

## ORIGINAL ARTICLE

 OPEN ACCESS

Received: 13-04-2020

Accepted: 19-04-2020

Published: 08-05-2020

Editor: Dr. Natarajan Gajendran

**Citation:** Sivaswamy S, Sambandan S, Ramasamy P, Surianarayanan M (2020) Prevalence and risk factors associated with wheezing among children and adolescents from Chennai, South India. Indian Journal of Science and Technology 13(12): 1342-1346. <https://doi.org/10.17485/IJST/v13i12.259>

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Funding: None

Competing Interests: None

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# Prevalence and risk factors associated with wheezing among children and adolescents from Chennai, South India

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## Abstract

**Aim:** To investigate the prevalence and associated risk factors that influence wheezing and asthma in children and adolescents. **Methods:** A total of 135 male children and adolescents were selected from various schools. Information about family history, dietary pattern, respiratory symptoms and environmental risk factors were obtained using questionnaire survey. **Results:** The prevalence of wheezing in the past 12 months was 31.85%. The prevalence of asthma was 2.2%. **Conclusion:** Consumption of fast food, overweight and obesity and exposure to traffic fumes were observed to be important risk factors with increased risk among the children. The impact of environmental factors such as air pollution must be quantitatively established with exposure assessments supplemented with questionnaire surveys to reduce the burden of disease. This study provides a cross-sectional outlook on modifiable risk factors that can be targeted to reduce the impact of asthma and wheezing in children.

**Keywords:** Asthma; ISAAC; Prevalence; Wheezing; Children; Chennai

## 1 Introduction

Asthma, wheezing and acute respiratory tract infections (ARI) are the most common chronic diseases affecting children. Childhood asthma affects approximately one in eight children, worldwide<sup>(1)</sup>. They are considered a leading cause for school absenteeism and hospitalization of children<sup>(2)</sup>. Wheezing during early childhood increases risk of asthma, wheezing and other respiratory disorders that can develop during later years of life<sup>(3)</sup>. Particulate matter of size fractions <2.5 μm diameter are capable of penetrating the alveolar sac and cause inflammation. Children are more prone to adverse effects when exposed to chronic air because of their developing lungs, high breathing rates

per body weight, developing metabolic pathways and amount of time spent exercising outdoors<sup>(4)</sup>. In a large multi-centric study conducted across Latin America and Europe, it was observed that recurrent wheezing was associated with a significant morbidity in terms of severe episodes (59.4%), visits to the emergency department (ED) (71.1%), and hospital admissions (26.8%)<sup>(5)</sup>. Phase three of the International Study of Asthma and Allergy in Children (ISAAC) conducted in India reported that the prevalence of symptoms of asthma among children was 5.35% in 6–7 year old and 6.05% in 13–14 year old. The global prevalence for symptoms of asthma was reported to be 11.5% in the 6–7 year old and 14.1% in the 13–14 year age groups<sup>(6)</sup>. Data from ISAAC study group revealed that children in the 13–14 year age group who were exposed to mild, moderate and heavy traffic exposure had 1.19, 1.51 and 1.51 times higher odds of developing asthma compared with the minimal traffic exposure group<sup>(7)</sup>. Similar conclusions were drawn from other studies that proximity of a residence to a road with heavy traffic is associated with a higher occurrence of respiratory symptoms and reduced pulmonary function<sup>(8)</sup>. Other air pollutants like oxides of nitrogen, carbon and sulphur present in traffic pollution can cause oxidative stress to the airways and increase occurrence of asthma<sup>(9)</sup>. Obesity has also been reported to increase risk of asthma in adults as well as children. Asthma prevalence was observed to be higher among females than males which were attributable to weight gain and early onset menarche. Obesity changes the lung mechanics in children with asthma by affecting their central and peripheral airway. Several studies have concluded that there are significant differences in prevalence of asthma and wheezing among gender, ethnicity, obesity and lung functions<sup>(10)</sup>. In view of this, the aim of this study was to investigate role of possible modifiable environmental factors that influence asthma and wheezing, so that may ultimately lead to a reduction in the personal burden of these diseases.

