

A study on respiratory morbidities among school children post Diwali in Bangalore city

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Abstract

BACKGROUND: Diwali is a Hindu festival celebrated every year in the month of October/November throughout India. The burning of firecrackers during the festival releases a large number of air pollutants leading rise in ambient air pollution. Children are at risk of exposing to these chemicals and have shown an increased incidence of respiratory morbidities.

OBJECTIVE: The objective of this study is to identify the magnitude of respiratory morbidities among school children post Diwali in Bengaluru city.

SETTING AND DESIGN: A cross-sectional study was conducted from November 2018 to January 2019 among school children aged between 10 and 16 years.

METHODOLOGY: Schools coming under the urban field Practice area of Medical College and consenting for the study were selected by the simple random sampling. Students willing to participate from each school were selected by the simple random sampling. Each student was interviewed using the pretested semistructured questionnaire.

STATISTICAL ANALYSIS USED: Data were entered and analyzed using Epi-info 7.2.2.1. Descriptive statistics such as mean, standard deviation (SD), and proportions and inferential statistics such as the Chi-square test were used.

RESULTS: A total of 637 participants were interviewed, of which 308 (48.35%) were boys and 329 (51.65%) were girls. The mean age of the study participants was 12.53 ± 1.65 years (mean $\pm$ SD). It was observed that 263 (41.28%) children were suffering from one or other respiratory morbidities. One hundred and thirty-five (21.19%) children were suffering from upper respiratory tract infection and 138 (21.66%) had lower respiratory tract infections. One hundred twenty-three (19.31%) suffered from allergic rhinitis, of which 59 (47.93%) had an exacerbation following Diwali. Twenty-seven (4.24%) were asthmatic, of which 17 (62.96%) experienced an exacerbation after Diwali.

CONCLUSION: There is a high burden of respiratory morbidities among children following Diwali festival in Bangalore city.

Keywords: Air pollution, children, firecrackers, respiratory disease

Introduction

Respiratory diseases such as asthma, allergic rhinitis, upper and lower respiratory tract infections (LRTI) are the major causes of morbidity and mortality in children. Worldwide, the burden of respiratory disorders has increased in recent years.^[1] Among all the diseases, respiratory tract infections are the most common morbidity in children. India reports about 40.742 million cases of acute respiratory infection annually.^[2] As per the WHO statistics, it is estimated that about 235 million people currently suffer from asthma and 400 million suffer from allergic rhinitis globally.^[3]

Air pollution is an important risk factor in the development of respiratory diseases. More than 80% of people living in the urban areas are exposed to poor air quality levels that exceed the WHO guideline limits.^[4] There is increasing evidence of the detrimental effect of air pollution on human health, both in the long and short term. Exposure to high levels of air pollution is frequently associated with increased morbidity from diseases such as bronchitis and upper and LRTI.^[5] Air pollution is also known to increase respiratory allergies such as allergic rhinitis and bronchial asthma.

Diwali, also called Deepawali or the festival of lights, is an ancient Hindu festival celebrated every year in the month of October/November throughout India. Firecrackers are most commonly used in its celebrations. The burning of firecrackers releases a large number of chemicals, particularly sulphur dioxide, carbon monoxide, carbon dioxide and particulate matter (PM), along with several metal salts such as aluminum, manganese, and cadmium.^{[6]·[7]·[8]} All these contribute to a rise in air pollution levels. Data on ambient air quality from the Karnataka State Pollution Board claims that an increase in air pollution levels in different parts of the city during the festival period.^[9]

Children are more susceptible to the ill effects of air pollution brought about by burning of fire crackers, than adults. As literature revealed only a few epidemiological studies on respiratory morbidities among children during the festival of Diwali, the present study was conducted.

Objectives

1. To identify the magnitude of respiratory morbidities among school children post Diwali in Bengaluru city
2. To describe the sociodemographic profile of study participants.

Methodology



The cross-sectional study was conducted from November 2018 to January 2019 among school children aged between 10 and 16 years. All the schools in the Urban Health Training Center area of a Medical College in Bangalore were listed, and five schools were selected by simple random sampling after obtaining permission from the school authorities. The sample size was calculated as 600, based on study by Mathew *et al.*^[10] assuming a confidence interval of 95% and a precision error of 10%. Data were collected from 637 children.

Schools willing to participate and assenting students along with parents' consent were included for the study. Students who were absent on the day of study were excluded. All the schools covered under the Urban Health Training Center of a Medical college and consenting to the study were enlisted. Schools were selected by the simple random sampling method. All students who fulfilled the inclusion criteria from each school were selected by simple random sampling. Informed consent was obtained.

Ethical approval for this study was obtained from the institutional ethics committee of the authors affiliated institute.

Each student was interviewed using a pretested semistructured questionnaire. Information on the basic demographic profile, recent history of upper/LRTI, pneumonia, exacerbations of allergic rhinitis, asthma, history of hospitalization for respiratory illness, and any other information was collected. Health education was given regarding the prevention and control of respiratory diseases.

