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"PREVALENCE OF EXERCISE INDUCED ASTHMA AMONG SCHOOL GOING CHILDREN IN NASHIK CITY"

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Abstract **Background:** Exercise-Induced Asthma (EIA), also known as Exercise-Induced Bronchoconstriction (EIB), is characterized by transient airway narrowing occurring during or after physical activity. It is commonly observed in children and adolescents and may significantly affect their participation in physical activities, overall fitness, and quality of life. Early identification is essential to prevent long-term respiratory complications and promote active lifestyles among school-going children. **Methodology:** A cross-sectional descriptive study was conducted among 151 school-going children aged 12–17 years in Nashik city using purposive sampling. Participants without a prior diagnosis of asthma were included. Baseline vital parameters and Peak Expiratory Flow Rate (PEFR) were recorded, followed by a 1-mile run test. Post-exercise PEFR measurements were taken at 2, 3, and 5 minutes. A reduction of more than 10% in PEFR from baseline was considered indicative of EIA. Data were analyzed using SPSS version 26, with quantitative data expressed as mean and standard deviation and qualitative data as percentages. **Results:** The mean pre-exercise PEFR was 263 L/min, which decreased to 205 L/min at 2 minutes post-exercise, followed by gradual recovery to 248 L/min at 5 minutes. The study revealed that 42.4% of participants exhibited clinically significant EIA. Among them, 57.6% had mild, 38.4% moderate, and 4% severe bronchoconstriction. Male participants demonstrated higher PEFR values compared to females across all time points. The mean percentage fall in PEFR was 26.8%, indicating notable variability in post-exercise airway response. **Conclusion:** The study demonstrates a high prevalence of exercise-induced asthma among school-going children in Nashik. The findings highlight the importance of early screening using simple tools like PEFR, along with increased awareness and implementation of preventive strategies in school health programs to ensure timely diagnosis and management.

Keywords:
Exercise-Induced Asthma, Exercise-Induced Bronchoconstriction, Peak Expiratory Flow Rate, School Children, Prevalence, Respiratory Function, Physical Activity

Introduction

Exercise-Induced Asthma (EIA), also referred to as Exercise-Induced Bronchoconstriction (EIB), is a condition characterized by transient narrowing of the airways that occurs during or after physical exertion. EIA is particularly common in children and adolescents, often affecting their ability to participate fully in physical activity and sports. Unlike classical asthma, which is a chronic inflammatory condition of the airways, EIA specifically refers to airway narrowing precipitated by physical activity, although individuals with underlying asthma are more susceptible.[1,2]

The prevalence of EIA varies widely depending on geographic location, population characteristics, and diagnostic criteria. Globally, studies report prevalence rates ranging from 5% to 20% in the general pediatric population, with higher rates among children with pre-existing asthma.[3,4] In athletes and children engaged in high-intensity sports, prevalence may rise as high as 45%. [5,6] In India, urban schoolchildren demonstrate higher prevalenceof EIA than their rural counterparts, potentially due to environmental factors such as air pollution, allergen exposure, and lifestyle differences.[7]

EIA has clinical significance beyond transient symptoms; repeated episodes may contribute to airway inflammation, impaired exercise tolerance, and reduced quality of life in children. Early recognition and management are therefore critical, particularly in school-age populations where participation in physical activity is essential for growth, development, and overall health.[8,9]

Pathophysiology of Exercise-Induced Asthma

The underlying mechanisms of EIA involve a complex interplay of airway hyper-responsiveness, inflammation, osmotic stress, and thermal changes. Two primary hypotheses explain the pathophysiology of EIA: the **osmotic theory** and the **thermal theory**.[10,11]

1)Osmotic Theory

During exercise, ventilation increases, particularly with mouth breathing, which bypasses nasal humidification. Inhalation of large volumes of dry or cold air leads to water loss from the airway surface, increasing the osmolarity of the airway lining fluid. This hyperosmolar environment triggers the release of inflammatory mediators from epithelial cells and mast cells, including histamine, prostaglandins, and leukotrienes. These mediators induce bronchial smooth muscle contraction, airway edema, and mucus hypersecretion, resulting in airway narrowing and symptomatic bronchoconstriction.[10,11]

2)Thermal Theory

The thermal hypothesis suggests that rapid cooling of airway tissues during hyperventilation, followed by rewarming after exercise, causes vascular changes that contribute to bronchoconstriction. Specifically, rewarming leads to vasodilation and increased blood flow, promoting airway edema and smooth muscle contraction. This mechanism is particularly relevant in cold or dry environments and may exacerbate EIA in children exposed to these conditions.[1,12]

