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Burden of asthma-like symptoms and a lack of recognition of asthma in Vietnamese children

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ABSTRACT

Objective: Lack of recognition of asthma in childhood results in unmet asthma treatment needs and leads to the risk of sub-optimal respiratory health. The present study assessed the prevalence of asthmatic under-recognition in middle school children in Vietnam.

Methods: We conducted a school-based survey among 15,112 Vietnamese children. Most of them are aged from 13 to 14. Schools and students were recruited using multi-stage sampling. Respiratory symptoms were collected via self-report using a standardized tool from the International Study of Asthma and Allergies in Childhood. Under-recognition of asthma was defined as a presence of at least one asthma-like symptom but a negative response to having ever asthma. Associations were investigated using logistic regression.

Results: Prevalence of asthma-like symptoms was 27.3% and prevalence of physician-diagnosed asthma was 8.5%. Over 80% of symptomatic children were not diagnosed with asthma. Under-recognition of asthma was found more in girls (adjusted odds ratio; aOR = 1.75; 95%CI: 1.54 to 1.98).

Conclusions: Asthma is significantly under-recognized in Vietnamese middle-school children. Urgent action is required to improve the recognition of asthma in Vietnam.

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1. Introduction

Asthma is one of the most common and serious chronic illnesses globally with an increasing incidence over the last few decades (1–3). Infants and children are particularly vulnerable (4). Asthma affects approximately 14% of children worldwide and leads to more than one million deaths annually (1). Asthma has more severe health effects in those living in non-affluent countries (2,5). In general, childhood asthma imposes a substantial burden on families and society. Asthma increases a family's medical expenses, decreases productivity due to carer's leave and loss of education due to illness, results in more hospital admissions, and increases the workload for existing

pediatric health systems (6). Asthmatic children may have restrictions on their daily lives, leading to lower quality of life (7–9). Childhood impairment may impact the respiratory system's anatomical and functional growth and potentially influence long-term pulmonary well-being (10,11) leading to significant chronic airway obstruction in adult life (12).

Multiple studies have examined asthma prevalence, including time trends (2,13,14). The prevalence of asthma symptoms and related allergic problems varies widely between and within regions and has changed over time (2,14). Methodological inconsistency is one explanation for this variation in prevalence, as there is a lack of a universally accepted epidemiological definition of asthma, leading to both over- and

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under-diagnosis. Reported asthma under-diagnosis, defined as having asthma-like symptoms not accompanied by physician-diagnosed asthma, varies broadly with estimates ranging from 20 to 70% (15,16). Lack of accurate asthma diagnosis results in a lack of adequate asthma treatment, which leaves children at risk of poor respiratory health. Contributing factors to asthma under-diagnosis include parents minimizing children's respiratory symptoms; lack of accurate reporting to physicians; differences in understanding as to what constitutes asthma symptoms and delay by physicians making a diagnosis of asthma (15,17,18). In some countries, physicians may not use the term asthma but initiate asthma treatment, due to perceived negative connotations in labeling a child as asthmatic, especially early in life (17).

In Vietnam, published information on the prevalence of asthma and asthma-like symptoms among children, especially adolescents, is limited to studies carried out almost two decades ago. In those reports, the prevalence of recurrent wheezing and childhood asthma differed with age. The prevalence of self-reported "current wheeze" increased with age, increasing from 5.1%, 17.0%, 14.9%, to 29.0% for children aged 6, 5–6, 5–11, and 13–14 years, respectively (19–22). Similarly, the prevalence of reported asthma varied between 4–8% in children aged under 5 years (20), 5% in those aged 5–6 years (19,22), 12% in those aged 5–11 years (21), and 5% in 13 to 14-year age-group (22). No previous study has investigated the status of under-diagnosis or under-recognition of asthma and associated problems in Vietnamese adolescents. The aim of this study was to (a) determine the current prevalence of asthma and asthma-like symptoms among children in secondary schools, (b) determine the prevalence of asthmatic under-recognition and (c) identify factors associated with the under-recognition of asthma in these children.

