Original Research Paper

Volume-9 | Issue-4 | April-2019 | PRINT ISSN No 2249-555X

Physiotherapy

ASSESSMENT OF PEAK EXPIRATORY FLOW RATE IN FIREFIGHTERS: AN OBSERVATIONAL STUDY

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ABSTRACT

Aim-To assess the Peak Expiratory Flow Rate in firefighters.

Need of study- Firefighters have continuous exposure to fumes and thus are at risk of compromised respiratory function. Smoke exposure has also been associated with a systemic inflammatory response further leads to acute airway inflammation. Firefighters use self-contained breathing apparatus to prevent smoke exposure but these apparatus not often and continuously used during firefighting. Peak expiratory flow rate measures the airflow through the bronchi. And PEFR helps in detecting early stages of airway obstruction. Thus, there is need to evaluate Peak Expiratory Flow Rate in firefighters.

Study Design- Cross Sectional Study.

Procedure-Ethical approval was taken by the Fire Bridget Officer. Total 202 Firefighters were selected according to inclusion and exclusion criteria. Informed consent was obtained. Procedure was explained to them, PEFR was recorded in sitting position, Best of 3 reading were taken. Predicated PEFR was calculated by the equation. And data was analyzed for result.

Result- The descriptive type of Statistical analysis was done which shows that PEFR decreases according to work experience and age.

Conclusion-we conclude that PEFR decreases according to work experience and also the PEFR decreases according to age. Considering both work experience and age we can focus more on breathing exercises as both increases.

KEYWORDS : Peak Expiratory Flow Rate, Firefighters,

INTRODUCTION

Firefighting is heavily stressed occupation.[1]Firefighters face serious risks at the job place.[2]They face flames, physical and mental stress and high levels carbon monoxide and other toxic risks in the areas around fires.[2]The lungs are exposed to fire smoke and toxic vapors etc.[2]

Fire smoke is toxic mixture of dangerous gases and dangerous for firefighters and responders suffered by headaches, nausea, sore throats. Firefighters have average lung function due exposure of smoke and fumes[3]. It has been observe that firefighters have more respiratory symptoms at work and suffer more often from atopy[4].

Fire produces hazardous substances like complex particulate matter, respiratory irritants, systemic toxins including asphyxiants. Exposure of substances like systemic toxins affects the parts of the body then the organs[5]. Fire smoke produces carbon monoxide which enters in the body via the lung and combines with haemoglobin in the blood to form carboxyhaemoglobin. This carboxyhaemoglobin is ineffective for delivering oxygen to bodily tissues.[5]It has been observed that respiratory irritants contains the substances which is source for non-specific inflammation of the lung.[5]As per water- solubility and concentration damage mainly occur in upper or the lower respiratory airways.[5]It has been observed that particles act as vehicles of absorbed toxicants into the respiratory tract.[5] Respiratory tract contains nasopharyngeal region, trachea, bronchi, bronchioles and alveoli. Particles between 5-30micron affected on the nasopharyngeal region. Particles between 1-5 micron affected on the large airways of the trachea, bronchi and bronchioles. Particles smaller than 1micron affected the alveoli.[5]

The peak expiratory flow rate is measured with help of Standardized Peak Flow Meter.[6] Peak flow meter device is designed to indicate the greatest expiratory flow rate.[7] Peak expiratory flow rate is a person's maximum speed of expiration. Peak expiratory flow has been correlated with age, height, and body surface area.[8] Also it has been observed that the PEFR decrease with increase in years of exposure to smoke and the fall was neither accounted for by age nor height. Normal values in adults range from 400-1200 L/min.[7]

For lung functions peak expiratory flow rate(PEFR) is the simplest appraisal.[9] Peak expiratory flow rate indicates severity of airflow limitation.[9]Peak expiratory flow meter (PEFM) is a device used to measured Peak expiratory flow rate (PEFR).[9] This device is used to measure the gas flow.[7] Peak expiratory flow meter (PEFM) is a simple, easy to handled and inexpensive device.[9] It has diagnostic and prognostic value in patients with reactive airway disease.[9]

METHODOLOGY

- Population-Firefighter workers in and around Mumbai (working for at least 5 years)
- Location-Mumbai
- Study type-Observational
- Study Design-Cross Sectional
- Sample size – 202

