

Prevalence of wheeze, bronchial hyper-responsiveness and asthma in the elderly Chinese

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Summary

Background Asthma is a common health problem affecting patients of all ages. Because of the ease of sampling, epidemiological studies have concentrated mainly on the paediatric and general population.

Objective This study aimed to determine the prevalence of wheeze, bronchial hyper-responsiveness and asthma amongst our elderly population and deduce any clinical and laboratory risk factors that might identify elderly asthmatics at an earlier stage.

Methods Two thousand and thirty-two elderly Chinese aged ≥ 70 years, randomly selected from a registered list of all recipients of Old Age and Disability Allowances in Hong Kong, were administered a questionnaire on lung health. Two hundred and fifty subjects were invited to attend our laboratory for skin tests and pulmonary function tests and 179 agreed. Of these, 173 (96.6%) and 176 (98.3%) had eosinophil count and serum IgE levels measured, respectively. Two definitions of asthma were used: (1) bronchial hyper-responsiveness (BHR) plus current wheeze, and (2) history of wheezing without previous diagnostic labels of emphysema or chronic bronchitis.

Results Fifteen patients (out of 179: 8.4%) reported wheezing over the past 1 year. Fifty-one patients (28.5%) demonstrated BHR on spirometry or histamine challenge tests. Seven patients had both symptoms of wheezing and evidence of BHR. The prevalence of asthma using this definition is therefore 3.9% (95% CI 1.6–7.9%). Nine patients had symptoms of wheezing without previous diagnostic labels of chronic bronchitis or emphysema and, using this definition, the prevalence is 5.0% (95% CI 2.3–9.3%). Using multiple logistic regression studies, sex, social class, age, smoking habits, serum IgE levels and eosinophil counts did not predict a diagnosis of asthma using either definition. We found no association between a positive skin test and any respiratory symptoms or illnesses including asthma.

Conclusion Wheeze, bronchial hyper-responsiveness and asthma are prevalent amongst our elderly population. However, there were no identifiable demographic and laboratory risk factors in this study that may help us predict a diagnosis of asthma.

Keywords asthma, prevalence, elderly

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Introduction

Asthma is a common and chronic health problem, affecting patients of all ages. The prevalence of asthma is increasing [1, 2], as are admission rates for adults with asthma [3]. There is evidence in the literature that there are serious problems within the primary care community of underdiagnosis, undertreatment and mismanagement [4, 5]. However, because of the ease of sampling, these studies have concentrated mainly on the paediatric and general population, with relatively little data available on elderly subjects. As we enter the 21st century, there is a world-wide trend towards an increase in the geriatric population. In Hong Kong, about 8.8% of the population were

over 64 year of age in 1991. This figure is projected to rise to 11.6% by the year 2001. Hence, asthma amongst the elderly population is likely to present an increasing challenge to the general physician.

Recent evidence suggests that asthma is in fact not uncommon in this age group. Amongst white subjects aged 65 year and over, prevalence rates of 3–7% have been reported [6–11]. In our previous study [12], we demonstrated that respiratory ailments in Hong Kong elderly were as common as those reported in Sweden and the USA. We also showed that while 10% of the surveyed population fit the diagnostic criteria for chronic obstructive pulmonary disease (COPD), only 6.8% were labelled as such. While we were unable to demonstrate that the same level of underdiagnosis held true for asthma in that study, this was likely to be the case as comparison with data from the western countries showed that our elderly had the lowest prevalence of asthma. As asthma is a potentially reversible disease,

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early diagnosis and appropriate treatment can help alleviate respiratory disability suffered by our elderly population, who already have a limited respiratory reserve as a result of ageing.

In our present study, we aim to determine the prevalence of wheeze, bronchial hyper-responsiveness and asthma amongst our elderly population, as well as deducing the clinical and laboratory risk factors that may help identify elderly asthmatics at an earlier stage so as to improve our care for the geriatric population.

