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A SURVEY OF POST RUN PULMONARY PARAMETERS IN LONG DISTANCE RUNNERS WITH EXERCISE INDUCED BRONCHOSPASM IN SANGLI CITY

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ABSTRACT
Background: Pulmonary function is critical in sustaining peak physical performance, particularly in endurance sports such as long-distance running. Regular running is known to cause respiratory system adaptations, impacting such as forced vital capacity (FVC), forced expiratory volume (FEV1), and peak expiratory flow rate (PEFR). Several studies have found different effects of endurance exercise on respiratory parameters, with some indicating improvement due to training adaptations and others indicating a transitory decrease immediately after exercise.
Methodology: A study is on 174 long-distance runners who were aged 20-40 years at a marathon ground. Pulmonary function parameters (FEV 1, FVC and PEFR) were measured using a PFT device following a 5 minutes run. Additionally, the participants were provided with an assessment questionnaire to assess against respiratory symptoms.
Result: The findings indicated that the percentage of people who stated that they have persistent weakness in relation to activity even after engaging in physical exercise was 7.5%. Findings also suggest that a few may be having mild cardiorespiratory limitations that are yet unreported.
Conclusion: It emphasizes the importance of regular screening, early diagnosis, and preventive steps, like adequate warm-up, environmental management, and medical check-up. The results of the study can inform the athletes, coaches, and medical and paramedical practitioners on how to enhance respiratory health and performance.

KEYWORDS: -Long-distance running, Pulmonary function test (PFT), Exercise-induced bronchospasm (EIB), FEV 1 and PEFR, Respiratory performance.

INTRODUCTION

Exercise-induced bronchospasm (EIB) that is a transient narrowing of the airways that is manifested by the contraction of bronchial smooth muscles during or after exercise.[1] Long-distance running is a demanding sport which exerts great demands on the cardiopulmonary system. A physiological modification of the pulmonary functioning post-exercise is an escalating matter of clinical and performance importance amongst endurance athletes. This phenomenon may result in quantifiable modifications of pulmonary measurements like forced expiratory volume in one second (FEV 1), forced vital capacity (FVC), peak expiratory flow rate (PEFR) and the FEV 1 / FVC ratio. [1]The initial documentation of EIB occurred in the 1960s when decreases in FEV1 were noted in people after exercise, especially in those with airway hyper responsiveness underlying. These decreases are usually immediate after the exercise and go back to normal within 10-15 minutes. Such pulmonary changes are significant to physiotherapy practice as they can be efficiently assessed to early detect complications and improve athletic performance. The most common objective diagnostic criterion used to diagnose EIB is a post-exercise reduction of FEV 1 over 10-15%.[2]
Post-run pulmonary changes has a multifactorial pathophysiology. According to the thermal and osmotic theory, accelerated cooling and warming of airways during an exercise can cause the bronchospasm of airways. Also, cell-mediated airway inflammation (neutrophils, eosinophil and basophils) plays a role in enhancing airway sensitivity. Other environmental factors, including cold air, air pollutants, allergens, etc., only make airway reactions worse especially in outdoor athletes such as long-distance runners.[3] We require both subjective and objective assessment tools. PFTs provide objective information about the efficiency of breathing. It is useful to standardize questionnaires that assess the frequency and severity of symptoms such as cough, wheezing, tightness of chest, and dyspnoea. The assessments guide evidence-based treatments aimed at improving breathing and exercising capabilities.[4]
Non-pharmacological and pharmacological approach to post-run lung dysfunction. Although short-acting beta-agonists and other bronchodilators are a regular therapy, graded warm-up breathing exercises, airway clearance techniques and educational counselling in making environmental modifications are invaluable in prevention and rehabilitation through physiotherapy.[6] One of the objectives of optimal respiratory mechanics and reduced airway reactivity is the improvement

of the safety and performance of athletes. be expelled forcefully following the intake of the deepest possible inhalation. It shows the lung capacity and strength of respiratory muscles. It is useful in determining the efficiency of ventilators and the presence of restrictive or obstructive lung patterns in athletes.Airway hyper responsiveness is the exaggerated bronco constrictive response of the airways to different stimuli like exercise, cold air or allergens. It is one of the essential characteristics in such conditions as EIB and asthma.[8,14] Long distance running exerts significant loads on the cardiopulmonary system, and there is frequently a temporary change in pulmonary activity after exercise. Although endurance activities have been known to be correlated with exercise induced bronchospasm (EIB), scanty region-specific evidence on whether EIB does occur among long distance runners in the city of Sangli has been established.This research is needed to measure the effects of long-term running on the post-exercise pulmonary variables and also the factors that influence the changes. The knowledge of these differences will guide physiotherapists, sports clinicians, coaches, and athletes to detect respiratory dysfunction early, to maximize training programmes and adopt preventive and rehabilitative measures. Moreover, the outcomes can be used to enhance athletic performance, recovery, and long-term respiratory health of endurance runners.[9,12].