3) Inflammation and Airway Hyper-responsiveness

Children with preexisting asthma or allergic conditions often demonstrate baseline airway inflammation and hyper-responsiveness, which predisposes them to EIA. Epithelial damage and mediator release further enhance airway reactivity during exercise. Environmental factors, such as pollutants, allergens, and climatic conditions, also contribute to airway sensitization and exacerbate symptoms.[(8,9)]

4) Other Contributing Factors

Other factors influencing EIA prevalence include genetic predisposition, obesity, sex differences, and the intensity or type of physical activity. Children involved in endurance sports or high-intensity interval training may exhibit higher rates of EIA due to increased ventilatory demand.[13,14]

Clinical Presentation

Symptoms-

EIA typically manifests within minutes of exercise and includes:

Wheezing
Cough
Chest tightness
Shortness of breath
Fatigue or reduced exercise tolerance

Symptoms are often more pronounced after cessation of exercise rather than during activity itself. In some children, EIA may be asymptomatic, with only measurable declines in lung function detectable through objective tests.[9,15,16]

Impact on Daily Life

Unrecognized or poorly managed EIA can lead to avoidance of physical activity, reduced participation in sports, and diminished overall fitness in children. It may also affect school attendance and psycho-social well-being, highlighting the importance of early detection and appropriate management strategies.[17,18]

Time Course and Recovery

The onset and recovery of EIA symptoms follow a characteristic pattern:

Onset: Symptoms typically begin during exercise or within 5–10 minutes post-exercise.[1,2]

Peak Bronchoconstriction: Maximum airway narrowing is generally observed within 5–15 minutes after cessation of activity.[19]

Recovery: In most children, airway function returns to baseline within 30–90 minutes without pharmacological intervention.[1,3] Some children may experience a late-phase response 4–8 hours post-exercise, characterized by mild recurrent bronchoconstriction.

Refractory Period: Repeated exercise within 1–4 hours may result in reduced bronchoconstriction due to temporary desensitization of airway mediators.[1]

Understanding this time course is critical for accurately diagnosing EIA and timing lung function assessments such as PEFR or spirometry.

Diagnostic Assessment: Peak Expiratory Flow Rate (PEFR)

Peak Expiratory Flow Rate (PEFR) is a widely used tool for assessing airway function in children suspected of having EIA. PEFRis simple, portable, and feasible for field testing in schools, making it suitable for prevalence studies.[9,12]

Baseline Measurement: PEFR is measured at rest before exercise.

Post-Exercise Measurement: PEFR is repeated at intervals after exercise (commonly 5, 10, 15 minutes).

Diagnostic Threshold: A reduction in PEFR of ≥10–15% from baseline is indicative of EIA.[9,15]

Advantages: PEFR is effort-dependent but provides rapid feedback and can be performed repeatedly.

Limitations: PEFR is less sensitive than spirometry, may underestimate mild EIA, and relies on consistent effort, particularly inyounger children.[12,16]

RISK FACTORS

Risk factors associated with EIA include personal or family history of asthma/allergy, presence of allergic rhinitis, environmental exposure to allergens or pollutants, and gender differences.[20]

AIMS & OBJECTIVES

Aim:

To indicate the prevalence of exercise-induced asthma among school going children in Nashik city.

Objective:

1. To assess the proportion of school-going children who exhibit symptoms of exercise- induced asthma during or after physical activity.
2. To identify the demographic factors (age, gender, BMI) associated with the occurrence of EIA among children.
3. To assess the gender-wise distribution of EIA among the study population.
4. To evaluate the timing of onset and recovery of EIA symptoms following exercise

MATERIALS AND METHODOLOGY

This study is designed as a cross-sectional descriptive study using a purposive sampling technique, with a total sample size of 151 participants. The study will be conducted in a playground setting over a duration of six months. The research aims to determine the prevalence of musculoskeletal disorders among school-going children in Nashik city.

The materials and apparatus used for the study include a consent form, assessment sheet, peak expiratory flow meter, sphygmomanometer, weighing machine, and pulse oximeter. The inclusion criteria consist of children aged 12 to 17 years, including both males and females, who have no prior diagnosis of asthma (non-asthmatic),

and for whom consent has been obtained from parents, guardians, or schools. The exclusion criteria include children with a previously diagnosed asthma condition, those suffering from respiratory tract infections, neurological disorders, or those with recent physical trauma.

The outcome measures for this study include the peak expiratory flow rate assessed using a peak expiratory flow meter and the 1-mile run test, which will be used to evaluate the physical fitness and respiratory function of the participants.

