

SPECIAL ARTICLE

Epidemiology and Current Status of Asthma and Associated Allergic Diseases in Taiwan- ARIA Asia-Pacific Workshop Report

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SUMMARY The prevalence of allergic diseases appears to have been increasing in recent years. The hospitalization rate of asthma in children showed an increasing trend. House dust mites and cockroaches are the two most common indoor aeroallergens in Taiwan. Various kinds of inhaled corticosteroids or combination medications are available, but in clinical practice these have not been used as much as oral beta-2 agonists. Generally 68% of the physicians would follow the asthma treatment guidelines. Because of the comprehensive health care insurance system, the majority of the population in Taiwan can afford the medical expense of diseases. The country's expenditure of asthma care is around USD 83.1 millions per year which is increasing by the year as well. In clinical aspects, asthma education should still be included as part of its treatment.

Taiwan is located on the east coast of Asia in the Western Pacific. There are 22.9 million people, and the land area is 36,188 km²; therefore, the population density is 636/km², which is only secondary to Bangladesh in the world. Taiwan is noted for her subtropical climate. The average monthly temperature in the lowlands is 16°C in the winter and ranges between 24 to 30°C in the rest of the year. The average relative humidity is 78%.

A compulsory National Health Insurance (NHI) was implemented in Taiwan since 1995, and more than 96% of the population is covered by this system. The participation rate of medical institutions was around 94% nationwide.¹ The gross domestic product (GDP) per person was USD 16,792 in 2007,

so the majority of the population can afford the payment of this insurance.

Epidemiology of allergy in Taiwan

Asthma, allergic rhinitis, and atopic dermatitis are very common allergic diseases in Taiwan. Although there were some reports that the prevalence of asthma might reach a plateau in western countries,^{2,3} the increasing prevalence of asthma and allergic rhinitis is still prominent in Taiwan. According