Statistical analysis

Data were entered and analyzed using Epi-info 7.2.2.1 Epi Info is an inter-operable software developed by the Center for Disease Control, Atlanta, USA, available free of cost from www.cdc/epiinfo/index.html. It was designed for public health practitioners and researchers. It enables easy data entry, database formation, and data analyses with epidemiologic statistics, maps, and graphs for public health professionals.^[11] Statistical analysis included descriptive statistics such as mean, standard deviation (SD), and proportions and inferential statistics such as the Chi-square test.

Results



A total of 637 participants were interviewed, of which 308 (48.35%) were boys and 329 (51.65%) were girls. The mean age of the study participants was 12.53 ± 1.65 (mean + SD) years, and median age was 12 years. Most of the study participants, i.e., 140 (21.8%) were aged 12 years, followed by 11 and 13 years (118, 18.52%) [Table 1].

Age (years)	Male	Female	Total
10	36 (11.69)	39 (11.85)	75 (11.77)
11	59 (19.16)	59 (17.93)	118 (18.52)
12	62 (20.13)	78 (23.71)	140 (21.98)
13	59 (19.16)	59 (17.93)	118 (18.52)
14	39 (12.66)	51 (15.50)	90 (14.13)
15	41 (13.31)	33 (10.03)	74 (11.62)
16	12 (3.89)	10 (3.05)	22 (3.46)
Total	308 (100)	329 (100)	637 (100)

*Figures in the parenthesis indicates percentages

Table 1: Age and sex of the study subjects (n=637)

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It was observed that 263 (41.28%) children were suffering from one or other respiratory morbidities. One hundred and thirty-five (21.19%) children were suffering from upper respiratory tract infection (URTI), among which 61 (19.81%) and 74 (22.49%) were boys and girls, respectively. One hundred and thirty-eight (21.66%) had LRTI among which 73 (23.70%) and 65 (19.76%) were boys and girls, respectively [Table 2]. One hundred and twenty-three (19.31%) suffered from allergic rhinitis, of which 59 (47.93%) had an exacerbation following Diwali. Twenty-seven (4.24%) were asthmatic, of which 17 (62.96%) experienced an exacerbation after Diwali [Figure 1] and [Figure 2].

Respiratory morbidities	Boys (n=308)	Girls (n=329)	Total (n=637)
URTI	61 (19.81)	74 (22.49)	135 (21.19)
LRTI	73 (23.70)	65 (19.76)	138 (21.66)
Allergic rhinitis	68 (22.08)	55 (16.72)	123 (19.31)
Asthma	15 (4.87)	12 (3.65)	27 (4.24)

*Figures in the parenthesis indicate percentages. URTI=Upper respiratory tract infection, LRTI=Lower respiratory tract infections

Table 2: Distribution of study subjects based on respiratory morbidities

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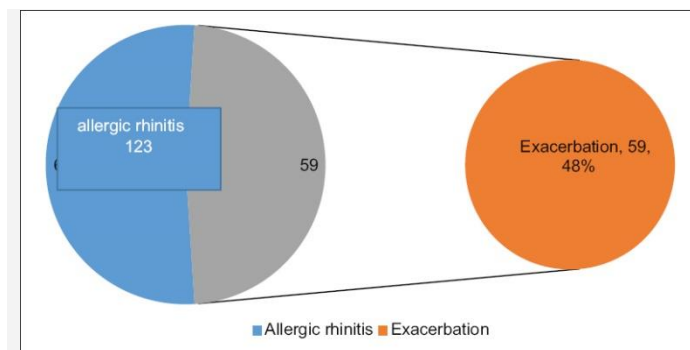


Figure 1: Exacerbation of allergic rhinitis post-Diwali

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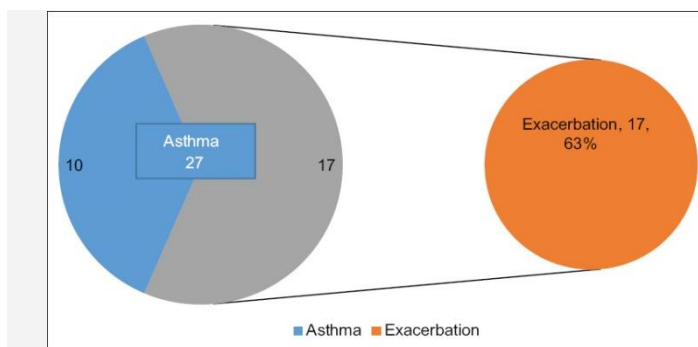


Figure 2: Exacerbation of asthma post-Diwali

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With respect to the management of respiratory morbidities following Diwali, 63 (23.95%) consulted a doctor, 44 (16.73%) took home remedies, 42 (15.97%) self-medicated with over the counter drugs provided by a pharmacy and 114 (43.35%) chose not to seek treatment due to the mild nature of their symptoms [Figure 3]. A statistically significant ($P < 0.05$) greater incidence of URTI and LRTI and exacerbation of allergic rhinitis and asthma was seen among children who burnt firecrackers, compared to those who did not [Table 3].