PROCEDURE

Ethical clearance for the study was obtained from the institutional ethics committee. All participants were provided with clear instructions regarding the study, including its risks and benefits, in their own language, and informed consent was obtained prior to participation. Subjects were selected using a purposive sampling method based on the defined inclusion and exclusion criteria. Baseline measurements of vital parameters, including heart rate, respiratory rate, blood pressure, oxygen saturation (SpO_2), and peak expiratory flow rate (PEFR), were recorded to ensure a stable pre-test condition. Participants then performed a 1-mile run test, where they were instructed to complete the distance in the shortest possible time, with walking and jogging permitted. Following completion of the test, vital parameters and PEFR were recorded at 2, 3, and 5 minutes post-exercise. PEFR was measured using a Wright Peak Expiratory Flow Meter, which consists of a handheld device with a mouthpiece and a calibrated scale with a movable indicator. Participants were instructed to inhale deeply, seal their lips tightly around the mouthpiece to prevent air leakage, and exhale as forcefully and rapidly as possible. Three readings were taken, and the highest value was considered for analysis. All measurements were obtained within the first 10 minutes following exercise. Exercise-induced asthma was defined as a decrease of more than 10% in post-exercise PEFR, with the 10% cutoff used as the outcome measure. Data were collected systematically and analyzed using SPSS software version 25.0.

FIG 1:- PEAK EXPIRATOR FLOW METER

FIG 3:- PULSE OXIMETER

FIG 2:- SPHYGOMOMANOMETER

FIG 4:- WEIGHING SCALE

DATA ANALYSIS

The data collected from study participants were meticulously entered into Microsoft Excel 2021 and systematically organized into a master chart. To ensure accuracy and reliability, rigorous data validation procedures were carried out. The finalized dataset was then imported into the Statistical Package for Social Sciences (SPSS) version 26 for detailed statistical analysis. Statistical analysis was performed using SPSS version 26, where quantitative data were summarized using mean and standard deviation, while qualitative data were expressed in terms of percentages. The presentation of data included the use of tables, pie charts, and bar charts to effectively illustrate the distribution patterns of categorical variables, providing a clear and comprehensive overview of the study findings.

RESULTS

This prevalence study aimed to investigate the prevalence of exercise induced asthma among school going children in Nashik city. A total of151school children, aging between 12 to 17 years participated in the study. Participants were recruited using a purposive sampling method.

TABLE 1: DESCRITPIVES OF ANTHROPOMETRIC AND DEMOGRAPHIC VARIABLES

	N	Mean	Median	SD	Minimum	Maximum
Age	151	14.5	14	1.75	12	18
Weight(kg)	151	44.5	45	8.38	28	65
Height(cm)	151	149.6	150	8.65	129	168
BMI	151	19.7	19.5	2.23	15.6	26.2

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Inference: The table summarizes key physical and demographic characteristics of the 151 school-going children who participated in the study: The mean age of participants was 14.5 years, with a standard deviation of 1.75, indicating a moderately varied age distribution centred around early adolescence. The average weight was 44.5 kg, and the mean height was 149.6 cm, both showing a relatively consistent physical profile among the group, as reflected by their respective standard deviations of 8.38 and 8.65. While some outliers may indicate underweight or overweight situations, the majority of individuals appeared to fall within the normal range for teenagers, as indicated by the average Body Mass Index (BMI), which was 19.7 with a minimum of 15.6 and a maximum of 26.2.

