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RESEARCH ARTICLE

EFFECT OF DIFFERENT BODY POSITIONS ON PEAK EXPIRATORY FLOW RATE IN YOUNG OLD ELDERLY

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ABSTRACT

Background: Young old elderly are the individuals in the age of 65-74 years. Changes due to aging leads to increased static air trapping, work of breathing & decreases overall pulmonary function including Peak expiratory flow rate (PEFR). Due to these changes, specific body positioning can cause improvement or deterioration in lung function. There is no evidence of PEFR in different body positions in young old elderly individuals.

Objectives:

- To evaluate the effects of different body positions on peak expiratory flow rate in Young old elderly, in which the positions are
  Standing
  Sitting in chair
  Semi-Fowler's position
  Supine
- To find out the position in which the PEFR value is greatest.

Methodology: Ethics approval & participant consent was taken. Study design was cross section observational study. 100 subjects were included. Subjects with the age of 65-74 years with no history of any respiratory distress 6 months before the study were included. Individuals with obstructive or restrictive lung diseases, major vision/auditory problem, neurological problems were excluded. Correct instructions were given to the patients according to the guidelines of National Institute of Health. PEFR was then taken in Standing, Sitting, Semi Fowler's & Supine position & readings were taken. SPSS 16.0 software was used to analyze the data. Data was tested for normality using Shapiro Wilk test. Results were analyzed using Friedman test. Level of significance was set at 5%.

Result: 1) Peak expiratory flow rate achieved by young old elderly individuals were significantly affected by body positions ($p<0.0001$). 2)Standing generated the highest PEFR amongst all 4 positions followed by Sitting, then Semi Folwer's while Supine generated the least PEFR.

Conclusion: There is a significant effect of different body positions on peak expiratory flow rate in young old elderly. According to the study, Standing is the best position in terms of PEFR following by Sitting, Semi fowler's and then Supine which has least PEFR value. It can also be concluded that forced expiratory maneuvers can be best performed in standing position in young old elderly individuals. It was also found that the more the upright position, better is the PEFR value.

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INTRODUCTION

Better medical care and resultant low mortality rates have led to an increase in geriatric population in both the developed and the developing countries. Therefore in coming years, many challenges will arrive in front of health care providers to ensure good quality of life for the elderly population in India and to make their aging a successful process (Jansen's, 2005). Gerontologists have identified sub groups in elderly with 1) young old: 65-74 years 2) Middle old: 75-80 years 3) Old old: above 80 years.

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The natural process of aging involves a lot of changes in all the systems of human body including cardio-respiratory system (Andrew Guccione, 2000). Changes of respiratory system includes geometric modification of the rib cage, reduced elastic recoil of the lung & sarcopenia that affects the respiratory muscle performances & lung function(5). Due to reduced elastic recoil & other respiratory system changes due to aging, there is reduction in Peak Expiratory Flow rate. PEFR is one of the convenient test and it measures the ease with which the lungs are ventilated. Lung function of our body is varied by the position of the body which in turn is influenced by gravity. Body positioning is prescribed by physical therapists to directly enhance oxygen transport and oxygenation, to minimize the risk of aspiration and to drain the pulmonary secretions. With the effects of gravity & positioning, lung function can be improved, maintained or worsened with changes in body position (Siva, 2015). In this study, PEFR is measured in 4 different positions in young old elderly which includes Standing, Sitting in chair, Semi Fowler's position & Supine lying.

Need of the Study

PEFR is one of the convenient method of measuring lung function & can be measured by untrained individuals with an inexpensive Mini-Wright peak flow meter (Parminder Kaur Sandhu, 2015). As higher the PEFR , the greater the elastic recoil of the lungs and chest wall and the expiratory muscles are at a more optimal part of the length tension relationship curve which are capable of generating higher intra thoracic pressure (Siva, 2015). The position in which the PEFR is greatest enhances oxygen transport will significantly reduce the WOB and thereby minimizes associated breathlessness and fatigue. In this way, a greater proportion of time can be spent in beneficial position in which PEFR value is greatest and less in deleterious position in which PEFR value is lowest. High respiratory flow rate is required for the production of strong and effective expiratory maneuvers. Thus, coughing and other forced expiratory maneuvers can be encouraged in this position. This will further help the elderly individual by aiding in activities of daily living and improving quality of life. Many individuals in young old elderly group are ambulatory & self sufficient to do their ADL & their lung function is not severely hampered. The results will be analyzed to see whether there is any effect of body positions on PEFR in young old elderly people. By understanding how PEFR is affected by different body positions, physiotherapists can advise their elderly patients, the positional changes in their daily activities that may help in preventing further complications.