The aim of study aimed to assess the incidence of pulmonary dysfunction in long-distance runners, which was disclosed by previous research work. Primary objectives is the study aimed to assess the rate of post-run pulmonary alterations of long-distance runners at Sangali city based on Pulmonary Function Test (PFT) parameters which includes Forced Expiratory Volume in one second (FEV1), Forced Vital Capacity (FVC), Peak Expiratory Flow Rate (PEFR), and Forced Expiratory Volume in one second/Forced Vital Capacity.[8,9] Secondary objective is to use a standardized Exercise-Induced Bronchospasm (EIB) questionnaire to assess the frequency and severity of post-exercise respiratory symptoms.

MATERIALS AND METHODOLOGY:

The cross-sectional study will be carried out at marathon grounds in Sangli city over a period of six months. A total of 174 marathon runners will be selected using convenience sampling. The participants will include male and female runners aged between 20 and 40 years who have at least 5 years of experience and who take part in 10 km or 21 km races. Runners with pre-existing respiratory conditions eg, asthma, COPD, pneumonia, interstitial lung disease, will excluded. Pulmonary function will be assessed using a Pulmonary Function Test the parameters measured will include FEV_1, FVC, the FEV_1/FVC ratio, and Peak Expiratory Flow Rate . Exercise-induced bronchospasm assessment questionnaire will be assessed using a standardized 16-item questionnaire that evaluates respiratory symptoms after running.

PROCEDURE:

Upon the authorization of both the Institutional Ethics Committee and other scientific authorities, then the study will be conducted. Based on predetermined inclusion and exclusion criteria, long distance runners aged 20-40 years and having a minimum of 5 years running experience will be recruited. Informed consent will be sought in written form, having briefly explained the purpose of the study, the procedures and risks.

Pulmonary Function Tests (PFTs) will be used to measure baseline pulmonary function after 15 minutes of rest. Recording parameters will include FEV 1, FVC, PEFR as well as FEV 1/ FVC ratio. The participants will be then subjected to exercise challenge which will be 8-10 minutes of running at 80-90 percent of the maximum heart rate.

Post-exercise PFT measurements will be measured immediately after the run using standardized equipment. The test will be done under the supervision of a medical doctor, the technique will be applied correctly using disposable mouthpieces and the participants will be instructed to give their best. Up to three participants will be tested at a time to maintain accuracy and avoid interference.

The changes related to exercise will be categorized according to the reduction of the FEV 1 (mild: 1025%, moderate: 2550%, severe: >50). Other parameters like a greater than 10% reduction of FEV1/FVC and greater than 15% reduction of PEFR will also be factored in. The measures of recovery will be evaluated based on the restoration of baseline values in 30-60 minutes.

The Peak Expiratory Flow Rate (PEFR) will be further assessed with the help of peak flow meter and classified according to the percentages (green 80-100% peak flow and yellow 50-80% peak flow) to assess airway constriction severity.

A standardized Exercise-Induced Bronchospasm (EIB) questionnaire (16 questions) will be used to evaluate the subjective symptoms. The investigator will conduct the data collection, and all information of the participants will remain confidential.

OUTCOME MEASURES

PFT and PEFR : Post-exercise PFT measurements will be measured immediately after the run using standardized equipment.The changes related to exercise will be categorized according to the reduction of the FEV 1 (mild: 1025%, moderate: 2550%, severe: >50).

PEFR: The Peak Expiratory Flow Rate (PEFR) will be further assessed with the help of peak flow meter and classified according to the percentages (green 80-100% peak flow and yellow 50-80% peak flow) to assess airway constriction severity.

Exercise induced bronchospasm questionnaire Scale: The Exercise Induced Bronchospasm Questionnaire has sixteen standard questions to determine whether the symptoms of getting bronchospasm in long distance runners by posing the following questions to the participants.