## 2 Materials and Methods

The participants selected for the study were all males, as they were a part of a larger study that assesses the role of air pollution on asthma. Evidence sourced from literature show that in childhood, boys have nearly twice the risk of developing asthma over girls. With increasing age however, the female gender has more predominance in prevalence of asthma and wheezing. The exact cause for gender difference is multi-factorial with sex hormones emerging as an interesting factor in the process<sup>(11)</sup>. Hence, only male participants were included in the study to control gender disparity. Children who participated in the study were recruited from selected schools in Kanchipuram and Chennai Districts, Tamil Nadu. Initially, 280 children were screened across five schools, out of which 135 children were recruited. This was based on parental consent and consent school authorities to administer the questionnaire to the children. Written informed consents were obtained from the parents for children below 13 years of age. The participants themselves consented to participate if they were above age 13. Age was ascertained by referring to their school admission records. The questionnaire tool used in the study is the well-validated ISAAC questionnaire. It was developed by The International Study of Asthma and Allergies in Childhood (ISAAC) Research Project which was set up in 1991 to investigate asthma, rhinitis and eczema worldwide. The tools are available at the ISAAC official website (<http://isaac.auckland.ac.nz/>). The ISAAC questionnaire was translated to Tamil and administered to the children through interview for children below 12 years of age. Children above 12 years were given the questionnaire to fill out. They were educated about each question and trained to answer correctly. There were 8 questions in total for the core questionnaire for asthma. Some of the participants who were above 12 years took the questionnaire home to report the symptoms. The younger children were interviewed during or after school hours. Parents provided the answer to certain questions which the children did not recall. Height and weight were measured for the participants with the help of trained staff.

### 2.1 Questionnaire assessment

The environmental questionnaire had 19 questions which covered smoking history in the household, dietary intake, physical activity, fuel usage, heavy-vehicle frequency, drug usage and socio-economic status. The core questionnaire for asthma had a total of 8 questions that assess wheezing, asthma cough and difficulty in breathing.

Data was entered in MS Excel and coded according to the ISAAC Coding Manual. All calculations were done using R Software, version 3.6.0. Prevalence of the symptoms was calculated using frequency and percentage. Odds ratio was calculated for the exposure variables associated with the symptoms reported.

## 3 Results and Discussion

The demographic characteristics of the participants are given in [Table 1](#). They were self-reported and parent-reported in some cases. The sample population was all male children and adolescent so as to control for gender confounding. It was observed that 57.77% of the population were aged 9–12 years.

[Table 2](#) shows the prevalence of wheezing, asthma and other respiratory symptoms among sample population, as given in

**Table 1. Characteristics of the sample population**

	n (%)
<b>Age</b>	
9-12	78 (57.77%)
13-15	57 (42.22%)
<b>Education level of parent</b>	
Profession or honour	28 (20.74%)
Graduate or Post graduate	46 (34.07%)
Intermediate or post high school diploma	31 (22.96%)
High school certificate	24 (17.77%)
Middle school certificate	6 (4.44%)
<b>Area of residence</b>	
Industrial	13 (9.62%)
Commercial	19 (14.07%)
Residential	103 (76.29%)
<b>Duration of residence (Years)</b>	
1 to 3	76 (56.29%)
>3	59 (43.7%)
Smoking habit of parent	37 (27.4%)
Alcohol habit of parent	48 (35.55%)
Size of family	
Less than or equal to 4 members	89 (65.92%)
More than 4 members	46 (34.07%)
<b>Siblings</b>	
One elder or younger sibling	73 (54.07%)
More than one elder or younger sibling	29 (21.48%)

the ISAAC questionnaire. The prevalence of wheezing occurrence in the past 12 months was reported to be 31.85%.

**Table 2. Prevalence of respiratory symptoms in the participants**

Symptoms (n=135)		Present	
		N	%
Q1	Have you <b>ever</b> had wheezing or whistling in the chest anytime in the past?	88	65.18%
Q2	Have you had wheezing or whistling in the chest <b>in the past 12 months</b> ?	43	31.85%
	How many attacks of wheezing have you had <b>in the past 12 months</b> ?		
Q3	1 to 3	32	23.7
	4 to 12	2	1.48
Q4	<b>In the past 12 months</b> , how often, on average, has your sleep been disturbed due to wheezing?		
	Never	39	28.88
	Less than one night per week	4	2.96
Q5	<b>In the past 12 months</b> , has wheezing ever been severe enough to limit your speech to only one or two words at a time between breaths?	13	9.62
Q6	Have you <b>ever</b> had asthma?	3	2.2
Q7	<b>In the past 12 months</b> , has your chest sounded wheezy during or after exercise?	19	14.07
Q8	<b>In the past 12 months</b> , have you had a dry cough at night apart from a cough associated with a cold or chest infection?	56	41.48

The association between environmental pollutants and symptoms of wheezing and asthma are assessed and presented in Table 3. Overweight and obese status showed a slightly increased odds of 1.41 for wheezing, than normal BMI children. Consumption of fast food also showed a slightly higher odds of 1.33, which can influence occurrence of wheezing in children.