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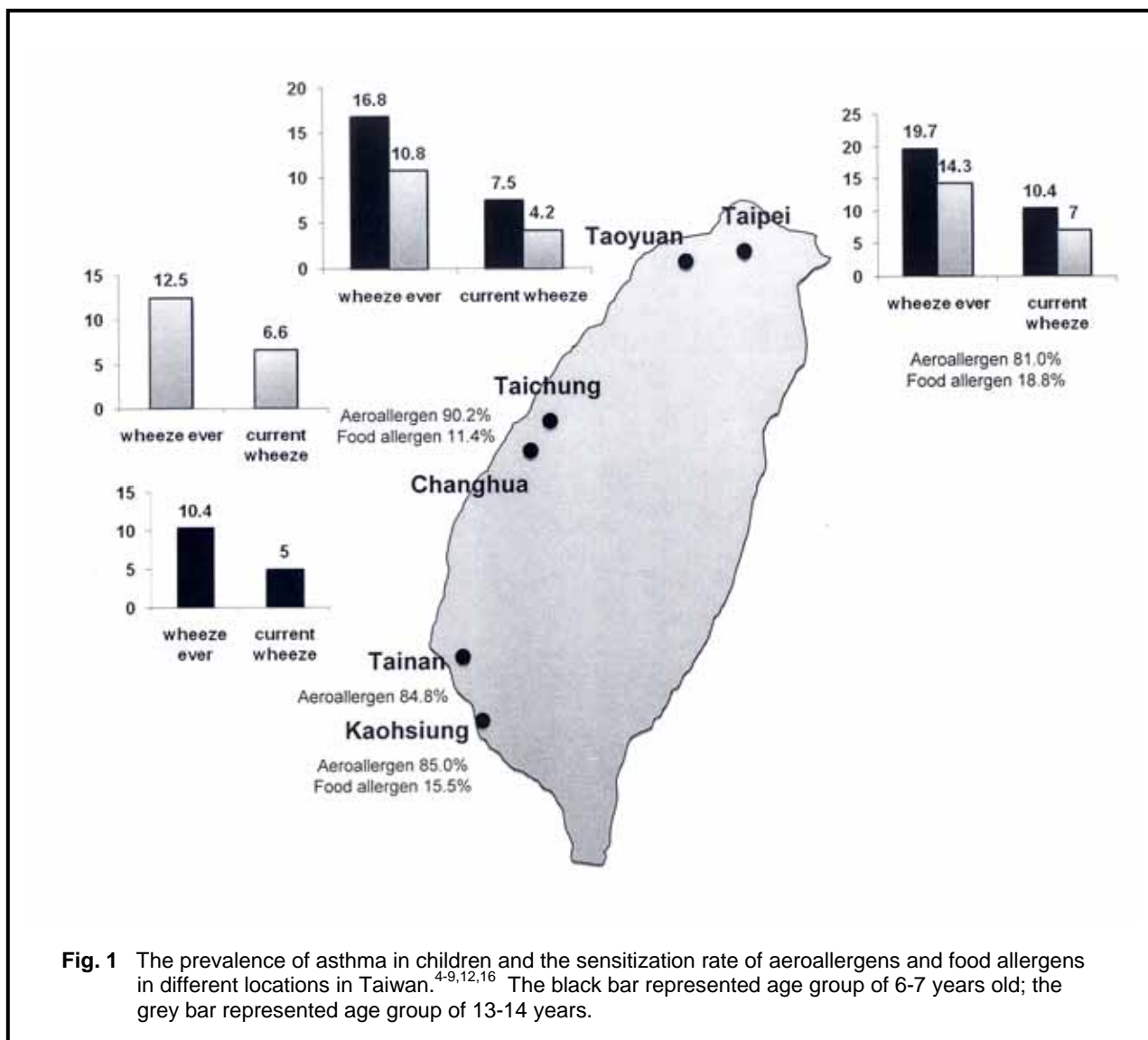
to the International Study of Asthma and Allergies in Childhood (ISAAC) survey in different parts of Taiwan, the asthma prevalence rate was 16.8% to 19.7% in children of age 6-7 years, and 10.8% to 14.3% in age of 13-14 years.^{4,7} The average admission rate of asthma was 105.0 per 100,000 population. However, the admission rate was significantly lower in the children group than in the adult group.⁸ As for the prevalence of allergens, mites are one of the major allergens. They have wide differences in the numbers in different locations and in different seasons. Generally, 79.3% to 82.5% of asthmatic children are sensitive to mites;⁹ however, up to 97.6% of atopic children have all clinical presentations of asthma, allergic rhinitis and atopic dermatitis.¹⁰ Most of the patients are sensitive to different species of mites at the same time instead of to a single mite allergen. That is, 2.4% of patients were only sensitive to *Dermatophagoides pteronyssimus* (Der p), and 2.9% to *Dermatophagoides farinae* (Der f). The mean numbers of mites was greater in August through November then gradually decreased from December to June, and the lowest amount appeared in July.^{11,12} Pollen is not a prominent allergen even in spring or summer. In terms of different parts in Taiwan, the incidence of sensitization of Der p, Der f, cockroach, feather, shrimp, crab, and peanut were higher in atopic subjects under 18 years of age in northern Taiwan, and there was a significant difference compared to age-matched subjects in southern Taiwan.¹³ However, the sensitization rate to Der p was 3.5 times lower in Kin-Men, an off-shore island, than in Taipei, the capital of Taiwan. On the other hand, ragweed pollen was a significant allergen in Kin-Men.¹⁴ There was no difference in sensitization to Der p and Der f whether in children below 16 or in adults (from 57.4% to 63.6%).¹⁵ In children below three years of age, around 44% of them were sensitive to mites, but the rate rose up prominently to 90% after three years old.¹³ Another survey also shows that mite allergy occurred more frequently in patients aged 11 to 20 years (96.8%).¹⁶ *Dermatophagoies microcera* (Der m) is another allergen seldom noticed. Its prevalence of sensitization was 79.5% in central Taiwan.¹⁷ In addition to the genus *Dermatophagoides*, *Blomia tropicalis* (Blo t) is also an important mite species in the tropical and sub-tropical regions of the world. Different studies show that there is around a 73% positive rate of sensitization among asthma patients in Taiwan.^{9,18} Concomitant

sensitizations to Blo t and Der p occurred in 63.3% of the asthmatic patients.¹⁸

Cockroach is the second most common aeroallergen. Among atopic patients, 57.5% of patients with asthma and 50.7% of patients with allergic rhinitis were sensitive to cockroach extracts.¹⁹ Like mites, this airborne allergen also became significant for patients over three years old, and there was no difference between children and adults.¹⁵ A study of the relationship between early exposure to allergens and atopic diseases in later life in Taiwan revealed that exposure to a mite allergen concentration of 1 µg/g of dust may be associated with a higher incidence of atopic dermatitis ($p = 0.0156$); the presence of Der p 1 IgE antibody at 18 months of age was associated with a higher incidence of asthma ($p = 0.0001$); and children sensitized to egg whites at 18 months of age had an increased risk of developing atopic dermatitis at three years of age ($p = 0.0187$).²⁰ Clinically sensitization to egg white and milk and subsequent tolerance appeared early in childhood, whereas allergy to inhalants appeared later and did not disappear.²¹ The prevalence of asthma in young children and sensitization rate of any aeroallergens and food allergens in different parts of Taiwan are shown in Fig. 1.