Subjects and methods

We had previously reported the respiratory symptoms and diseases of 2032 elderly Chinese [12]. These subjects, aged 70 years and over, were selected by random sampling from a registered list of all recipients of Old Age and Disability Allowances in Hong Kong. A total of 3400 letters were sent via the Social Welfare Department to these subjects to recruit the required numbers. Interviewers visited these subjects and a questionnaire on lung health based on the one used by Dow et al. [13] was completed. The questionnaire (see Appendix) consisted of information on symptoms of wheeze, morning chest tightness, breathlessness, sputum production and cough, either occurring spontaneously or on exposure to common aeroallergens or irritants; past history of respiratory diseases including asthma, chronic bronchitis, and emphysema, smoking habits and previous full-time occupation. Subsequently, 250 subjects were randomly selected for invitation to attend our hospital for measurements of pulmonary function and skin tests. One hundred and seventy-nine agreed to participate (72%). Of these, 173 (96.6%) had serum eosinophil counts and 176 (98.3%) had IgE levels measured (IMx analyser, Abbott Laboratories, Chicago, IL, USA). This subgroup had a symptom and disease profile similar to the original group of patients and therefore could be regarded as a representative sample.

Skin prick tests

Atopy was measured by skin prick test reactions to eight common allergens, applied to the forearm using the method of Pepys [14]. Allergens used include house dust, house dust mites (*Dermatophagoides pteronyssinus* and *D. farinae*), animals including dog hair and cat fur, pollens, aspergillus, and whole egg. Histamine and saline were included as positive and negative controls, respectively. After 10 min, weal size was recorded as the long axis and its perpendicular and its mean calculated. A skin prick test was regarded as positive if the reaction to allergens was larger than or equal to 3 mm. A subject was regarded as atopic if there was one or more positive reactions.

Lung function measurements

The baseline forced expiratory volume in 1 s (FEV₁) and forced vital capacity (FVC) were measured using a compact spirometer (Vitalograph, Buckingham, UK). Subjects whose FEV₁ was above 1 litre and >60% of predicted value were then tested with a histamine bronchial challenge. One hundred and nine patients (60.9%) were eligible and they were challenged serially with an increasing concentration of histamine given via a nebuliser using Yan's method until the FEV₁ fell by 20% from the baseline value [15]. The concentration of histamine that produced such a fall was recorded as the PC₂₀FEV₁ and a value of

less than 8 mg/mL was regarded as indicating the presence of bronchial hyper-responsiveness (BHR). Where subjects do not qualify for the histamine bronchial challenge test on the basis of inadequate lung function, a 15% increase in FEV₁ with a minimum change of 200 mL/s, measured at 10 min after 800 µg of salbutamol had been given via a meter dose inhaler was taken as indicating BHR.

We used two different definitions of asthma. The first defined asthma as BHR plus recent wheeze (in the past 12 months). Toelle et al. found that this definition of asthma was able to discriminate a group with greater severity of both clinical and physiological measures [16]. The second defined asthma as a history of wheezing without previous diagnostic labels of emphysema and chronic bronchitis. This definition was used as other causes of chronic wheezing in population-based surveys were unusual.

Analysis

The relationship of respiratory symptoms and diseases with FEV₁, PC₂₀ and eosinophil count was examined using Mann–Whitney test. Demographic and laboratory characteristics of elderly asthmatics vs. non-asthmatics were analysed with Chi-square exact test. Eosinophil counts and serum IgE profiles comparing elderly asthmatics and non-asthmatics were performed using Mann–Whitney test.

Results

One hundred and seventy-nine patients who completed the questionnaire attended our respiratory function laboratory for blood tests, skin tests and lung function tests. There were 88 males (47 aged 70–79, 41 aged 80+) and 91 females (52 aged 70–79, 39 aged 80+). The demographic data of the responders, non-responders and sample population are presented in Table 1.

Fifteen patients (8.4%) reported symptoms of wheezing over the past 1 year. These patients as a group had significantly lower FEV₁ (% predicted) and higher eosinophil count than those who did not ($P < 0.05$ by Mann–Whitney) (Table 2). Patients who suffered chest tightness on waking, breathless at rest, bronchitis and emphysema had significantly lower FEV₁ (% predicted) ($P < 0.05$ by Mann–Whitney) as expected. Bronchitis was associated with a significantly lower PC₂₀ ($P < 0.05$ by Mann–Whitney). Breathlessness at rest and morning phlegm were associated with a higher eosinophil count ($P < 0.05$ by Mann–Whitney).

