Mikyas Demissie, Abera Kumie,. *Ethiop Med J, 2018, Vol. 56, No. 4*

ORIGINAL ARTICLE

PREVALENCE OF SYMPTOMS OF ASTHMA AND ASSOCIATED FACTORS AMONG PRIMARY SCHOOL CHILDREN IN ADDIS ABABA

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ABSTRACT

Background: *Asthma prevalence is expected to increase globally by 50% every decade. Respiratory illness, including asthma among children, has become a public health concern in Ethiopia.*
Objective: *To determine the prevalence of symptoms of asthma and associated factors among primary school children in Addis Ababa.*
Methods: *Cross sectional study was conducted from January 2015 to March 2015 using questionnaire adapted from International Study of Asthma and Allergies in Childhood. A total of 20 primary schools were selected randomly from Addis Ababa to collect data from school children. The questionnaires were completed by parents/ guardians of the children. Descriptive and analytic methods were used in analysis of data.*
Results: *A total of 1,259 primary school children aged 6-7 years were included in this study. The prevalence of ever wheeze, wheeze in the past 12 months, ever diagnosed asthma, exercise induced wheeze in the past 12 months, and dry cough at night in the past 12 months were 13.1% (95 % CI, 11.21% -14.99 %), 8.9% (95% CI, 7.30% -10.50%), 4.1% (95% CI, 2.98% -5.22%), 6.5% (95% CI, 5.09% -7.91%), and 19.2% (95% CI, 16.99% -21.41%) respectively. Diet (eating pasta ≥3 time per week in the past 12 months) and fuel for cooking (kerosene) were significantly associated with wheezing in the past 12 months.*
Conclusion: *The prevalence of wheeze in the past 12 months was high and factors associated with it were eating pasta frequently and use of kerosene as a fuel for cooking.*
Keywords: *Asthma, Child, Cross-sectional studies, Ethiopia, Prevalence, School*

INTRODUCTION

Developmental aspects such as the maturation of the immune response, development of atopy and timing of infectious exposure during the first year of life, are emerging as important factors that modify the risk of asthma in a genetically susceptible person. Link between asthma and socioeconomic status, with higher prevalence of asthma in affluent compared with poor population in developing nations is likely to reflect the life style difference such as exposure to allergens, infections, diet and access to health care (1).

It was estimated that asthma prevalence increases globally by 50% every decade (2). Asthma is one of the most common non-communicable diseases in children (3, 4). Responses to questions about self-reported wheezing in the previous 12-month period have been shown to have good specificity and sensitivity for both bronchial hyper-responsiveness and a diagnosis of asthma in both children and adults.

Wheezing is not a symptom specific to the diagnosis of asthma. From a clinical standpoint, a diagnosis of asthma is made on the basis of combined information from history, physical examination, and physiological tests (2).

In Global Initiative for Asthma (GINA) report an arbitrary figure of 50% of the prevalence of ‘‘current wheezing’’ in children (self-reported wheezing in the previous 12-month period in 13- to 14-year old children) has been used as the prevalence of ‘‘clinical asthma.’’ In support of this approach, in different populations from high- and low income countries: the proportion of individuals with bronchial hyper responsiveness (BHR) plus current wheeze is around 40% to 60% of that reporting current wheeze (2). This criteria of BHR plus current wheeze has been proposed as the ‘‘gold standard’’ for identifying clinical asthma in population-based studies. There is a close correlation between International Study of Asthma and Allergies in Childhood (ISAAC) asthma prevalence data for teenagers (13- to 14-year age group) and young children (6- to 7-year age group).

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In the countries which studied both age groups in the ISAAC program, the mean prevalence rate of current wheezing in the 6- to 7-year age group was 105% of that recorded in the 13- to 14- year age group (2).