2. Methods

2.1. Study setting and population

The study was conducted in Ho Chi Minh City, the economic center of Southern Vietnam with the highest population density. Schools and students were selected using multistage sampling (Appendix 1). Ho Chi Minh City has a total of 24 districts with 19 inner districts and 5 suburban districts. Suburban is defined and used following the regulations on geographical boundaries of the Vietnamese national system. Generally, inner districts and suburban districts refer to central and peripheral parts of Ho Chi Minh city. The list

of 268 public secondary schools, for 365,640 students attending (Data in 2018 provided by Provincial Department of Education) was divided into 24 groups according to the district. A random selection method was used to select 24 schools (one school from each district). Based on school and class size, up to 650 students per school were recruited to achieve the target sample size of 15,000 students. Students between seventh and eighth grades were chosen because they contain most children aged 13 to 14. Children between seventh and eighth grades regardless of age were chosen for this study as they were able to complete self-report international standard questionnaires. All students from selected classes were invited to participate in the survey. Appendix 2 shows the distribution of the 24 selected schools in Ho Chi Minh city.

2.2. Study questionnaire

The study used a standardized tool from the International Study of Asthma and Allergies in Childhood (ISAAC). The questionnaire used in this study was based on the Vietnamese-language version of the ISAAC tool created in 2003 (21). The tool was revised through an exploratory, sequential mixed study to update the translated questionnaire to fit with Vietnamese terminology for children's understanding to ensure the tool's validity. Eleven in-depth interviews and five focus group discussions included 121 secondary school students and nine professional experts in Vietnam were conducted. Firstly, three researchers (HL, PT, DP) who are all experienced environmental health professionals and native Vietnamese speakers checked the consistency of the meaning of the English and Vietnamese versions. Next, a test-retest study was carried out to test the agreement of answers. The agreement percentages between two repeated measures three days apart ranged from 66% to 99%. Some words were replaced, and some questions were deleted from the old version. More details of this method were presented in an earlier paper (23). Lastly, the revised version of the ISAAC standardized questionnaire in the Vietnamese language was used for the current research. The questionnaire includes 21 questions about asthma-associated symptoms (8 questions), allergic rhinitis symptoms (7 questions), and eczema/rash symptoms (6 questions) (Appendix 3).

2.3. Ethics consideration

The study obtained approval from the Board of Ethics in biomedical research at the University of Medicine

and Pharmacy in Ho Chi Minh City (342/UMP-BOARD). The research team worked closely with the local education authorities and selected schools' principals to get permission for the survey. We sent a newsletter to parents to inform them about the study one week in advance. Parents who did not wish their children to participate in the survey were asked to reply to the teachers or the research team (24). Students gave assent for their participation in writing. All survey activities were under the supervision of the student's teacher. Students completed the questionnaire and then sealed it in an envelope for collection. Students who did not want to join the survey could leave the questionnaire blank in the envelope.

2.4. Data collection and analysis

Volunteers and researchers made all efforts to explain the study and questionnaires to children prior to them completing the survey. An instrument was printed in A0 size and displayed on the classroom wall to clarify some questions and avoid extra explanations that could influence participants' responses.

Data were collected between November 2019 and February 2020 before the COVID-19 pandemic happened in Vietnam.

Severe wheezing symptoms were identified by (1) the condition of wheezing in the preceding 12 months, and (2a) having four or more attacks of wheeze symptoms, or (2b) one or more nights every week waking at night due to wheezing, or (2c) having any episodes of wheezing affecting the ability to speak. The presence of at least one asthma-like symptom was defined as (1) having current whistling breathing, and (2a) this condition was induced during or after exercise or (2b) persistent nocturnal cough in the last 12 months. Under-recognition of asthma was defined as a presence of at least one asthma-like symptom but a negative response to having ever asthma (question number 6).

2.4.1. Statistical analysis

Summary statistics are described as mean and standard deviation for continuous data and as frequency and percentage for categorical data. The association between sex and location (inner area/suburban area) with symptoms was investigated using logistic regression with robust standard errors to account for the possible non-independence of responses from children who attended the same school. First univariable analyses were undertaken, and then multivariable analyses,

where models were adjusted for the potentially confounding variables sex, age, location, child's smoking status, tobacco smoke exposure, food allergy and whether there are pets in the child's residence. The results of these analyses are expressed as adjusted odds ratios (aOR) and 95% confidence intervals (95%CI). All statistical analyses were performed using Stata version 16.0 (StataCorp, College Station, TX, USA).

3. Results

A total of 15,699 middle-school students were invited to the survey. Thirty-five (0.2%) students refused to participate, 482 (3.1%) students were absent when the questionnaire was completed, and 70 (0.5%) responses were excluded due to incomplete data. There were 15,112 (96.3%) valid responses.