Associated allergic diseases

Allergic rhinitis is another annoying problem. It had an even higher prevalence rate than asthma. From a survey for 2,240 six- to seven-year-old children, 47.7% suffered from rhinitis, but only 10.7% of them were not troubled by it in their daily activities. As for physician-diagnosed allergic diseases, the prevalence was 24.6% for rhinitis and 18.0% for eczema, respectively.⁴ Among food allergens, milk and egg white were found more frequently in patients below 10 years old.^{22,23} More specifically, crab, milk and egg white were prominent food allergens in two- to six-year-old children in Taiwan.²⁴ Seldom were asthma symptoms ascribed to food. One study showed that among 88 subjects who were only sensitive to food by having specific IgE in serum, 33 had been diagnosed as asthmatic. Among these asthmatic patients, 72.7% of them were only sensitive to one kind of food.²⁵ An investigation of 1,166 teenagers to find the relationship of food pattern and physician-diagnosed asthma revealed



that asthma was associated with intakes of liver (OR = 2.32, 95% CI 1.11-4.80), deep-fried foods (OR = 2.13, 95% CI 1.06-4.30) and butcher's meat (OR 1.84, 95% CI 0.89-3.80). Allergic rhinitis was associated with liver (OR = 1.67, 95% CI 1.06-2.63). There was no protective effect demonstrated for any of the food items examined, but protein-rich and fat-rich foods of animal origin were associated with a higher prevalence of asthma in teenagers.²⁶ And girls, not boys, in the highest body mass index (BMI) quintile had higher prevalence of atopy and rhinitis symptoms (OR = 1.77, 95% CI 1.15-2.73).²⁷

As for latex allergy, its prevalence among hospital personnel was 6.9-8.6% and certain predis-

posing factors such as atopic dermatitis, current hand eczema and surgical work appeared to play a critical role in triggering and aggravating the symptoms. The symptoms were not associated with the number of years of employment, daily working hours or previous history of hand eczema, but with a total exposure to latex gloves more than 9,000 hours.^{28,29}

Diagnosis and treatment of asthma

Till now the diagnosis of asthma has mainly been based on clinical history. Both general practitioners and asthma specialists provide asthma care. From the data of the Department of Health, there were 21,158 registered physicians, including 1,292

qualified asthma specialists residing and practicing in Taiwan in 2005. Using a questionnaire to survey 526 physicians, approximately 80% of clinicians responded that they had confidence in dealing with asthma problems.³⁰ It was notable that specialists had more confidence in diagnosing asthma than general practitioners ($p < 0.01$).³¹ And doctors in higher levels of referred institutions were more competent in diagnosing asthma.³⁰

Generally 68% of the physicians would follow the asthma treatment guidelines to manage patients.³⁰ Approximately 90.4% of specialists would follow published guidelines in treating asthma patients, whereas only 63.2% of general practitioners practiced such guidelines.³¹ The adherence to asthma treatment guidelines is sub-optimal for specialists in medical centers and regional hospitals. Poor adherence to asthma guidelines may be due to doctors' behavior and patients' attitudes.^{32,33} For the quality of asthma care, 51% of doctors do not use peak flow meters to monitor asthma symptoms because of prohibitive costs. It was significant that 79.8% of the specialists would instruct patients to use a peak flow meter to monitor symptoms, whereas only 41.9% of primary practitioners would do the same ($p < 0.001$).³¹

Treatment modalities

It is commonly suggested to wash sheets, duvets or clothes in warm water to remove mite allergens. It is necessary to use at least 55 °C to kill 80% of mites, but 120-140°C is required to denature the mite allergens.³⁴ Using western standards and recommendations, however, are not practical in Taiwan because families are rarely equipped with temperature-adjustable washing machines at home, and it is impractical to prepare hot water in advance for washing clothes. Although exposing beddings to direct sunlight could kill mites,³⁵ this is also not convenient for those who live in high-rise buildings in urban areas of Taiwan. A tumble dryer might be an alternative choice to reduce mites. The mite numbers in duvets reduced significantly from 410/m³ to 6/m³ after hot tumble drying for one hour, but neither Der p 1 concentrations in duvet dust samples nor total dust weights were significantly altered by tumble drying.³⁶ The clinical benefits of symptoms improvement after reducing allergen load by tumble drying require further evidences.