Few studies were conducted in Ethiopia to determine the prevalence of asthma and associated factors in children. As a part of multi-centre study by ISAAC, school children aged 13-14 years were studied in three Ethiopian ISAAC centers .The 12 month prevalence of self-reported wheeze were 10.4%, 1.9% and 16.2% in Addis Ababa, Jimma and Gondar, respectively. The reported rates of diagnosed asthma were 2.8%, 2.2% and 2.2% in the three centers respectively (5, 6).

Other studies in Butajira and Jimma studied risk factors related to asthma. Living with animals and hook worm infection were associated with reduced risk of wheeze while environmental tobacco smoke, use of kerosene, use of paracetamol and allergen skin sensitization to house dust mites were associated with increased risk of wheeze in these studies (7-12). The purpose of this study was to determine prevalence of symptoms of asthma and associated factors among school children aged 6-7 years, in Addis Ababa. The result of this study can be used as an input by policy makers in planning interventions to control asthma in Ethiopia.

PATIENTS AND METHODS

A cross sectional study was conducted among primary school children in Addis Ababa from January 2015 to March 2015. According to 2007 census, 2.7 million inhabitants lived in Addis Ababa (13). Addis Ababa city is organized in 10 sub city administrations.

According to the report by the City Government of Addis Ababa Education Bureau, there were 795 primary schools in Addis Ababa in August 2014. A total of 496,053 regular students were attending primary school. And, 239,211(48.2%) of them were attending in government schools and 256,842 (51.8%) of regular students were attending in schools such as private, church, mosque, non- governmental organization, etc (14). Our study populations were sampled from primary school children in Addis Ababa aged 6/7 years.

Sample size was calculated by a formula used to test a hypothesis about the difference between two population proportions. The calculated sample size (using Epi info Version 3.5.3.)
for cross sectional study was 1,747 taking OR=2, margin of error (d) = 2% , with confidence interval (CI) = 95%, power = 80%, non-response rate (NR) = 10%, design effect = 1.5, r = 4, proportion of exposure among non-ill in Jimma= 21% (8), prevalence of wheeze in the past 12 mo in Addis Ababa (P)= 10.4% (5). Multi stage sampling technique was used. A total of 20 primary schools were selected from Addis Ababa. One government and one private (private, church, mosque, non- governmental organization, etc.) primary schools were selected from each sub city of Addis Ababa by simple random sampling. A maximum of two classes from upper kindergarten (UKG), two classes from grade 1 and two classes from grade 2 were selected randomly from each school when the numbers of classes in each section were more than two. All students aged 6-7 years in the selected class were studied (Figure 1).

<table>
<tr><td colspan="2">496,053 regular students</td><td colspan="3">795 primary schools</td><td></td></tr>
<tr><td colspan="3">Stage 1</td><td colspan="3">Simple random sampling</td></tr>
<tr><td colspan="6">20 primary schools (one government and one private school from each sub city)(stratified)</td></tr>
<tr><td colspan="3">Stage 2</td><td colspan="3">Simple random sampling</td></tr>
<tr><td colspan="6">A maximum of 2 classes from each section of upper kindergarten, grade 1 and grade 2 were selected</td></tr>
<tr><td colspan="2">Stage 3</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">Classes were taken as clusters and all children aged 6-7 years were included in the study(1,711)</td></tr>
</table>

Figure 1. Sampling procedure chart

Data were collected using standardize questionnaire adapted from ISAAC. The questionnaire includes socio-demographic data, respiratory health (core questionnaire), environmental and life style related data. Wheeze in the past 12 month was dependent variable while socio-demographic and environmental variables were independent variables.

The principal investigator supervised the data collection. Four health officers and 20 teachers were involved in the data collection process. After identifying children aged 6-7 years in selected schools, their weight and height were measured by the health officers. The children were asked to deliver participant information sheet and consent form to their parents/ guardians. The Amharic versions of questionnaires were completed by parents or guardian of children. Questionnaires were collected within a week from each respondent. Reminder letters were sent to those who did not return the questionnaire and who returned incomplete questionnaire.