Characteristics of the study sample are displayed in Table 1. The sample had approximately equal proportions of males and females and equal distribution among grade 7 and grade 8. The mean age was 13.5 ± 0.6 years. Most respondents (79.5%) lived in the inner districts of Ho Chi Minh City, Vietnam, reflecting the distribution of districts in the city.

Table 2 displays the prevalence of self-reported asthma and associated symptoms by sex and location. A total of 47.9% of all secondary-school children reported wheezing ever, with 8.5% reporting a diagnosis of asthma. The lifetime prevalence of wheeze (wheeze ever) and prevalence of children reporting wheezing and exercise-induced wheezing in the previous 12-months were significantly higher in females (50.5%, 42.1%, and 32.2%, respectively), compared with males (45.2%, 36.9%, and 27.8%, respectively). However, males were more likely to report recognized asthma (9.9% vs. 7.0% respectively, aOR = 1.44; 95%CI 1.25–1.67). The lifetime prevalence of wheeze and both wheezing and night dry cough reported in the previous 12-months were higher in children studying in inner areas than suburban areas (49.9%, 41.1%, and 41.3%, respectively compared with 39.8%, 33.2%, and 37.9%,). When considering allergic rhinitis symptoms, 78.8% of responders had nasal problems at some point in the past, 69.3% had these symptoms within the last 12 months, and 28.4% of the children had both nasal problems with itchy-watery eyes (allergic rhino-conjunctivitis). In addition, the study investigated the history of eczema. However, only 5.2% of the sample had experienced eczema. Over half of the child respondents were unsure about eczema because they did not understand the meaning of the word "eczema."

Table 1. Characteristics of the study population ($N=15,112$).

Variable	Number	%
Total number	15,112	(100%)
Sex ^{a,b}		
Male	7616	50.5
Female	7465	49.5
Grade		
Grade 7	7771	51.4
Grade 8	7341	48.6
Age ^{a,c}	(Mean = 13.5; SD = 0.6)	
<13 years old	4	0.1
13 years old	7403	49.0
14 years old	7222	47.8
>14 years old	320	2.1
School location (Total 24 districts)		
Inner area (19 districts)	12,021	79.5
Suburban area (5 districts)	3091	20.5
Current smoking status		
Yes	73	0.5
No	15,039	99.5
Family member smoking near a child		
Yes	2450	16.2
No	12,662	83.8
Food allergic in the last 12 months		
Yes	1635	10.8
No	13,477	89.2
Pets in house		
Yes	6363	42.1
No	8749	57.9

^aIn the results, the actual denominator may be somewhat lower since subjects with missing answers were excluded.

^bMissing: $n=31$, 0.2%.

^cMissing: $n=163$, 1.1%.

Consequently, we have not reported any results focusing on eczema.

Table 3 presents the burden of severe wheezing symptoms with reference to reported asthma status. Over 3000 secondary school children (about 20% of the study population) experienced at least one severe wheeze symptom over the last year. However, only 15.2% of those who reported these symptoms reported a history of asthma. Importantly, when asthma was not recognized in these children, reports of wheezing symptoms in the preceding 12 months were much higher than those in whom the asthma was recognized.

Table 4 describes the under-recognition of important asthma symptoms in the study sample. There were 4123 child respondents (27.3% of the study population) who reported having at least one typical symptom of asthma and 1367 students (9.0% of the study population) having all symptoms of asthma. Up to 18% of these children had recognized asthma. Therefore, over eighty percent of children reporting asthma symptoms were undiagnosed and represent under-recognition of asthma. Table 5 showed both univariable and multivariable analyses. Under-recognition of asthma was significantly more likely to occur in females, when family members smoked near the child, in children with food allergy, and when children have pets in their house.