GRAPH 1: ANTHROPOMETRIC AND DEMOGRAPHIC VARIABLE

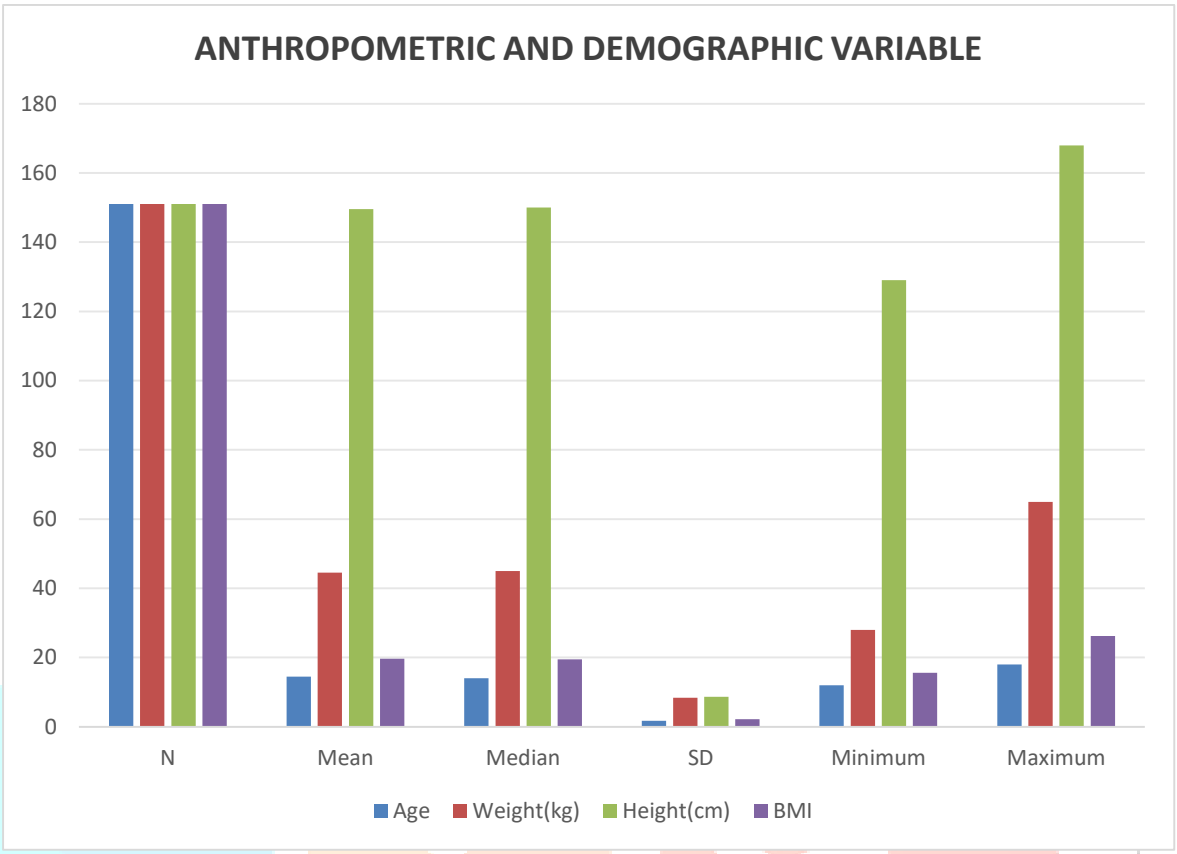


TABLE 2: DESCRIPTIVES OF PEAK EXPIRATORY FLOW RATE MEASURMENTS

	N	Mean	Median	SD	Minimum	Maximum
Peak expiratory flow rate Pre test	151	263	270	71.9	100	420
Peak expiratory flow rate Post 2min	151	205	220	70	60	370
Peak expiratory flow rate Post 3min	151	226	230	67.7	80	380
Peak expiratory flow rate Post 5min	151	248	250	66.2	100	400

Inference: The table presents the Peak Expiratory Flow Rate (PEFR) recorded at four time intervals—pretest, and 2, 3, and 5 minutes post-exercise—for 151 school-going children. The mean PEFR decreased significantly from 263 L/min pretest to 205 L/min at 2 minutes post-exercise, indicating a notable drop in expiratory capacity immediately after physical exertion. Gradual recovery was observed at 3 and 5 minutes post-exercise, with mean values rising to 226 L/min and 248 L/min respectively. This pattern suggests a transient decline in pulmonary function following exercise, which may be indicative of exercise-induced bronchoconstriction in some participants.