The prevalence of asthma symptoms were estimated based on the responses to the written questionnaire on wheeze in the past 12 months (current wheeze) and frequent or severe episodes of wheeze in the past 12 months (symptoms of severe asthma) (15).

Symptoms of severe asthma are defined as those with current wheeze who, according to the written questionnaire, in the past 12 months, have had >4 attacks of wheeze, or >1 night per week sleep disturbance from wheeze, or wheeze affecting speech (15).

Data were entered and cleaned using Epi Info Version 3.5.3. The data were transferred to Statistical Package for Social Sciences (SPSS) version 22 using Stat Transfer. Then, analysis was done. Body mass index for age was calculated using WHO Anthro Plus software. Determinants were identified in logistic regression analysis. Hosmer and Lemeshow test showed the model was fit in the binary logistic regression. The magnitude of each variables, the p value, crude and adjusted odds ratio with 95% CI were calculated. The p value < 0.05 was considered significant.

An English version of standardized questionnaire adapted from ISAAC was translated to Amharic. Then, it was translated back to English. The questionnaire was pretested. Training was given to health officers and orientation was given to teachers. Data collection was started after formal approval of the research proposal by ethics committee of Addis Continental Institute of Public Health.

Additionally, permission was obtained from Addis Ababa City Administration Education Bureau and Education Bureau in each Sub city and from school directors. Written consent was obtained from parents/guardians. The parents/guardians were sending back the questionnaire using sealed post.

RESULTS

Demographic Characteristics: Questionnaires were distributed to 1,711 eligible children who were considered to be age 6-7 years according to school record. However, 140 (8.2%) of them were over age and under age when their birth date was checked during the collection of the questionnaires and data cleaning. A total of 312 (18.2%) children did not have completed responses. Finally, a total of 1,259 primary school children aged 6-7 years were included in the study. Among these children, 709 (56.3%) of them were 6 years old and 550 (43.7%) of them were 7 years old. Additionally, 556 (44.2%) of them were male and 703 (55.8%) of them were female. One of the 20 schools (Ledeta Catholic Lijageredoch) was only for female children. Based on school ownership, 628 (49.9%) children were from government primary schools and 631 (50.1%) children were from private primary schools (private, church, mosque, non- governmental organization, etc.).

Prevalence of Symptoms of Asthma: Among 1,259 primary school children in Addis Ababa, 161 [13.1% (95 % CI, 11.21% -14.99 %)] of them had ever wheezing in the chest any time in the past. Wheeze in the past 12 months was reported in 109 [8.9% (95% CI, 7.30% -10.50%)] children. The symptoms of severe asthma like more than 4 attacks of wheeze in the past 12 months was reported by 13 [1% (95% CI, 0.45% -1.55%)] children, sleep disturbance due to wheezing more than one night per week was reported by 22 [1.7%(95% CI, 0.99% - 2.41%)] children, and speech limitation during wheezing attack was found in 34 [2.7% (95% CI, 1.80% -3.60%)] children. Additionally, 50 [4.1% (95% CI, 2.98% - 5.22%)] of respondents had ever asthma (diagnosed asthma). Exercise induced wheeze in the past 12 months was reported in 77 [6.5% (95% CI, 5.09% - 7.91%)] of them. And, 234 [19.2% (95% CI, 16.99% - 21.41%)] of children had dry cough at night in the past 12 months in the absence of cold or chest infection (Table 1).