4. Discussion

There is significant under-recognition of asthma in Vietnamese school children aged 13 to 14 years old. Global surveys have shown that the prevalence of 12-month wheeze among Vietnamese children was amongst the highest reported. While the worldwide prevalence of current wheeze varied from 1.6%-36.8% in the 1990s (13), The prevalence in Vietnamese children was over 20% in 2003 (21,22), and 39.5% in this present study. This increase is consistent with previous forecasts that asthma symptom prevalence in Asian countries would continue to rise due to an increased industrialization and pollution, with consequent increased airway problems (25–27). Two-thirds of participants (69.3%) reported allergic rhinitis symptoms, 28.4% reported allergic rhino-conjunctivitis symptoms, and a minority (approximately 5%) had a recurrent rash and ever had eczema. Even though asthma-like symptoms were reported by a large number of respondents (27.3%), the prevalence of self-reported asthma among school-aged children in the present study was much lower, at 8.5% of the population. The figure in previous surveys fluctuated from 5.0% to 15.0% though applying the same tool and population age range (22,25). Also, the global prevalence of asthma ranged from 1% to 20% of the population in different countries (2). This wide

Table 2. Prevalence of symptoms related to wheezing, allergic rhinitis, and recurrent rash, and their association with sex and area.

Variable	Sex ^{c,d}						Location ^d					
	Total		Male		Female		Inner area		Suburban area		aOR ^b (95% CI)	
	No.	%	No.	%	No.	%	No.	%	No.	%		
Total number	15,112	(100)	7616	(50.5)	7465	(49.5)						
<i>Self-reported asthma and associated-symptoms</i>												
Ever had wheeze	7231	(47.9)	3442	(45.2)	3772	(50.5)	0.80 (0.73–0.87)*	6002	(49.9)	1229	(39.8)	1.52 (1.34–1.73)*
Ever had diagnosed asthma	1281	(8.5)	754	(9.9)	523	(7.0)	1.44 (1.25–1.67)*	1095	(9.1)	186	(6.0)	1.57 (1.27–1.93)*
<i>Symptoms in the last 12 months</i>												
Current wheeze	5969	(39.5)	2810	(36.9)	3143	(42.1)	0.80 (0.73–0.87)*	4944	(41.1)	1025	(33.2)	1.41 (1.23–1.62)*
≥ 4 of wheeze attacks	2330	(15.4)	1200	(15.8)	1122	(15.0)	1.34 (1.21–1.51)*	1935	(16.1)	395	(12.8)	1.00 (0.89–1.14)
Sleep disturbances due to wheezing	509	(3.4)	236	(3.1)	271	(3.6)	0.98 (0.79–1.21)	410	(3.4)	99	(3.2)	0.84 (0.71–0.99)
Speech-limiting wheezing	1609	(10.7)	723	(9.5)	877	(11.8)	0.90 (0.81–1.00)	1330	(11.1)	279	(9.0)	0.98 (0.81–1.19)
Exercise-induced wheezing	4534	(30.0)	2119	(27.8)	2404	(32.2)	0.81 (0.75–0.87)*	3596	(29.9)	938	(30.4)	0.98 (0.83–1.17)
Night dry cough	6135	(40.6)	2742	(36.0)	3380	(45.3)	0.68 (0.64–0.72)*	4965	(41.3)	1170	(37.9)	1.17 (1.06–1.29)**
<i>Allergic rhinitis symptoms</i>												
Ever had allergic rhinitis symptoms	11,911	(78.8)	5826	(76.5)	6061	(81.2)	0.74 (0.68–0.81)*	9688	(80.6)	2223	(71.9)	1.65 (1.36–2.00)*
<i>Symptoms in the last 12 months</i>												
Allergic rhinitis symptoms	10,471	(69.3)	5030	(66.0)	5420	(72.6)	0.74 (0.66–0.83)*	8545	(71.1)	1926	(62.3)	1.17 (1.06–1.29)**
Allergic rhino-conjunctivitis symptoms	4287	(28.4)	1861	(24.4)	2416	(32.4)	0.72 (0.66–0.78)*	3510	(29.2)	777	(25.1)	1.05 (0.96–1.14)
Allergic rhinitis symptoms interfere with daily activities	448	(3.0)	211	(2.8)	235	(3.2)	0.97 (0.80–1.16)	369	(3.1)	79	(2.6)	1.07 (0.91–1.25)
Use medicine to treat flu or cold or runny nose every month	896	(6.0)	523	(6.9)	372	(5.0)	1.40 (1.20–1.62)*	742	(6.2)	154	(5.0)	1.25 (1.01–1.54)**
<i>Self-reported eczema and rash problems</i>												
Ever had recurrent rash	1048	(6.9)	478	(6.3)	567	(7.6)	0.81 (0.71–0.92)**	854	(7.1)	194	(6.3)	1.15 (0.93–1.43)
<i>Symptoms in the last 12 months</i>												
Recurrent rash	831	(5.5)	366	(4.8)	465	(6.2)	0.76 (0.65–0.89)*	682	(5.7)	149	(4.8)	1.12 (0.95–1.53)
Recurrent rash in specific places	579	(3.8)	247	(3.2)	332	(4.5)	0.84 (0.58–1.20)	472	(3.9)	107	(3.5)	0.90 (0.73–1.11)
Rash cleared completely	546	(3.6)	245	(1.9)	301	(4.0)	1.10 (0.81–1.49)	452	(3.8)	94	(3.0)	1.20 (0.95–1.51)
Awake at night by the itchy rash (one more night per week)	79	(0.5)	38	(0.5)	41	(0.6)	1.18 (0.74–1.87)	67	(0.6)	12	(0.4)	1.31 (0.77–2.21)