SR NO	QUESTIONS	YES /NO
1	Are you allergic to any medications ?	
2	Do you have any food allergies ?	
3	Do you take any over the counter medication ?	
4	Do you ever get itching of the nose or throat or sneezing ?	
5	Do you ever have whistling sound coming out during running?	
6	Do you ever have chest tightness or chest discomfort?	
7	Are you a chronic smoker or have you quit in last 6 month?	
8	Has running ever cause breathlessness ?	
9	Do you ever experience pain or discomfort in the upper body ?	
10	Do you ever experience dizziness while exertion ?	
11	Do you consider yourself physically in active ?	
12	Do you have any physical reason to be physically inactive ?	
13	Is there family history of any medical condition?	
14	Do you daily workout and still experienced weakness ?	
15	Do you ever experienced cough during or after physical activity or mild exertion ?	
16	Have you consulted any doctor for cardiorespiratory condition ?	

STATICTICS :
The study emphasizes the significance of educating athletes and runners about respiratory symptoms, as well as periodic screening in this demographic. Given the type of data gathered, both Chi-square and ANOVA tests were deemed adequate for statistical analysis. The Chi-square test was used on nominal questionnaire responses (Yes/No) to see if there was a significant relationship between symptoms and demographic characteristics such age group, occupation, and marital status.

However, because the majority of responses were "No," there was little variation in the results. As a result, the Chi-square test likely found no significant connection ($p > 0.05$). Furthermore, several cells had anticipated frequencies less than 5 due to the low number of "Yes" replies, which violated the Chi-square test assumptions and made the results statistically unreliable. In such cases, Fisher's Exact Test might be a better option For continuous variables such as FEV1, FVC, FEV1/FVC ratio, and PEFR, ANOVA was used to compare mean lung function values among age groups (20-30 vs 31-

40), occupation, and marital status. The investigation sought to determine whether there were any significant variations in lung function between these groups. Based on the results, the pulmonary function test values were consistent with a low standard deviation, indicating limited variance across participants. As a result, the ANOVA findings most likely showed no statistically significant differences ($p > 0.05$), meaning that age, occupation, and marital status had no significant influence on lung function in this group.Overall, the statistical results point to a homogeneous sample with similar features across groups and a low prevalence or under reporting of respiratory symptoms. The Chi-square test found no significant link between demographic characteristics and questionnaire responses, while the ANOVA revealed no significant variations in lung function metrics between groups. As a result, the study suggests that there is no significant statistical relationship between demographic characteristics, lung function, and reported symptoms in the sample population.

RESULT:
The PFT results demonstrate that the mean FEV1 (70.31 ± 4.54) and FVC (73.91 ± 5.13) values are slightly lowered, indicating mildly diminished lung function among participants. However, the FEV1/FVC ratio (79.78 ± 5.24) remained near normal, indicating no major signs of obstructive lung disease. The PEFR score (392.52 ± 52.13) is within a moderate range, indicating adequate but inadequate expiratory airflow. Overall, these findings suggest modest respiratory impairment, which could be impacted by factors including exercise-induced stress, environmental exposure, or early-stage bronchospasm.
The questionnaire-based examination of knowledge and symptoms suggests that the majority of participants answered "No" to common respiratory symptoms and risk factors. Only a less percentage experienced symptoms such as weakness during exercises (7.47%), chest discomfort (1.14%), shortness of breath (1.14%), dizziness (1.14%), and food allergies (0.58%). This suggests that symptom prevalence is quite low in the study group. The analysis of questionnaire results reveals a strong tendency toward limited symptom reporting. Classic respiratory symptoms like wheezing, coughing, and sneezing were virtually nonexistent. This could indicate that symptoms are not common in this community, or that there is under reporting due to a lack of knowledge or failure to detect mild symptoms. Furthermore, none of the participants reported medication use, smoking history, or past medical consultation, indicating a severe information deficit about respiratory health and the possibility that people are ignoring or disregarding early indicators of respiratory problems. The most prevalent complaint was physical weakness during exercise (7.47%), which could suggest a lack of exercise tolerance. This could be an early sign of weariness, poor physical condition, or sub clinical bronchospasm. Other clinical symptoms, such as dyspnea, chest tightness, and dizziness, were reported at extremely low rates, suggesting that participants are either reasonably healthy or unable to effectively recognize and describe symptoms.
Distribution of patients according to PFT value