Aim

To study the effect of various body positions on peak expiratory flow rate in young old elderly individuals.

Objectives

- To evaluate the effects of different body positions on peak expiratory flow rate in elderly individuals, the positions are 1. Standing 2. Sitting in chair 3. Semi Fowler's position 4. Supine.
- To find out the most effective body position in elderly individuals.

HYPOTHESIS

Null Hypothesis: There will be no significant difference in PEFR measurements in young old elderly in different body positions.

Alternate Hypothesis: There will be significant difference in PEFR measurements in different body positions in young old elderly individuals.

Selection Criteria

Inclusion Criteria

- Healthy young old elderly individuals with age 65-74 years
- No history of any respiratory disorder or distress 6 months before the study.
- Ability to understand the purpose of the study.
- Voluntary consent to participate

Exclusion Criteria

- If the individual suffers from any type of obstructive or restrictive lung disease.
- Major traumatic injuries
- Major vision/auditory problem.
- Any major Neurological or neuromuscular disorders.
- Major cardiac problems with grade 2-4 on NHYA scale
- Major respiratory problems with grade 2-5 on MMRC scale
- Inability to understand the study and co-operate.

Study Design

Research Design: Cross sectional observational study.

Sample Population: Elderly individuals with age>65 years.

SAMPLE SIZE: Comparison of mean method

$n = \{(Z_{1-\alpha} + Z_{1-\beta})^2 (\sigma_1^2 + \sigma_2^2)\} / (\mu_1 - \mu_2)^2$

Thus the total sample size will be taken as 100 for this study.

Type of sampling: Conventional sampling.

Source of sampling: Patient's relatives coming to tertiary health care centre.

MATERIALS AND METHODS

To measure the PEFR, Wright's peak flow meter is used. PEFR IS measured in 4 different positions i:e standing, sitting, supine, semi Fowler's position. The correct instructions for PEFR technique are given according to guidelines of National Institute of Health, they were as follows.

- Move indicator to the bottom of numbered scale.
- Stand up
- Place mouthpiece into your mouth and close your lips around it. Do not put your tongue inside hole.
- Place nose clip on the nose.
- Blow out as hard and as fast as you can in a single blow.

The steps are repeated 3 times and the best of 3 attempts were used for analysis. The same maneuver is performed in sitting , supine, semi fowlers position (Nikita, 2016). Participants are instructed to rest in each of the specified position approximately for 10 minutes prior to measurement (Krista Coleman, 2003). Between two different positions, sufficient time interval will be given so that the subject stabilizes and normalizes. In case the subject gives sign that fit into termination criteria, the procedure will be stopped and no further evaluation will be continued. The data collected will be analyzed using proper statistical tests.

RESULTS

- Results shows that Peak expiratory flow rate achieved by young old elderly individuals were significantly affected by body positions.

Descriptive Statistics

Postures	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Standing	100	3.7145E2	89.24863	8.924	190.00	600.00
Sitting		3.4980E2	84.71855	8.471	185.00	590.00
Supine		3.2735E2	82.14749	8.214	155.00	560.00
Semi Fowler's		3.3975E2	82.52142	8.252	170.00	550.00

Ranks

Positions	Mean Rank
Standing	3.56
Sitting	2.80
Supine	1.50
Semi_Fowler's	2.14

Test Statistics

N			100
Chi-Square			144.916
Df			3
Asymp. Sig.			>0.0001
Monte Carlo Sig.		Sig.	.0001
	95% Confidence Interval	Lower Bound	.0001
		Upper Bound	.030

χr^2 critical value – 144.916
level of significance – 0.05

Posture	Mean	Standard deviation	Coeffecient of variation
Standing	371.35	89.24	24.03
Sitting	349.80	84.71	24.21
Supine	327.35	82.14	25.09
Semi Fowler's	339.75	82.52	24.28

- Standing generated the highest PEFR amongst all 4 positions followed by Sitting, then Semi Fowler's while Supine generated the least PEFR.
- Level of significance was set at 5%.
- Results were analyzed using Freidman's Test.

