±0.48	−0.61	0.53
FIV-1/FIVC	%	32	84.02±16.69	22	72.32±24.76	−2.07	0.042*
MVV	L	42	89.69±33.81	31	50.36±28.69	−5.23	0.0001*
BHT	S	42	27.66±9.85	30	24.33±9.01	−1.46	0.147
40endur	S	42	23.73±9.42	30	16.36±13.60	−2.71	0.0083*
MEPT	mmHg	42	85.57±22.67	30	57.43±24.65	−5.00	0.0001*

FVC: Forced vital capacity, FEV: Forced expiratory volume, FEF: Forced expiratory flow, PEF: Peak expiratory and inspiratory flow, MVV: Maximum voluntary ventilation, MEPT: Maximum expiratory pressure test

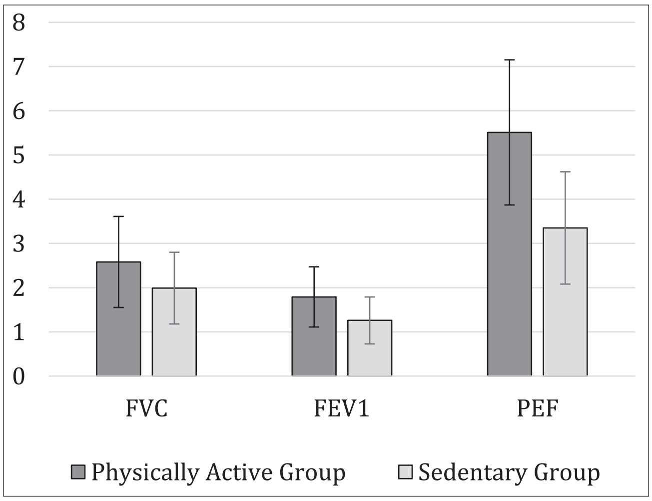

Figure 1: Comparison of forced vital capacity, forced expiratory volume 1 and peak expiratory and inspiratory flow rates in physically active and sedentary group

group. The previous studies showed similar results in active individuals in comparison to sedentary subjects.[12]

Increased strength and muscular endurance are associated with the level of physical activity.[17] Respiratory muscle strength is measured by maximum inhalational pressure, MEPT, and MVV. Studies have reported that there is a positive correlation between peripheral muscle strength and respiratory muscle strength. Individuals with lower peripheral muscle strength have an effective reduction in respiratory muscle strength.[18] MEPT in test group was significantly higher in comparison to control group in our study ($P < 0.0001$). 40 mm endurance test result also show statistically significant difference between two groups. These findings are consistent with previous studies.[18]

It appears that exercise in older subjects may have either slowed the rate of deterioration associated with aging or was capable of increasing these pulmonary measures; this trend may not be evident in the younger individuals because the age-associated deterioration have not yet begun to occur. Physically active elderly maintained their pulmonary function well above average elderly values and hence they are at an advantage of better pulmonary reserve when they are affected by disease or other debilitating conditions.

CONCLUSION

In conclusion, regular physical activity is beneficial for the elderly in all aspects, particularly in maintaining their better pulmonary function and preventing debility and mortality from respiratory diseases.

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