Fifty-one patients (28.5%) demonstrated BHR on spirometry or histamine challenge tests. Seven patients had both symptoms of wheezing and evidence of BHR. The prevalence of asthma in our study population using the first definition was therefore 3.9% (95% CI 1.6–7.9%). Interestingly, only one of these seven patients had a previous diagnosis of asthma. The other six patients had diagnostic labels of chronic bronchitis or emphysema. Nine patients reported symptoms of wheezing without having previous labels of emphysema or chronic bronchitis. The prevalence of asthma using the second definition was therefore 5.0% (95% CI 2.3–9.3%).

We attempted to identify patients at risk of having asthma by performing multiple logistic regression studies on demographic variables and blood tests results. We found that sex, social class, age, smoking habits, serum IgE levels and eosinophil counts did

Table 1. Demographic data of responders, non-responders, and the sample population

Demographic variable	<i>n</i>		
	Responders	Non-responders	Sample population
Sex			
Male	88 (49.2%)	34 (47.9%)	1002 (49.3%)
Female	91 (50.8%)	37 (52.1%)	1030 (50.7%)
Education			
No formal education	105 (58.7%)	42 (60.0%)	1206 (60.0%)
Primary or below	47 (26.3%)	17 (24.3%)	502 (25.0%)
Secondary or above	27 (15.1%)	11 (15.7%)	302 (15.0%)
Smoking habits			
Lifelong non-smoker	94 (52.5%)	37 (52.1%)	1065 (52.7%)
Ex-smoker	52 (29.1%)	21 (29.6%)	622 (30.8%)
Current smoker	33 (18.4%)	13 (18.3%)	333 (16.5%)
Age			
70–79	99 (55.3%)	38 (53.5%)	1139 (56.1%)
80+	80 (44.7%)	33 (46.5%)	893 (43.9%)
Social class			
Non-manual	33 (18.4%)	14 (20.0%)	447 (22.2%)
Skilled	77 (43.0%)	28 (40.0%)	814 (40.4%)
Unskilled	69 (38.5%)	28 (40.0%)	753 (37.4%)

The total number of subjects amongst the non-responders with information on education, and social class were 70. The total number of subjects in the base population with information on education, smoking habits and social class were 2010, 2020 and 2014, respectively.

not predict a diagnosis of asthma using either definition (Tables 3–6). We found no association between a positive skin test and any respiratory symptoms or illnesses including asthma (Table 7).

Discussion

Asthma is a chronic disabling disease, especially in elderly people in whom prevention of the loss of autonomy becomes very important. In a population-based case-control study, Nejjari and coworkers found that elderly asthmatic patients had a higher dependence in the Activities of Daily Living, a greater self-perception of poor health, and a greater handicap in mobility when compared with matched controls [17]. Recent data have also suggested that mortality related to asthma amongst the elderly has increased over the past 10 years [18]. However, asthma, a potentially treatable disease, is often overlooked in the elderly. Because most patients develop asthma in childhood or adolescence, it is often assumed that its occurrence in the elderly is quite rare. Asthmatic symptoms are instead attributed to ageing or other common diseases of the elderly. In an epidemiological survey, Burrows and coworkers found that most elderly newly diagnosed asthmatics had significant symptomatology, especially wheezing, more than 8 years before their diagnosis [19]. They found in a community survey that 40% of their active elderly asthmatic patients had developed their first symptoms after the age of 65 years.