PFT Value	N	Minimum	Maximum	Mean	Std. Deviation
FEV1	174	60.00	80.00	70.31	4.54
FVC	174	62.00	91.00	73.91	5.13
FEV1/FVC	174	68.00	95.00	79.78	5.24
PEFR	174	300.00	500.00	392.52	52.13

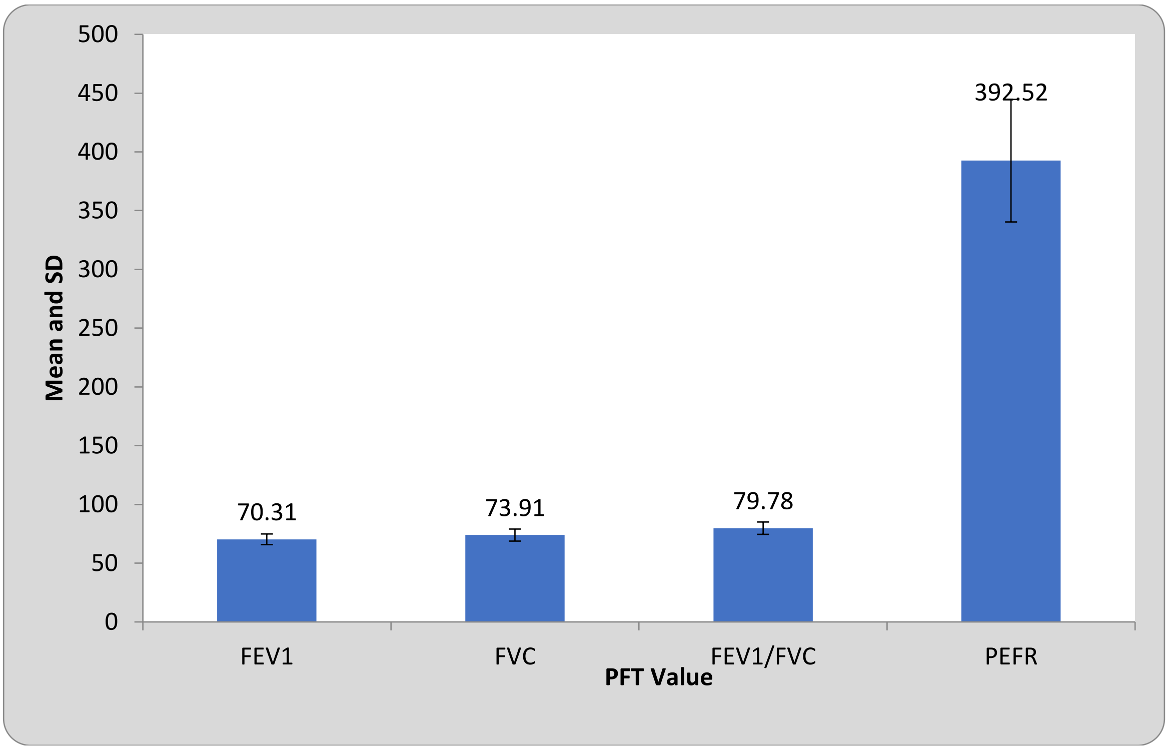

Table 5: Questionnaire (Knowledge) score Analysis.

Knowledge	Yes	No
Are you allergic to any medications?	0(0%)	174(100%)
Do you have any food allergies?	1(0.58%)	173(99.42%)
Do you take any over the counter medication?	0(0%)	174(100%)
Do you ever get itching of the nose or throat or sneezing?	0(0%)	174(100%)
Do you ever have whistling sound coming out during running?	0(0%)	174(100%)
Do you ever have chest tightness or chest discomfort?	2(1.14%)	172(95.85%)
Are you a chronic smoker or have you quit in last 6 month?	0(0%)	174(100%)
Has running ever cause breathlessness?	2(1.14%)	172(95.85%)
Do you ever experience pain or discomfort in the upper body?	0(0%)	174(100%)
Do you ever experience dizziness while exertion?	2(1.14%)	172(95.85%)
Do you consider yourself physically in active?	0(0%)	174(100%)
Do you have any physical reason to be physically inactive?	0(0%)	174(100%)
Is there family history of any medical condition?	0(0%)	174(100%)
Do you daily workout and still experienced weakness?	13(7.47%)	161(92.53%
Do you ever experience cough during or after physical activity or mild exertion?	0(0%)	174(100%)
Have you consulted any doctor for cardiorespiratory condition?	0(0%)	174(100%)