GRAPH 2: GRAPHS OF PEAK EXPIRATORY FLOW RATE MEASURMENTS

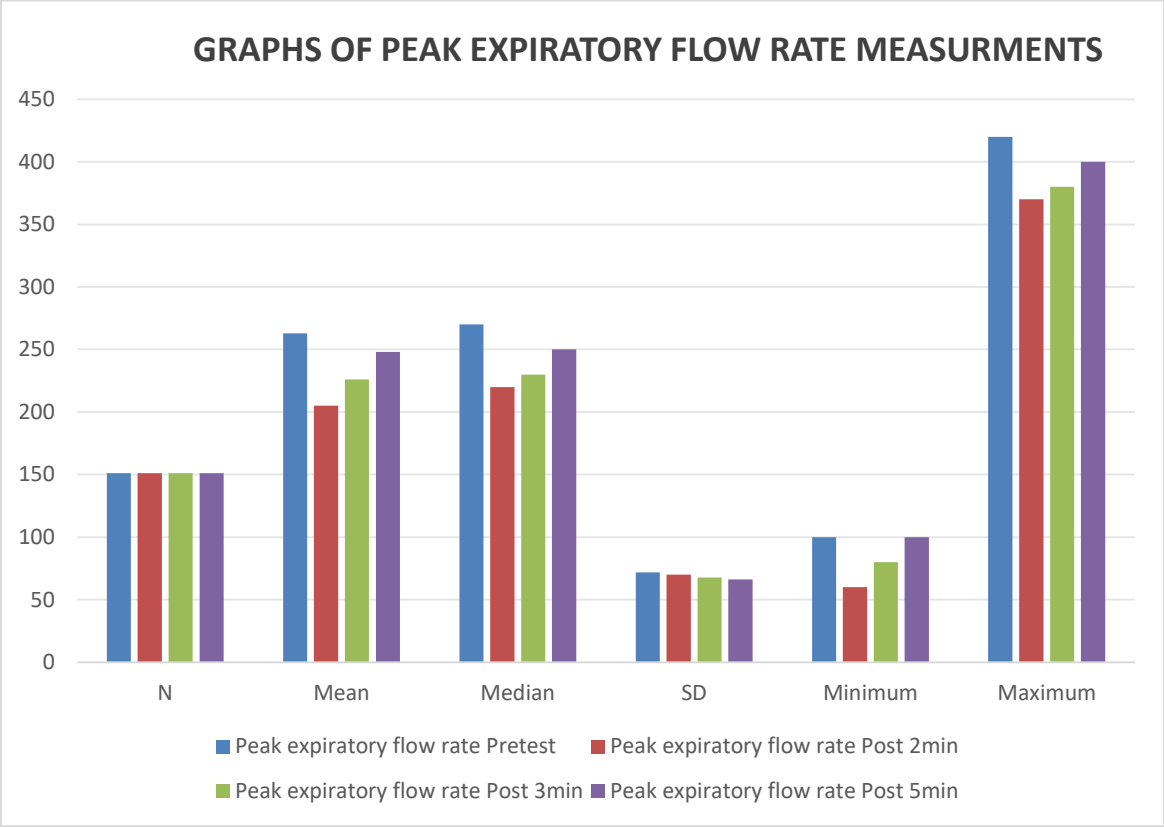


TABLE 3: GENDER-WISE DESCRIPTION OF PEFR

	Gender	Peak expiratory flow rate Pre test	Peak expiratory flow rate Post 2min	Peak expiratory flow rate Post 3min	Peak expiratory flow rate Post 5min
N	**Female**	81	81	81	81
	Male	70	70	70	70
Mean	**Female**	255	195	218	237
	Male	273	216	236	260
Median	**Female**	260	190	220	240
	Male	280	220	240	260
Sd	**Female**	76	75.2	72.3	70
	Male	65.9	62.4	61.1	59.4
Minimum	**Female**	100	60	80	100
	Male	140	100	120	120
Maximum	**Female**	390	320	360	400
	Male	420	370	380	400

Inference: This table presents a gender-based comparison of Peak Expiratory Flow Rate (PEFR) among 151 school-going children. Across all time points, male participants consistently showed higher mean PEFR

values than females, with pre test averages of 273 L/min for males and 255 L/min for females. Post-exercise, both groups experienced a decline in PEFR, most notably at 2 minutes, followed by gradual recovery at 3 and 5 minutes. The standard deviations indicate greater variability among females. These findings suggest that male children generally exhibit stronger expiratory performance and faster recovery following exercise, which may be relevant in assessing susceptibility to exercise-induced asthma.