MATERIALS

1. Wright's Peak expiratory flow meter.
2. Height Meter Scale

OUTCOME MEASURE

- Peak expiratory flow rate

PROCEDURE

1. Ethical approval was taken by the Firebridget Offices.
2. Firefighters were selected according to inclusion and exclusion criteria . and procedure was explained to them
3. Informed consent was obtained
4. All the parameters (Age, Height, Weight and Work of Experience) were noted .
5. PEFR was recorded in sitting position –

- Firefighters were seated in a back supported chair
- Asked them to relax their upper body(Shoulder girdle)
- Asked them to hold the Peak Expiratory Flow Meter tightly in mouth and told them to take a deep breath and exhale forcefully in the peak flow meter.
- Same procedure was repeated for 3 times.

6. Predicted PEFR was calculated from equation

Equation[14] -

Males- PEFR=-1.807(Age)+3.206(Height)

Females-PEFR=-1.454(Age)+2.368(Height)

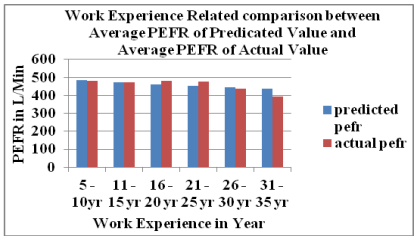
7. Data was analyzed for results.

Data Analysis and Interpretation

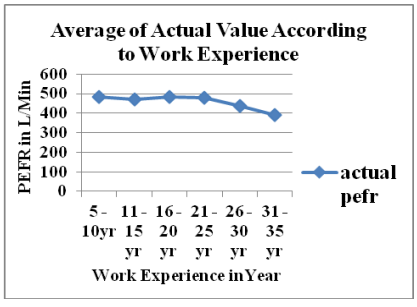
- According to work experience -A total 202 firefighters were taken out of which 56 firefighters having 5-10years of work experience, 26 firefighters having 11-15years of work experience, 19 firefighters having 16- 20years of work experience,45 firefighters having 21-25years of work experience, 51 firefighters having 26-30years of work experience,5 firefighters having 31-35years of work experience.

- Work experience related comparison between Average PEFR of Predicated Value and Average PEFR of Actual Value and their Standard Deviation.

No. of Individuals	Work Experience Range	Predicated ValueSD	Actual ValueSD
56	5-10yr	483.2744.77	481.6198.4
26	11-15yr	473.3519.46	472.3197.38
19	16-20yr	462.0518.61	482.6371.64
45	21-25yr	454.3621.35	477.7898.09
51	26-30yr	445.2218.78	438.43112.02
5	31-35yr	437.813.42	392 132.74

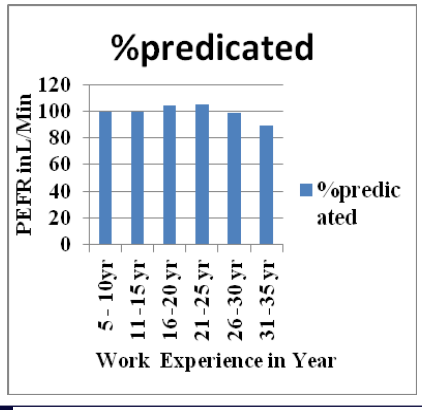


- As per graph the Average PEFR of Predicated Value and Actual Value is nearly similar in work experience 5-10yrs,11-15 yrs with respective values
- 483.2 ± 44.77 (Predicated Value), 481.61± 98.4(Actual Value) , 473.35 ± 19.46(Predicated Value), 472.31 ± 97.38 (Actual Value).
- From Average PEFR of Predicated Value and Actual Value the Average Actual Value is increases in work experience 16-20yrs, 21-25yrs with respective values 462.05 ± 18.61 (Predicated Value), 482.63 ±71.74 (Actual Value), 454.36 ± 21.35 (Predicated Value), 477.78 ± 98.09 (Actual Value).
- From Average PEFR of Predicated Value and Actual Value the Average Actual Value is increase in work experience 36-40yrs with values-456 ± 0(Predicated Value), 52 ± 0 (Actual Value).