CI: Confidence interval.

^aOdd ratios were adjusted by age and location and included robust standard errors with clusters of schools.^bOdd ratios were adjusted by age and sex and included robust standard errors with clusters of schools.^cIn the results, the actual denominators were lower since subjects with missing answers were excluded (less than 2%).^dReference category is female or suburban area.*Significant (p -value < 0.001).**Significant (p -value < 0.05).

variation of rates could be the lack of an agreed definition and methodology changes (27).

Our data highlighted that there was a substantial rate of under-recognition of asthma among Vietnamese adolescents. Over 80% of study participants having all asthma-like symptoms and burden of severe wheezing symptoms had not received a diagnosis of asthma resulting in an under-reporting of asthma prevalence. This has been observed in many other populations, with under-reporting varying between 20% and 70% (15,16). Both child and physician

factors could be contributing to this issue (28). Experience in Vietnam and other Asian countries shows that due to the social stigma of asthma, children and caregivers probably deny their condition or look for another physician, causing a hesitancy among medical practitioners to confirm a diagnosis of asthma, especially for children. Another underlying reason for this delay could be that doctors tried to avoid finalizing the diagnosis of 'asthma' because of uncertainty at a young age (29–31). Instead, sick children had been diagnosed with other respiratory

Table 3. Summary of under-recognition of asthma ($N=15,112$).

Asthma-like symptoms	Diagnosis of asthma	
	Reported asthma No. (%)	Not reported asthma no. (%)
Current wheezing (a)	789 (13.2)	5180 (86.8)
Exercise-induced wheezing (b)	602 (13.3)	3932 (86.7)
Night dry cough (c)	606 (9.9)	5529 (90.1)
Have at least one asthma-like symptom (a&b OR a&c) ($n=4123$, 27.3%)	606 (14.7)	3517 (85.3)
Have all asthma-like symptoms (a&b AND a&c) ($n=1367$, 9.0%)	243 (17.8)	1124 (82.2)

Table 4. Burden of severe wheezing symptoms stratified by the diagnosis of asthma and by the condition of under-recognized asthma.

Severe wheezing symptoms in the last 12 months	Diagnosis of asthma ($N=15,112$)		Under-recognition of asthma ($N=1367$)	
	Reported asthma no. (%)	Not reported asthma no. (%)	Under-recognized asthma no. (%)	Not under-recognized asthma no. (%)
One severe wheezing symptom ($n=2104$)	292 (13.9)	1812 (86.1)	412 (19.6)	1692 (20.4)
Two severe wheezing symptoms ($n=877$)	160 (18.2)	717 (81.8)	214 (24.4)	663 (75.6)
Three severe wheezing symptoms ($n=188$)	30 (16.0)	158 (84.0)	63 (33.5)	125 (66.5)
At least one symptom ($n=3169$)	482 (15.2)	2687 (84.8)	689 (21.7)	2480 (78.3)

Table 5. Association between child factors and under-recognition of asthma ($N=15,112$).