Table 1: Prevalence of symptoms of asthma in primary school children aged 6-7 years in Addis Ababa, Ethiopia, 2015

Symptom		Number	percent
Ever wheeze (n=1228)	Yes	161	13.1
	No	1067	86.9
Wheeze in last 12 months (n=1220)	Yes	109	8.9
	No	1111	91.1
Number of wheezing attacks in last 12 months (n= 1259)	1–3	75	6.0
	4–12	4	0.3
	>12	9	0.7
Sleep disturbed by wheeze in last 12 months (n= 1259)	Never woken with wheezing	53	4.2
	Less than once per week	25	2.0
	One or more nights per week	22	1.7
Speech-limiting wheeze in last 12 months (n= 1259)	Yes	34	2.7
	No	74	5.9
Diagnosed asthma(ever asthma) (n= 1211)	Yes	50	4.1
	No	1161	95.5
Exercise induced wheezing in the past 12 months (n= 1176)	Yes	77	6.5
	No	1099	93.5
Dry cough at night in the past 12 months (n=1217)	Yes	234	19.2
	No	983	80.8

Factors related to wheeze in the past 12 months: In bivariate analysis, factors associated with wheezing in the past 12 months were diet (eating pasta ≥3 time per week in the past 12 months), fuel for cooking (kerosene), use of paracetamol in infancy, use of paracetamol in the past 12 months, use of antibiotics in infancy, trucks pass through street where the child lives (frequently through the day) on week days, and home exposure to cat in infancy.

After adjusting for confounding factors in multivariate analysis, eating pasta ≥ 3 times per week in the past 12 months [OR=2.27 (95% CI, 1.04-4.96)] and using kerosene as fuel for cooking [OR=2.70 (95%CI, 1.06-6.90)] were significantly associated with wheeze in the past 12 mo (Table 2).

Table 2. Factors associated with wheezing in the past 12 months in primary school children aged 6-7 years in Addis Ababa, 2015 - multivariate analysis

Factors		Wheeze in 12 months	No wheeze in 12 months	Crude OR	95% CI	Adjusted OR	95% CI
Eating pasta	Never/ occasionally	24	332	1.0			
	Once/twice/ wk	46	497	1.28	0.75-2.21	1.12	0.52-2.41
	≥ 3times/wk	33	251	1.82	1.01-3.27	2.27	1.04-4.96*
Fuel for cooking	Electricity	56	669	1.0			
	Kerosene	14	82	2.04	1.03-3.97	2.70	1.06-6.90*
	Charcoal	29	269	1.29	0.78-2.11	1.49	0.74-3.00
	Wood and others	7	57	1.47	0.58-3.54	2.74	0.82-9.11
Use of paraceta-mol in infancy	Yes	49	293	3.40	2.10-5.49	1.91	0.94-3.88
	No	29	589	1.0			
Use of paraceta-mol in the past 12 mo	Never	39	572	1.0			
	At least once in a year	43	351	1.80	1.12-2.90	1.33	0.64-2.74
	At least once per month	20	108	2.72	1.46-5.01	1.86	0.75-4.62
Use of antibiotics in infancy	Yes	47	351	2.37	1.42-3.95	1.87	1.00-3.49
	No	24	424	1.0			
Trucks pass near residence on week days	Never	32	450	1.0			
	Seldom	46	405	1.6	0.97-2.63	1.47	0.74-2.92
	Frequently / day	19	137	1.95	1.03-3.69	1.17	0.46-3.00
	Almost all the day	10	84	1.67	0.74-3.71	1.84	0.64-5.25
Home exposure to cat in infancy	Yes	33	225	1.72	1.11-2.67	1.35	0.71-2.57
	No	69	808	1.0			

* Factors associated with wheeze in the past 12 months after adjusting for confounding factors

DISCUSSION

This study has indicated important findings on symptoms of asthma among young children. In this study, the prevalence of wheeze in the past 12 months (current wheeze) was high when compared to study done in Nigeria constituting 5.1% (16). The prevalence of wheeze in the past 12 months and the prevalence of symptoms of severe asthma in our study were within the range of the prevalence in other countries according to the study done by ISAAC between 2000 and 2003 (15). The 12 month prevalence of wheeze ranged from 2.4% in Jodhpur (India) to 37.6% in Costa Rica in the 6–7 year olds. The prevalence of symptoms of severe asthma, ranged from 0% in Pune (India) to 20.3% in Costa Rica in the 6–7 year olds (15).