This study shows that the prevalence of asthma amongst our elderly patients varies from 3.9% to 5%. This is comparable to figures (1.8% to 7.9%) obtained in the West [6–11]. In our study, we used two different definitions of asthma: one based on questionnaire alone and the other based on questionnaire with additional laboratory criteria. Other authors have used various

Table 2. Relationship of respiratory symptoms and disease with FEV₁, PC₂₀ and eosinophils

Symptom/ disease	FEV ₁ (% predicted)		PC ₂₀ (mg/dL)		Eosinophils (× 10 ⁹ /L)	
	<i>N</i>	Median	<i>N</i>	Median	<i>N</i>	Median
Wheeze						
Yes	15	52.80*	4	4.100	15	0.1890*
No	164	88.70	105	8.000	158	0.1180
Chest tightness on waking						
Yes	11	49.10*	3	3.860	11	0.1320
No	168	88.15	106	8.000	162	0.1200
Breathlessness at rest						
Yes	10	57.25*	3	8.000	9	0.1890*
No	169	87.90	106	8.000	164	0.1180
Nocturnal breathlessness						
Yes	13	67.60	7	8.000	12	0.2055
No	166	87.50	102	8.000	161	0.1200
Morning phlegm						
Yes	51	91.00	36	8.000	50	0.1715*
No	128	86.10	73	8.000	123	0.1160
Breathlessness and/or tightness on exposure to common allergens						
Yes	11	83.9	7	8.000	11	0.1560
No	168	87.4	102	8.000	162	0.1191
Breathlessness and/or tightness on exposure to one or more irritants						
Yes	16	71.8*	7	7.500	15	0.1890
No	163	88.5	102	8.000	158	0.1191
Cough on exposure to one or more irritants						
Yes	31	80.8	20	8.000	29	0.1200
No	148	87.8	89	8.000	144	0.1210
Wheeze on exposure to one or more irritants						
Yes	2	68.6	1	1.45	2	0.1875
No	177	87.4	108	8.000	171	0.1200
Bronchitis						
Yes	11	61.60*	5	2.200*	11	0.1770
No	168	88.15	104	8.000	162	0.1200
Emphysema						
Yes	6	44.85*	2	5.775	6	0.1755
No	173	87.90	107	8.000	167	0.1200
Asthma (reported by patient)						
Yes	6	71.90	3	8.000	6	0.1365
No	173	87.40	106	8.000	167	0.1200
Asthma (1st definition)						
Yes	7	61.60*	3	1.500*	7	0.2220
No	172	87.65	106	8.000	166	0.1200
Asthma (2nd definition)						
Yes	9	58.90*	2	4.750	9	0.2070*
No	170	88.00	107	8.00	164	0.1191

*: $P < 0.05$ by Mann–Whitney when compared with corresponding values in those without the symptoms.

combinations of diagnostic criteria in their studies including questionnaire surveys, bronchodilator responses and histamine challenges [6–11]. Studies based on questionnaire surveys generally report a higher prevalence, for example 5% in our study vs. 6.3%–7.9% in others [8, 10] whilst studies which require additional laboratory criteria generally report lower figures, for example 3.9% in our study vs. 1.8%–5.9% in others

Table 3. Demographic and laboratory characteristics of elderly asthmatics vs. non-asthmatics using an asthma definition of BHR + current wheeze

		Asthma (definition 1)		Chi-square exact (<i>P</i> -value)
		Yes (<i>N</i> (%))	No (<i>N</i> (%))	
Age (years)	70–79	5 (2.8%)	94 (52.5%)	0.46
	80+	2 (1.1%)	78 (43.6%)	
Social class	Non-manual	1 (0.6%)	32 (17.9%)	0.88
	Skilled	4 (2.2%)	73 (40.8%)	
	Non-skilled	2 (1.1%)	67 (37.4%)	
Sex	M	4 (2.2%)	84 (46.9%)	0.72
	F	3 (1.7%)	88 (49.2%)	
Education	Nil	5 (2.8%)	100 (55.9%)	0.61
	Primary	1 (0.6%)	46 (25.7%)	
	Secondary or above	2 (1.1%)	25 (14.0%)	
Smoking habits	Never-smoker	2 (1.1%)	92 (51.4%)	0.33
	Ex-smoker	4 (2.2%)	48 (26.8%)	
	Current-smoker	1 (0.6%)	32 (17.9%)	
Eosinophil count	< 0.4	7 (4.0%)	160 (92.5%)	1.00
	≥ 0.4	0 (0%)	6 (3.5%)	
Skin test	Atopic	1 (0.6%)	35 (19.6%)	1.00
	Non-atopic	6 (3.4%)	137 (76.5%)	