GRAPH -3 GENDER-WISE DESCRIPTION OF PEFR

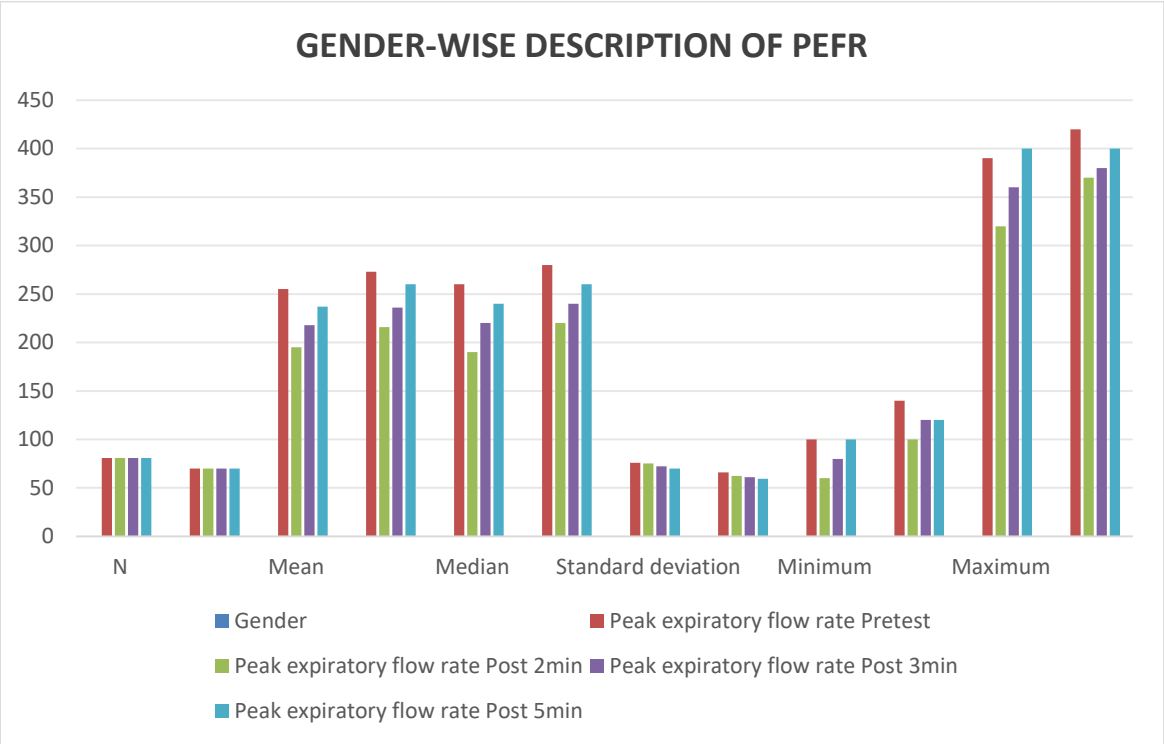


TABLE 4: PERCENTAGE OF FALL IN PEFR

	N	Mean	Median	SD	Minimum	Maximum
% fall in PEFR	151	26.8	22.2	31.7	7	390

Inference-The mean percentage fall was 26.8%, with a median of 22.2% and a wide range from 7% to 390%, indicating significant variability in post-exercise respiratory response. The high standard deviation (31.7) suggests that while many participants experienced mild to moderate reductions in PEFR, a subset showed pronounced declines, potentially indicative of exercise-induced bronchoconstriction. These findings support the need for further evaluation of exercise-induced asthma within this population.