**Table 3. Association between environmental pollutants and wheezing**

Wheezing in the past 12 months	Present		Absent		Odds Ratio	95% CI	p-Value
	N	%	N	%			
BMI (n=42)	5	11.9	37	88.09	1.41	0.49-4.68	0.75
Seafood (n=78)	25	32.05	53	67.94	1.02	0.49-2.12	1
Meat (n=69)	27	39.13	42	60.86	2	0.95-4.21	0.06
Eggs (n=83)	31	37.34	52	62.65	1.98	0.9-4.3	0.08
Fast food (n=109)	36	33.02	73	66.97	1.33	0.5-3.4	0.6
Intensive physical activity (n=83)	16	19.27	67	80.72	-	-	0.01*
Trucks (n=26)	9	34.6	17	65.38	1.16	0.47-2.88	0.74

The mean age of the sample population was observed to be 12.57 years. This may be due to the fact that 57.77% of the participants being 9-12 years of age. The mean height of the population was found to be 140.65 cm. The mean weight was found to be 43.57 Kg. BMI of 19% of the participants were found to be overweight. Odds ratio showed a higher odds of 1.41 for children in the overweight and obese category as compared with participants who had normal BMI. These results were in similarity with a systematic review that compiled results from 38 studies carried out worldwide. The review concluded that the odds ratio of the overweight and obese category were 1.23 and 1.46 respectively. They were all found to be significant at p value less than 0.01 (12). The prevalence of history of wheezing, in the sample population was found to be 65.18 %. The prevalence may have been caused due to small sample size. Nevertheless, the presence of wheezing reported was undeniable. Self-reported and parent-reported wheezing accounted for the prevalence. The prevalence of wheezing occurring in the past 12 months, among the sample population was 31.85%. This was further stratified by age, which revealed that the prevalence of wheezing occurring in the last 12 months in age group 9-12 was 17.8 %, while the prevalence was 14.07% for the age category 13-15 years. The findings were similar to previous studies that showed that the incidence of wheezing was observed to decrease gradually with increase in age. The respiratory system begins to develop immunity, which causes decrease in number of wheezing attacks (13).

The prevalence of participants experiencing a wheezing attack of 1 to 3 times a week was reported to be 23.7 %. Only 2.96 % of the participants reported wheezing induced disturbance to their sleep. It was observed that 9.62 % of participants reported having had difficulty talking when experiencing a wheezing attack. 14.07 % of the participants reported having experienced chest sounds which were wheezy after intense physical activity such as after sports. This was similar to a previous study showed that night wakening from cough was independently associated with emergency room visits (p<0.001) and 36.7 % of diagnosed asthma cases were found to have Exercise Induced Bronchoconstriction (EIB) and 8.6% of the cohort had a positive EIB test (14). The prevalence of asthma was 2.22 %. The prevalence of dry cough was 41.48 %. Similar results were also observed in earlier studies that reported that 10% of the sample children cohort had increased cough. About 69 % had a cough usually accompanied with cold, 34 %-55 % had cough associated with cold and 25 % had nocturnal coughing. These symptoms were often seen in children with frequent wheezing (15).

In this study, it was found that children who consumed fast food on an average of one or more times a week had an increased odds of 1.33 compared with children who never consumed fast food or did so occasionally. This was similar to the findings in previous studies that showed that there was a trend that tended towards an increased risk of asthma associated with increasing fast food consumption (p=0.07) (16).

It was observed in this study that children consuming seafood, meat, and eggs regularly one or more times a week were found to have a slightly increased odds of 1.02, 2.0 and 1.98 respectively, as compared to children who rarely consumed these foods or never consumed them. Our findings show inverse association to consumption of seafood, eggs and meat, though some studies have shown that consuming fish can be protective against wheezing and other respiratory problems (17,18). Dietary pattern could not explain temporality of wheezing as odds ratio was observed to be insignificant.

Children who indulged in physical activity once or more times in a week had an increased wheezing compared with children who never or occasionally indulged in sports or other physical activities (p <0.01). This was found to be similar to results in earlier studies that showed that Exercise-Induced Wheezing (EIW) was associated with increased asthma –related emergency

room visits ( $p < 0.001$ ) and overnight hospitalizations ( $p < 0.001$ )<sup>(19)</sup>. Children who reported trucks plying regularly near their residence had an increased odds of 1.16, compared to children who reported no heavy vehicle activity near their residence. It was similar to findings in previous studies where, living in residential areas near four-way traffic intersections was associated significantly with wheezing with an odds ratio of 1.26<sup>(20)</sup>.

## 4 Conclusion

Overweight and obese status have an adverse health impact among children with wheezing. It may be due to insufficient physical activity. Healthy food choices and prolonged physical activity can be considered to negate the impact of obesity on wheezing and asthma. Our findings support the hypothesis that traffic density can increase exposure to diesel exhaust particles, which can exacerbate wheezing and asthma. Dietary pattern should be further analyzed to examine protective mechanism of dietary fatty acids. Nutritional status, outdoor air pollution and physical activity appear to be important risk factors for identifying early signs of wheezing and asthma in children and adolescents.

## 5 Acknowledgment

The authors express immense gratitude to children who participated in this study.

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