From the table, it is observed that the χr^2 statistical value χr^2= 144.916 are significant at 5% level of significance. The p value of >0.001 showing extreme significance. It implies that mean values of peak expiratory flow rate differ significantly with different body positions. To determine which position is more consistent, co-efficient of variation was calculated. From the table, it is observed that the coefficient of variation is least for standing position compared to sitting, supine and Semi Fowler's position. The less the coefficient of variation, the more the consistency. From the results, standing position is the most consistent position followed by sitting position. The consistency of the positions for peak expiratory flow rate in young old elderly individuals are in the order of Standing>Sitting>Semi Fowler's>Supine.

DISCUSSION

In this study, standing position generated the maximum PEFR value in young old elderly individuals which was followed by sitting, Semi Fowler's position while supine recorded the least PEFR value.

Standing

The upright standing position maximizes lung volumes and capacities. It is due to

- Less closing capacity in standing causes more the elastic recoil of the lungs and PEFR increases.
- Upright position increases the main airway diameter slightly with lesser compression of heart and lungs. This causes reopening of compressed alveoli (Donna Frownfelter, 1996).
- Pulling of the abdominal contents caudally within the abdominal cavity due to gravity, increasing the diameter of the thorax (Castle, 1982).
- The thorax remains unrestricted to expand in all directions by the inspiratory muscles (Charbel Badr, 2002 and Bartolome, 2000).
- The shortened position of the diaphragmatic fibers is countered by an increase in the neural drive to breathe in the upright position (Druz, 1982).

Sitting

Chair sitting leads to second highest PEFR following standing due to

- Young old elderly individuals taking less inspiration than standing position due to the upward displacement of the diaphragm.
- In sitting position, the back of the chair may restrict full thoracic expansion and it may results in lower lung volumes.
- Hip flexion required in chair sitting moves the diaphragm cephalad as the abdominal contents are pushed upwards. In young old elderly, there is a decrease in abdominal tone as well as strength. Due to the reduced length of the abdominal muscles, PEFR is further reduced.

Supine

Supine position leads to lowest PEFR value in our study. It is due to

- In young old elderly people, supine position causes the diaphragm to move 4cms higher and there is reduction in FRC (Nunns, 2000). More posterior excursion of the diaphragm.
- The normal anteroposterior configuration becomes more transverse (Donna Frownfelter, 1996).
- The diaphragm is pulled upward due to pressure of abdominal viscera (Jayapal, 2016).
- Reduction in the vertical gravitational gradient causing increased closure of the dependent airways and thus reduced PEFR.
- Increase in intrathoracic blood volume also contributes to a reduction in FRC, lung compliance and increased airway resistance.
- Collectively, these factors predispose the patient to airway closure and an increased work of breathing leading to reduction in PEFR (Castle, 1982).

Semi Fowler's

Semi Fowler's position leads to second lowest PEFR value after supine. It may be due to

- Reduction in the vertical gravitational gradient in Semi Fowler's position as compared to sitting.
- As it is a semi recumbent position, diaphragm position is slightly higher than that of sitting position. Thus, lung volume is slightly lower than sitting.

Thereby, when we recommend positioning in young old elderly patients for any respiratory disease, standing position should be the most preferred position. If the patient cannot stand, sitting is the second best position and it can be used in these patients.

Conclusion

- The study concluded that there is a significant effect of different body positions on peak expiratory flow rate in young old elderly.
- According to the study, standing is the best position in terms of PEFR following by sitting, Semi fowler's and then supine which has least PEFR value.
- It can also be concluded that forced expiratory maneuvers can be best performed in standing position in young old elderly individuals.
- It was also found that the more the upright position, better is the PEFR value.

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