DISCUSSION

This study evaluated 174 patients between the ages of 20 and 40 who were receiving cardiovascular rehabilitation. In previous study they were having 107 athlete having age criteria was 17 to 23 yrs the result was found out that 1.8% elite having being previously diagnosed with EIB .But in this study there are different age criteria and sample size the result it comes out that nearly 7.5% experienced persistent weakness despite daily activity and mild cardiorespiratory restictions . Several noteworthy discoveries emerged that merit discussion: 1. Age and Demographic Profile The participants' average age was 29.59 ± 5.34 years, and the proportion of those in the 20–30 age group was slightly higher (53.4%) than that of those in the 31–40 age group (46.6%). This young adult population highlights the importance of early detection and intervention in cardiovascular risk management since behaviors and physical abilities developed in early adulthood can impact long-term results.

Workplace and Lifestyle Factors Nearly a quarter of patients were employed in service-related occupations (24.7%), followed by engineers (21.8%) and business owners (17.8%). These occupations tend to be sedentary, which may raise cardiovascular risk and deconditioning. However, students (17.2%) may show different levels of activity. Rehabilitation programs should therefore be tailored to the needs of the individual: students may require guidance on how to integrate regular physical activity into their academic schedules, while office workers may benefit from workplace exercise programs.

Ability to Exercise and Pulmonary Function The mean FEV_1 was 70.31 ± 4.54%, the FVC was 73.91 ± 5.13%, the FEV_1/FVC ratio was 79.78 ± 5.24%, and the PEFR was 392.52 ± 52.13 L/min, based on baseline spirometric readings. Despite being within moderate limitation levels, these data show inadequate pulmonary function that may limit exercise tolerance.Symptoms self-reported and patient awareness A nearly complete lack of medication use, allergy history, or symptomatic triggers was found in the knowledge evaluation (100% without drug allergies; >99% without food allergies or exercise-induced symptoms). Merely 7.5% experienced persistent weakness despite daily activity. This implies a high level of baseline physical stability, but it also raises the possibility that mild cardiorespiratory restrictions can go unreported. Educational modules should include symptom awareness, especially exertional dyspnea or tiredness, to ensure timely reporting and exercise intensity reduction.

Implications for Programming in Rehabilitation Specific Exercise Recommendation: Because of the mostly minor pulmonary impairments, a graded aerobic program starting at 50–60% VO_2max and rising weekly is advised. To improve tolerance without becoming overly exhausted, use interval training. Respiratory Training: By doing daily inspiratory muscle training sessions at 30% maximal inspiratory pressure, FEV_1 and PEFR can be raised over a period of 6–8 weeks. Interventions in behavior and education: Particularly for those in high-stress occupations, workshops on long-term lifestyle change—such as stress management, diet, and smoking cessation—are crucial.

LIMITATIONS AND SUGGESTIONS

- Participants are limited to long-distance runners from Sangli city only, so findings may not represent runners from other regions.
- Pulmonary parameters are assessed only after running, without long-term follow-up.
- Variations in age, gender, fitness level, training intensity, and duration of running among participants may affect results.
- Use of a cross-sectional survey design limits the ability to establish cause-and-effect relationships.
- Participants' effort during pulmonary function testing may vary and affect accuracy of readings.

- Lifestyle factors such as diet, sleep, smoking history, or previous respiratory illness may influence pulmonary parameters.
- The study may not include a control group of non-runners for comparison.

Future studies should:

- A wider age range should be added to facilitate comparisons.
- Explore the long-term compliance with rehabilitation programs.
- Include qualitative measures to enhance the subjective experience, like dyspnoea and fatigue.
- Use more sensitive diagnostic tools for detecting subclinical EIB.

CONCLUSION

- The study results revealed that exercise-induced bronchospasm (EIB) might exist in a mild or unidentified form among athletes. Although the pulmonary function had a mild value, they reported little symptoms themselves, probably indicating the under-diagnosis or lack of awareness.
- EIB is a clinically important condition that, without treatment, could affect physical activity performance and respiratory health. As such, measures for screening on pulmonary functions, as well as early intervention, are necessity.
- Proper medical advice, organized warm-up exercises and environmental management should be encouraged as strategic preventive measures. Making athletes, coaches and medical practitioners aware of EIB can aid in its early detection and treatment which will eventually improve performance and quality of life.

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