Characteristics	Under-recognized asthma Yes (%)	Odds ratio (95% CI)	Adjusted odds ratio ^a (95% CI)
Sex		1.00	1.00
Male	423 (5.6)	1.75 (1.54–1.98)	1.75 (1.54–1.98)
Female	695 (9.3)		
Age		1.00	1.00
<14	530 (7.2)	1.08 (0.96–1.22)	1.08 (0.95–1.22)
≥14	594 (7.7)		
School location		1.00	1.00
Suburban districts	208 (6.7)	1.14 (0.98–1.34)	1.17 (0.92–1.48)
Inner districts	916 (7.6)		
Current smoking status		1.00	1.00
No	1117 (7.4)	1.32 (0.61–2.89)	1.33 (0.60–2.94)
Yes	7(9.6)		
Family member smoking near the child		1.00	1.00
No	852 (6.7)	1.73 (1.50–2.00)*	1.66 (1.44–1.93)*
Yes	272 (11.1)		
Food allergic in the last 12 months		1.00	1.00
No	919 (6.8)	1.96 (1.67–2.30)*	1.86 (1.58–2.19)*
Yes	205 (12.5)		
Pets in house		1.00	1.00
No	619 (7.1)	1.13 (1.01–1.28)*	1.14 (1.01–1.29)*
Yes	505 (7.9)		

^aThese results included robust standard errors with clusters of schools; and the adjusted odds ratios are adjusted for all variables in the table.

*Significant (p -value < 0.05).

problems such as acute upper respiratory infections, acute bronchitis, bronchiolitis, and allergic rhinitis or only a symptom diagnosis (including dyspnea, wheezing, and cough) (32–34). Previous studies have demonstrated that delays in diagnosing asthma impair patients' access to asthma therapy, hindering effective health care or exacerbating the disease condition (35). In this study, we found that symptoms were more prevalent where an asthma diagnosis was not reported. Asthma was also under-recognized more commonly in girls and respondents studying in suburban schools. Little is known about the reasons for these disparities,

but it might suggest an association with poorer access or barriers to health services among underprivileged groups. As reports of asthma symptoms were common, further research among these populations should be undertaken to investigate these potential causes further.

Female adolescents reported a significantly higher prevalence of wheeze and allergic symptoms but were less likely to report asthma than males. The prevalence of reported asthma was 1.5 times greater in boys than in girls. Some publications reported gender differences in adolescent asthma incidence and

prevalence (36–38). During childhood, boys were more likely to develop asthma than girls, and then this was reversed as they grow up, with higher prevalence in the female group (36). The current results revealed that more Vietnamese female than male adolescents experienced asthma symptoms but fewer reported asthma. Thus, the relationship to pubertal status and biology development in the cohort may explain the gender difference in symptom prevalence and frequency but cannot explain the difference in diagnosis of asthma (38). Our data are consistent with gender inequality in accessing health care. These sex biases in asthma diagnosis might be explained partly by social norms in South Asian countries that always prioritize males. The boy-biased parents are also less likely to seek formal health treatment and tend to care less when a daughter is sick (39). Continued efforts are required to investigate and identify solutions to reduce the lack of asthma reporting and/or diagnosis in the female group.

The present study supports the finding that children in urban schools had a significantly higher prevalence of allergic diseases and reported asthma than their suburban counterparts. Despite greater levels of diagnosis, and consequent likely better access to health care, symptoms in urban children were much greater. The obvious evidence showed children studying in urban settings were confronting daily health challenges (40). The inevitable development of cities and towns led to overcrowded living conditions and severe environmental degradation, following an apparent increase in urban-related symptoms and illnesses. Hence, it is likely that improvements in cities' living environment are essential to promote young citizens' health (41). Far greater efforts will be needed to protect children's well-being in rapidly growing cities.

This study's strengths lie in the high response rate, the large sample size, and the use of validated questionnaires, to obtain representative results. One limitation could be that some technical terms used to describe diseases or symptoms throughout the questionnaire could confuse children despite conducting a pilot that applied sequential mixed methods to limit this. As the above discussion, we know that asthma prevalence could switch between boys and girls in this study age group due to pubertal and hormonal changes which could impact the study findings. Besides, this study was conducted in the large city with better healthcare access, and consequently results may not be generalizable to the non-city dwelling Vietnamese population. Another limitation of the study is that we did not record respiratory treatment information among non-asthmatic children. Previous

studies (27,35,36) have reported that prescription of asthma medication without a doctor-confirmed diagnosis occurs in children. These medications are used when diagnosed with other respiratory infections. In the subsequent studies, data on treatment should be taken into consideration to estimate asthma prevalence and explain the hypothesis of underestimating asthma in the Vietnamese medical system.

In conclusion, there is significant under-recognition of asthma among Vietnamese adolescents. Difference in gender is important associated factors that should be considered in solving the problem of the under-recognition of asthma.

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Declaration of interest

The authors have no conflicts of interest relevant to this article to disclose.

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