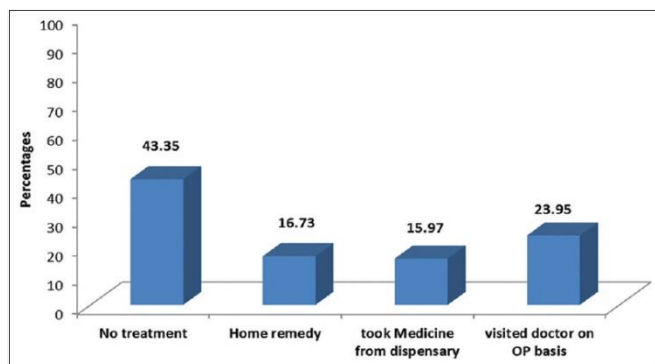


Figure 3: Distribution of study subjects based on treatment for respiratory problems

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Respiratory morbidities	Burning of fire works			
	Yes	No	χ^2	P
URTI	91	44	6.31	0.01
LRTI	104	34	21.97	<0.001
Exacerbation of allergic rhinitis	35	24	0.05	0.81
Exacerbation of asthma	10	07	0.005	0.93

Table 3: Respiratory morbidities among those who burnt fireworks (n=369)

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URTI=Upper respiratory tract infection, LRTI=Lower respiratory tract infections

Discussion



The use of fireworks with their consequent detrimental effect on air quality with elevated ambient air levels of PM and its several metallic components and gases, is widely recognized. Crackers contain potassium nitrate, charcoal, sulphur, potassium, and trace elements, which adversely affect the environment as well as human health.^[12] Poor air quality due to the burning of firecrackers results in both acute and chronic problems affecting the respiratory system of children most commonly.^[5] Over recent years, the prevalence of allergic diseases has increased in most industrialized countries, as exposure to air pollutants enhances airway response to inhaled allergens in susceptible individuals.^[13] A study by Shah *et al.* in the year 2019 states that burning of firecrackers produce extremely high levels of personal exposure to PM 2.5 levels that are likely to have significant adverse short-term and long-term health effects.^[14]

Compared to adults, children are especially susceptible to the harmful effects of ambient air pollution owing to poorer defences against PM and gaseous air pollutants, a differential ability to metabolize and detoxify environmental agents, and an airway epithelium that is more permeable to inhaled air pollutants. In addition, with a greater level of physical activity in children, their air intake into the lungs per day is much greater than in adults.^[5]

In the present study, 41.28% of children suffered from a respiratory morbidity post Diwali, of which 21.19% suffered from URTI and 21.66% from LRTI. A post Diwali morbidity survey in a resettlement colony of Delhi conducted by Sharma *et al.* in the year 2013 with sample size of 1826 observed that 8.1% suffered from a respiratory problem post Diwali. Majority of the participants (70.9%) had respiratory complaints ranging from mild cough and wheeze to asthmatic attack.^[6]

In the present study, out of 637 study participants, 4.24% were asthmatic, of which 62.96% experienced an exacerbation post Diwali. This is an important observation in this study as air pollution is a major trigger for asthma. A study conducted by Raghu *et al.* in Bangalore in the year 2016 showed that the number of admissions attributed to an exacerbation of symptoms in patients already suffering asthma and other lung diseases in the post Diwali period was significantly greater than prediwali in both rural and urban locations.^[7]

Few investigators have identified the association between asthma and exposure to fireworks. According to the researchers from the Institute of Environmental Assessment and Water Research CSIC stands for Spanish National Research Council (CSIC), metallic particles in smoke emitted from fireworks poses a health risk, particularly to asthmatics. In India, a 30%–40% increase in cases of wheezing, respiratory diseases, exacerbation of bronchial asthma, and bronchitis in patients of all ages and gender were reported during the Diwali festival.^[5]

In the present study, 19.31% suffered from allergic rhinitis, of which 47.93% had an exacerbation post Diwali. A community-based cross-sectional study by Sinha *et al.* was conducted in Mehrauli, South Delhi, with sample size of 1200, which observed a prevalence of 11% (132 subjects) with allergic rhinitis, among which 33.3% (44 patients) additionally had asthma.

In the present study, only 23.95% of participants consulted a doctor for the management of their illness. In a community-based assessment among adults in Delhi, Sinha *et al.* observed that a greater proportion of patients of allergic rhinitis with asthma (75%) sought treatment, compared to those without asthma (40%) who either predominantly relied on home remedies (42%) or did not seek any treatment altogether (18%).^[3]

Conclusion



There is an increased burden of respiratory morbidities among children during the post Diwali period, in particular, an exacerbation of symptoms in nearly two-third of previously diagnosed asthmatic children.

Recommendation

Updated awareness of the community regarding the harmful effects of burning of fire crackers on human health, should be done regularly in the prediwali period. Susceptible individuals, mainly patients suffering from respiratory conditions, should avoid direct exposure to the aforementioned pollutants so as to minimize the possibility of exacerbation of their preexisting illness.

Relevance of the study

Diwali is a most popular festival celebrated in India. Levels of ambient air pollution increase during the Diwali period due to firecrackers. This study has identified and highlighted the various respiratory morbidities in children who are the most vulnerable group.

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Conflicts of interest

There are no conflicts of interest.

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