GRAPH-4:GRAPH OF PERCENTAGE FALL IN PEFR

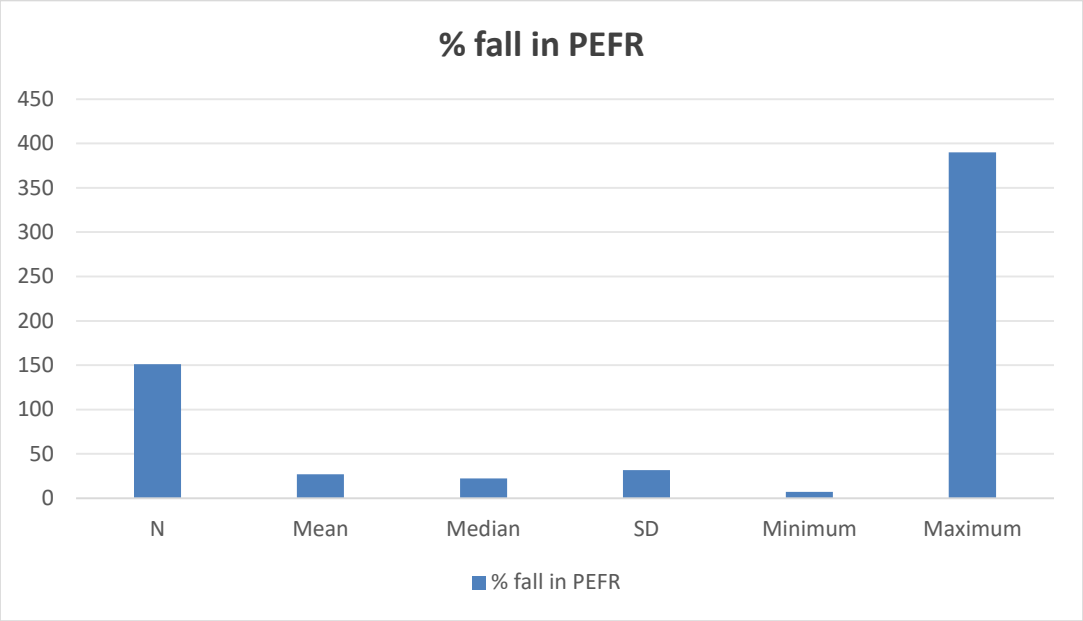
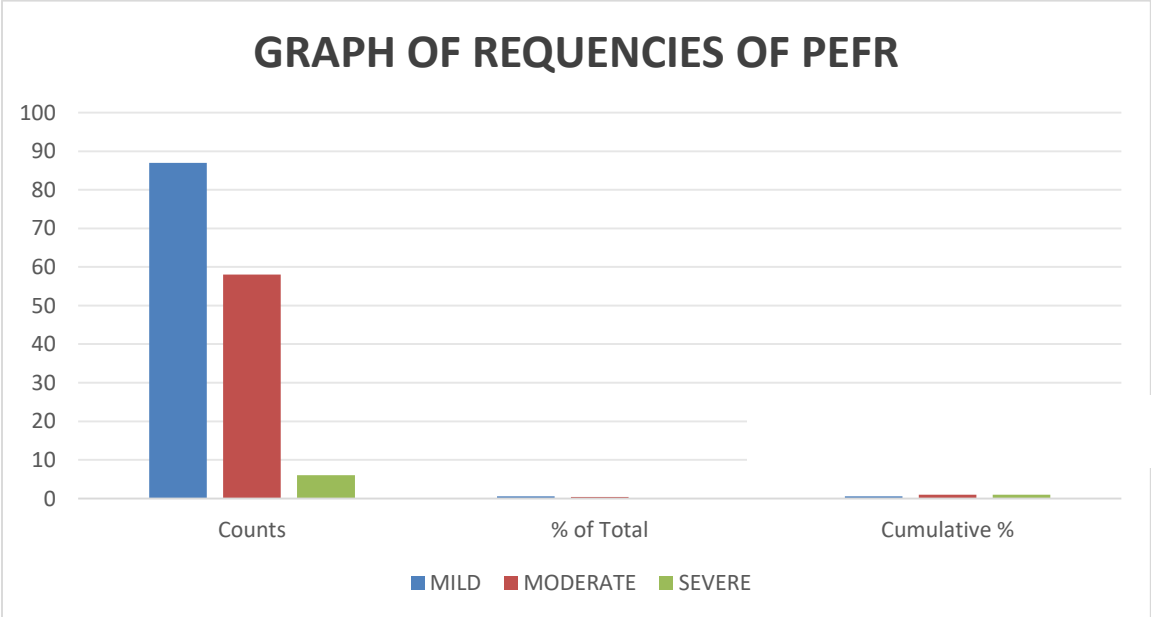


TABLE 5: FREQUENCIES OF PEFR

PEFR INTERPRETATION	Counts	% of Total	Cumulative %
MILD	87	57.60%	57.60%
MODERATE	58	38.40%	96.00%
SEVERE	6	4.00%	100.00%

Inference- This table categorizes the severity of decline in Peak Expiratory Flow Rate (PEFR) among 151 school-going children following exercise. The majority of participants (57.6%) experienced a mild reduction in PEFR, while 38.4% showed a moderate decline. A small proportion (4%) exhibited a severe drop, suggesting a potential risk for exercise-induced asthma. These findings highlight that although most children had only mild respiratory changes, a notable segment experienced moderate to severe bronchoconstriction.

GRAPH-5:GRAPH OF REQUENCIES OF PEFR



DISCUSSION

The present study aimed to assess the prevalence and severity of Exercise-Induced Asthma (EIA) among 151 school-going children in Nashik, India. The results revealed a high prevalence of EIA, with 42.4% of the participants experiencing clinically significant bronchospasm post-exercise. Among these, 57.6% exhibited mild EIA, 38.4% had moderate EIA, and 4% had severe EIA. These findings highlight a pressing public health concern, particularly in the adolescent population, where early diagnosis and intervention can significantly improve quality of life and prevent long-term pulmonary complications.

The observed mean pretest peak expiratory flow rate (PEFR) of 263 L/min dropped to 205 L/min at 2 minutes post-exercise, indicating a sharp decline in airway function immediately after exertion. A gradual recovery was noted, with PEFR rising to 248 L/min at 5 minutes post-exercise, demonstrating partial reversibility of bronchospasm, a characteristic feature of EIA. This pattern aligns with the clinical definition of EIA, which is a transient narrowing of the airways following strenuous physical activity, typically peaking 5–10 minutes after exercise and resolving within 30–60 minutes.