The estimated prevalence of "clinical asthma" was 4.5 % (half of the prevalence of current wheeze (8.9%)) in this study (2). The prevalence of diagnosed asthma was similar to the prevalence of diagnosed asthma in Nigerian primary school children aged 6-7 years which was 3.1%.(16) Because wheezing is not a symptom specific to asthma, the prevalence of diagnosed asthma (ever asthma) in this study was not to low when it was compared with the prevalence of ever wheeze. Our study did not show under diagnosis of asthma (2). The prevalence of exercise induced wheezing in the past 12 months was slightly higher than prevalence of exercise induced wheezing in Nigerian primary school children, which was 4.6%. The prevalence of dry cough at night (19.2%) was much higher than the prevalence of dry cough at night in Nigerian primary school children(6.5%) (16).

Food aid (including processed food) has been associated with the rapid increase in asthma prevalence, suggesting a potential environmental factor (17). According to ecological analysis by ISAAC, starch, calories from cereal and protein from cereals showed a consistent negative association with current and severe wheeze.

These negative associations were significant between starch and current wheeze (17, 18). Pasta is a processed food made of cereals. As a cereal its protective effect might be expected and as a processed food it might have increased the risk of occurrence of wheeze. The most common food allergens in young children are milk (2.5%), egg (1.3%), peanut (0.8%), and wheat (0.4%) in USA (19). Food allergy and asthma frequently co-exist.

Children with food allergy are more than two to four times as likely to have other atopic conditions such as asthma, eczema, or respiratory allergy compared to children without food allergies (19). Further studies are required to know the association of pasta with symptoms of asthma in Ethiopia.

Similar to our study, use of kerosene as a fuel for cooking was significantly associated with wheeze in the past 12 months among children in Jimma (9). Fuel type (gas) was significant predictor of asthma symptoms in Nigerian school children aged 13-14 years (20). Kerosene is widely used in developing world. Some kerosene using devices emit substantial amount of particulates, carbon monoxide (CO), nitric oxide (NO), and sulfur dioxide (SO_2). Fine particulate matter (PM) is emitted as a product of incomplete combustion. The median aerodynamic diameter of particles emitted from combustion is typically well below 2.5 μm, the particle size below which the majority of PM deposits in deep lung (21). Studies of kerosene used for cooking or lighting provide some evidence that emissions may impair lung function and increase infectious illness (including tuberculosis), asthma and cancer risks (9, 21). Least polluting alternative energy sources at household level are solar power and electricity (21).

Environmental conditions contribute to asthma and allergies. Given the potential risk of kerosene, policy makers may consider alternatives to kerosene (21, 22). The use of cleaner technologies, such as solar power and electricity, for cooking could prevent asthma and other respiratory illnesses (21).

Strengths and limitations of the study: The large sample size and wide coverage of primary school children in Addis Ababa were the strength of the study. However, self-reported current wheezing could be subjective and recall bias could not be avoided.

Conclusions and recommendations: The prevalence of symptoms of asthma was high in this study. Diet (eating pasta) and use of kerosene as fuel for cooking were significantly associated with wheezing in the past 12 months. The effect of processed food like pasta on the prevalence of asthma needs further evaluation using stronger study design. The use of alternative cleaner technologies for cooking instead of kerosene could prevent asthma.

ACKNOWLEDGEMENTS

Authors would like to thank Professor Yemane Berhane, Dr Amare Worku and Professor Alemayehu Worku for their professional advice on the questionnaire development and data analysis. We want to thank Addis Continental Institute of Public Health (ACIPH) and Haramaya University for giving this opportunity to do the research. Finally, we want to thank the children and their parents for their willingness to participate in the study. This research was funded by Ethiopian Pediatric Society.

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