- Initially the average actual value is near normal from the baseline for 5-10yrs,11-15yrs, 16-20yrs and 21-25yrs of work experience it drop down for 26-30yrs, and 31-35yrs of work experience .
- Work experience related to percentage predicated value

No. of Individuals	Work Experience	% Predicated
56	5-10yr	99.66
26	11-15yr	99.78
19	16-20yr	104.45
45	21-25yr	105.15
51	26-30yr	98.47
5	31-35yr	89.54



- As per graph, according to work experience percentage predicated value near normal to the baseline in work experience 5-10years and 11-15years with 99.66% and 99.78% respectively.
- The percentage predicated is increasing in 16-20years and 21-25 years of work experience with 104.45% and 105.15% respectively.
- The percentage predicated is decreasing in 26-30years and 31-35years of work experience with 98.47% and 89.54% respectively.

DISCUSSION

Firefighters are frequently exposed to significant concentrations of hazardous materials including carbon monoxide, benzene, sulphurdioxide, hydrogen cyanide, aldehydes, hydrogen chloride, dichlorofluoromethane and particulates [8] .The filtering mechanism of lung becomes overloaded and get damaged once they are damaged by various bacteria, viruses etc. they are more likely to grow in the lungs and caused infections.

During this study we found that Average Actual Value is decreasing as compared to Average Predicated Value in work experience 26-30yrs and 31-35yrs due to age related changes takes place in them and also there is obesity in those group participants. Most likely in this group age related changes may have occurred and also most of the participants ,obesity may have affected PEFR. Some studies also have found that the obesity is the cause for decline of various respiratory functions and also decrease in distensibility of chest wall or limited expansion of thoracic cavity.[12] Maximal inspiratory and expiratory pressures have been reported to decrease 15% between the sixth and eighth decades[11] Some studies also have found that PEFR declines with advancing age due to degenerative changes in musculoskeletal system leading to decrease in respiratory muscle strength.[15]

Also we found that as per graph of percentage predicated value, the PEFR is decreasing in 26-30years and 31-35years of work experience. And near normal in 5-10years, 11-15years of work experience, and increasing in 16-20years and 21-25years of work experience. As there is no change in PEFR or it is increasing in work experience of 5-10year, 11-15year,16-20year and 21-25year,some studies shows that regular yoga practice and due to danger of exposure to toxic fumes during the combustion of modern plastics, breathing apparatus is used routinely because of that no reduction of lung functions in firefighters.[3]

During this study we found that Average Actual Value is increasing as compared to Average Predicated Value in work experience 16-20yrs, 21-25yrs, and also we found that Average Actual Value and Average Predicated Value are nearly similar in work experience 5-10yrs and 11-15yrs because they are doing yoga and exercise regularly during their working period. Studies done by several researchers showed that regular practice of yoga lead to significant improvement in peak expiratory flow, vital capacity, forced vital capacity, forced expiratory volume in one second. [13] Some studies also states that, during yoga practice ,one consistently and consciously over-rides the stimuli to respiratory centers, thus acquiring control over the respiration, this improves cardiorespiratory performance.[13]

Also we found that as per graph of percentage predicated value, the PEFR is decreasing in 26-30years and 31-35years of work experience. And near normal in 5-10years, 11-15years of work experience, and increasing in 16-20years and 21-25years of work experience. As there is no change in PEFR or it is increasing in work experience of 5-10year, 11-15year,16-20year and 21-25year,some studies shows that regular yoga practice and due to danger of exposure to toxic fumes during the combustion of modern plastics, breathing apparatus is used routinely because of that no reduction of lung functions in firefighters.[5] And the PEFR is decreasing in work experience 26-30years and 31-35 years of work experience, some studies have shown that some people exposed to heavy smoke have temporary changes in lung function, which makes breathing more difficult, fire smoke contains carbon monoxide, inhalation of carbon monoxide decreases the body's oxygen supply.There is various type of smoke exposure which also contains fine particles and inhalation of fine particles can cause a respiratory irritation and shortness of breath as fine particles are able to travel deeply into the respiratory tract.[18]

CONCLUSION

Hence we can conclude that PEFR decreases according to work experience. Considering work experience we can focus more on breathing exercises.

LIMITATIONS

No. of times firefighters were exposed to fire was not considered.

RECOMMENDATIONS

PEFR can be assessed and monitored periodically in firefighters. And can also be considered as and assessment tool for them.

In future pulmonary function testing can be done in firefighters

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