When compared to similar studies conducted globally, the prevalence found in this cohort is notably high. For example, studies from urban regions in India (e.g., Mumbai, Delhi) have reported EIA prevalence ranging from 20% to 35% among adolescents.[2] Internationally, prevalence rates vary widely depending on environmental factors, diagnostic criteria, and population demographics. For instance, the ISAAC (International Study of Asthma and Allergies in Childhood) Phase III study reported a wide range of asthma prevalence globally, from 5% in developing countries to over 20% in developed nations like Australia and the UK.

The elevated rates in this study could be attributed to several region-specific factors such as air pollution, lack of awareness, poor fitness levels, or undiagnosed atopic conditions. Additionally, climatic conditions in Nashik, such as dry air and seasonal changes, might contribute to increased airway hyperresponsiveness, making children more susceptible to EIA.

Gender-wise analysis in this study revealed that males had consistently higher PEFR values at all measured time points compared to females. The pre-exercise PEFR was 273 L/min in males and 255 L/min in females, showing a physiological advantage in lung function among boys. This aligns with previous research, which has consistently demonstrated higher lung volumes and expiratory flows in males, particularly during adolescence, due to differences in airway caliber, thoracic dimensions, and muscle mass.[5]However, despite higher PEFR values, the rate of decline post-exercise and susceptibility to EIA symptoms must be carefully analyzed in both genders, as females often report more symptoms due to heightened perception of breathlessness, despite relatively milder objective impairment.

The study's finding that 42.4% of children experienced moderate to severe EIA raises significant clinical concerns. Moderate-to-severe cases indicate functional impairment, which can restrict participation in physical activity and negatively impact academic performance, social development, and overall well-being. These children are also at greater risk of developing chronic asthma later in life if not identified and managed early. The relatively high incidence of mild EIA (57.6%) underscores the need for proactive screening in schools. Since mild symptoms can often go unrecognized, routine PEFR monitoring and exercise challenge tests may help identify at-risk individuals. Moreover, early intervention through pharmacologic agents like short-acting beta-agonists (SABAs) or leukotriene receptor antagonists, and non-pharmacologic strategies such as pre-exercise warm-ups and nasal breathing, could substantially reduce symptom burden.

LIMITATIONS

The study has certain limitations that should be considered while interpreting the findings. Firstly, it was conducted in a single geographic location, Nashik, which may limit the generalizability of the results to other regions with different environmental, socioeconomic, and healthcare conditions. Secondly, the study utilized Peak Expiratory Flow Rate (PEFR) as a measurement tool instead of spirometry; although PEFR is a convenient and useful screening method, it is less sensitive and specific compared to full spirometric evaluation. Lastly, the cross-sectional design of the study captures data at only one point in time, which restricts the ability to assess long-term outcomes, recurrence of exercise-induced asthma episodes, or the progression to chronic asthma.

SUGGESTIONS

The findings of this study highlight several key directions for future research to better understand and address work-related musculoskeletal disorders (WMSDs) among shopkeepers in developing urban areas. Expanding the sample size across multiple cities would improve the generalizability of results and enable meaningful regional comparisons. Addressing gender imbalance by ensuring equal representation can lead to more accurate gender-based ergonomic insights. Future studies should also examine variations in work schedules, shift patterns, and task intensity to better capture ergonomic exposure. Including psychosocial factors such as job stress, mental fatigue, and emotional well-being would provide a more holistic view of occupational health risks, as these often interact with physical stressors to influence WMSD development. Longitudinal research tracking symptom progression and evaluating ergonomic interventions like adjustable workstations, task rotation, supportive footwear, cushioned flooring, and REBA-based assessments can help shape effective prevention strategies and inform policy. Overall, a multidimensional and inclusive approach is essential for improving occupational health in retail environments.

SUMMARY

A cross-sectional study in Nashik City assessed the prevalence of exercise-induced asthma (EIA) among 151 school-going children aged 12–17 years, using a 1-mile run test and pre- and post-exercise PEFR measurements. Results showed a significant drop in mean PEFR from 263 L/min pre-exercise to 205 L/min post-exercise, recovering to 248 L/min after 5 minutes. Overall, 57.6% had mild EIA, 38.4% moderate, and 4.0% severe, with 42.4% experiencing clinically significant EIA. Males had higher PEFR values than females. The study highlights a high prevalence of EIA among school children, underscoring the need for school-based screening and interventions.

CONCLUSION

The study found a high prevalence of exercise-induced asthma (EIA) among school children in Nashik, with 42.4% showing moderate to severe symptoms. A drop in PEFR post-exercise confirmed reversible airway obstruction typical of EIA. Gender differences in PEFR highlight the need for personalized assessment. Integrating PEFR screening, awareness, and preventive strategies into school health programs and national policies like RBSK can aid early detection and management.

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