Table 4. Eosinophil and serum IgE profiles of elderly asthmatics vs. non-asthmatics using an asthma definition of BHR + current wheeze

	Asthma (definition 1)		<i>P</i> -value (Mann–Whitney)
	Yes	No	
Eosinophil count ($\times 10^9/L$)	<i>N</i> = 7	<i>N</i> = 166	0.07
Median (interquartile range)	0.22 (0.09–0.37)	0.12 (0.08–0.20)	
IgE (kIU/L)	<i>N</i> = 7	<i>N</i> = 169	0.48
Median (interquartile range)	98.4 (29.8–114.0)	51.4 (21.8–160.3)	

Table 5. Demographic and laboratory characteristics of elderly asthmatics vs. non-asthmatics using an asthma definition of history of wheezing without previous diagnostic labels of emphysema or chronic bronchitis

		Asthma (definition 2)		Chi-square exact (<i>P</i> -value)
		Yes (<i>N</i> (%))	No (<i>N</i> (%))	
Age (years)	70–79	5 (2.8%)	94 (52.5%)	1.00
	80+	4 (2.2%)	76 (42.5%)	
Social class	Non-manual	3 (1.7%)	30 (16.8%)	0.45
	Skilled	4 (2.2%)	73 (40.8%)	
	Non-skilled	2 (1.1%)	67 (37.4%)	
Sex	M	4 (2.2%)	84 (46.9%)	1.00
	F	5 (2.8%)	86 (48.0%)	
Education	Nil	4 (2.2%)	100 (55.9%)	0.51
	Primary	4 (2.2%)	43 (24.0%)	
	Secondary or above	1 (0.6%)	26 (14.5%)	
Smoking habits	Never-smoker	4 (2.2%)	90 (50.3%)	0.09
	Ex-smoker	1 (0.6%)	51 (28.4%)	
	Current-smoker	4 (2.2%)	29 (16.2%)	
Eosinophil count	< 0.4	9 (5.2%)	158 (91.3%)	1.00
	≥ 0.4	0 (0%)	6 (3.5%)	
Skin test	Atopic	1 (0.6%)	35 (19.6%)	0.69
	Non-atopic	8 (4.5%)	135 (75.4%)	

Table 6. Eosinophil and serum IgE profiles of elderly asthmatics vs. non-asthmatics using an asthma definition of history of wheezing without previous diagnostic labels of emphysema or chronic bronchitis

	Asthma (definition 2)		P-value (Mann–Whitney)
	Yes	No	
Eosinophil count ($\times 10^9/L$)	<i>N</i> = 9	<i>N</i> = 164	0.06
Median (interquartile range)	0.21 (0.17–0.26)	0.12 (0.08–0.20)	
IgE (kIU/L)	<i>N</i> = 9	<i>N</i> = 167	0.61
Median (interquartile range)	110 (23.1–270.8)	51.4 (21.8–156)	

Table 7. Odds ratio for respiratory symptoms and diseases in the presence of a positive skin test

	Odds ratio (95% Exact Confidence Limit)
Wheeze	0.58 (0.06–2.74)
Chest tightness on waking	0.77 (0.08–3.84)
Breathlessness at rest	0.97 (0.10–5.17)
Nocturnal Breathlessness	2.65 (0.64–9.84)
Morning phlegm	1.06 (0.43–2.46)
Breathlessness and/or chest tightness on exposure to common allergens	2.37 (0.48–9.91)
Breathlessness and/or chest tightness on exposure to one or more irritants*	0.89 (0.15–3.5)
Cough on exposure to one or more irritants*	1.69 (0.62–4.28)
Wheeze on exposure to one or more irritants*	3.97 (0.05–313.9)
Bronchitis	0.86 (0.09–4.42)
Emphysema	0.77 (0.02–7.22)
Asthma (real)	0.65 (0.01–5.66)

*irritants = cold air, household chemicals, traffic fumes, smoke.

NB: none of the results were statistically significant.

[6, 9, 11]. The various diagnostic criteria used highlight the problems with the definition of asthma, especially in the elderly. The American Thoracic Society has defined asthma as a disease that can be characterized by reversible airflow obstruction, airway inflammation, and airway hyper-responsiveness to a variety of stimuli. However, COPD, which is common amongst elderly patients, may share similar definition characteristics, making it difficult to distinguish among these disorders despite their different pathophysiology and natural history. For example, some patients with COPD show partial reversibility of their airflow obstruction after treatment whilst certain asthmatic patients may show little or no reversibility after treatment. Such a problem with definition together with the inherent diagnostic biases makes the diagnosis of asthma in the elderly even more challenging and underlies the importance of a formal steroid trial in patients with COPD who remain symptomatic despite adequate bronchodilator therapy.

Burrows and coworkers in their study of elderly asthmatics found that a positive skin test, elevated blood eosinophilia and serum IgE level were associated with an increased risk of newly diagnosed asthma [19]. We found no such association amongst our local population of elderly asthmatics. These

differences may reflect the inherent genetic differences between Chinese and white people. However, there are also significant differences in the methods of studies. The population of elderly asthmatics recruited by Burrows had an average age of 70.8 years while all our patients were aged > 70 years. It has been shown in several studies that skin test sensitivity and serum IgE levels decrease with increasing age [19–21]. Hence, these factors may no longer be good predictors in our population of asthmatics.

As discussed previously, the subgroup of patients who had lung function tests and blood tests had a symptom and disease profile similar to the original cohort of patients. A potential for selection bias was the selection of only patients who were mobile enough to attend our lung function laboratory. Nevertheless, this was the group of patients whom we were most interested in, as they still had a preserved quality of life and hence would benefit most from appropriate medical intervention. We may be criticized for the definitions used as bronchial hyper-responsiveness on bronchoprovocation and bronchodilator reversibility on pulmonary function testing may give rise to false positive results in this age category [22, 23]. However, it would not be feasible to perform steroid trials on a large scale. Furthermore, these definitions were thought to be appropriate in previous epidemiological studies [6, 9, 11].

In conclusion, our study confirms that wheezing, bronchial hyper-responsiveness and asthma are prevalent amongst the elderly. Unfortunately, we are unable to determine any demographic and laboratory risk factors that may help the clinician to predict a diagnosis of asthma. The lack of identifiable predictive factors in our study may be related to the small sample size. Further studies designed to address this clinical problem are essential as asthma is a potentially treatable condition with a much better prognosis than COPD.

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Appendix

Respiratory symptom questionnaire

(1) Symptoms of wheeze and chest tightness

Have you ever had wheeze at any time in the past 12 months? Yes
No

Have you ever had chest tightness on waking in the past 12 months? Yes
No

(2) Symptoms of breathlessness

Have you ever had breathlessness at rest over the past 12 months? Yes
No

Have you ever had breathlessness at night over the past 12 months? Yes
No

(3) Production of phlegm

Do you often produce phlegm on waking in the morning? Yes
No

(4) Allergens

When you are exposed to dusts, cat and dog hair, or feathers including pillows and blankets, have you ever experienced:

Breathlessness?	Yes No Don't know
Chest tightness?	Yes No Don't know

(5) Precipitants of breathlessness, wheeze, or cough

Which of the following precipitants may give rise to symptoms of breathlessness, wheeze, or cough:

Cold air	None Breathlessness Wheeze Cough Don't know
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Household chemicals, e.g. bleach, hairspray, perfumes	None Breathlessness Wheeze Cough Don't know
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Traffic fumes	None Breathlessness Wheeze Cough Don't know
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Smoke	None Breathlessness Wheeze Cough Don't know
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(6) Illnesses

Have you ever been diagnosed with:

Chronic bronchitis?	Yes No
Emphysema	Yes No
Asthma	Yes No