Alternative therapies such as herbal medicine, acupuncture, or other health remedies are popular in Taiwan because people generally believe that traditional medicine will modulate physical constitution and does not have side effects. There is a trend to use scientific research to prove the efficacy of traditional medicine and to convince people of its safety and clinical effects.^{37,38} One study shows that applying Ding Chuan Tang to asthmatic children for 12 weeks could improve their airway hyperresponsiveness, clinical symptoms and medication use.³⁸ A popular treatment modality, San-Fu-Tie, used by applying a patch of the herbal medicine over an acupuncture point on the back during summertime, was claimed to prevent asthma or allergic rhinitis symptoms in the winter season. However, as yet there is insufficient scientific data to prove these effects. More *in vitro* or *in vivo* studies should be done on traditional medicine. A survey for physicians receiving western medical education revealed that 71.4% of them would not agree to use herbal medicine as a long-term treatment modality for asthma. However approximately 60% of asthmatic patients had been using herbal medicine concomitantly with western medicine for their diseases.

Expenditure on treatment

The major brands of anti-asthma medication are all available in Taiwan. In terms of physicians' prescription behaviors, 20.2% of physicians use oral corticosteroids for maintenance therapy and 77.2% of physicians use inhaled corticosteroids.³⁰ However, using the National Health Insurance Research Database to survey the prescribing patterns of anti-asthma drugs in children, younger patients were treated more frequently with oral medications. 69.4% and 40.2% of patients used oral beta-agonists and methylxanthines, respectively. Monotherapy with oral beta-agonists was the most popular regimen, accounting for 13.7% of the total prescriptions studied. Only 6.7% of patients took inhaled corticosteroids for asthma control.³⁹ Another survey had similar findings that oral beta-agonists was the most frequently prescribed monotherapy (52.6-77.6%), but inhaled corticosteroids were used only in 3.0-11.0% of patients with asthma.⁴⁰ As for asthmatic children who needed inhaled corticosteroids for maintenance therapy prescribed by doctors, only 17.4% of them would follow doctor's orders and had good compliance.⁴¹ Misunderstanding and misuse of inhaled cor-

ticosteroids is still a common phenomenon. A new monoclonal antibody, anti-IgE, for severe persistent asthma was launched in Taiwan in 2007.

The mean total of direct costs of asthma management per patient as a proportion of the per capita GDP was 3%, and as a percentage of per capita health spending was 53%. The mean total direct annual cost per patient was USD 328±23, including USD 206±11 for maintenance care and USD 121±19 for urgent care. The drug costs were USD 176±9 equivalent to 53.7% of total cost.^{42,43} As for asthma hospitalization, the average asthma hospitalization rate was 113.4 per 100,000 population. The average annual cost was USD19.6 millions. The hospitalization stay was 7.2 ± 8.2 days per admission, and cost USD 623.0 ± 1,266.1 in each admission. The hospitalization cost per day per admission was USD 79.8 in children group; however, it was average USD 97.4 per day per admission with and increasing rate of 4.3% per year in adult group.⁸

The total expenditure on asthma is around USD 81.3 million per year. All the asthmatic medication is covered by the insurance system except the spacer and peak flow meter. So all those who have this problem can afford the expense of asthma treatment and obtain appropriate care. However, as mentioned above, the knowledge of asthma care among patients and physicians should be reinforced by a continued educational program.

Indoor and outdoor pollutants and their impact

Air pollutants are considered to be one of the reasons of the increasing prevalence and exacerbation of symptoms of asthma or allergic diseases. To investigate the relation between air pollutants and asthma, a study enrolled 12,926 junior high school students and collected pollutant data from the Environmental Protection Agency (EPA). Complete monitoring data for the air pollutants including nitrogen oxides (NO), ozone (O₃), carbon monoxide (CO), and tiny particles with a diameter less than 10 μm, as well as daily temperature and relative humidity, were available from monitoring stations. It was found that the prevalence rates of asthma were correlated significantly with NO₂ ($r = 0.63$) and O₃ ($r = 0.51$) concentrations.⁴⁴ The physician-diagnosed allergic rhinitis was also found to be associated with higher non-summer (September-May) warmth and

traffic-related air pollutants, including, NO, O₃ and CO.⁴⁵ The prevalence of both asthma and allergic rhinitis is higher in urban areas than in the suburbs, a finding that could be related to higher levels of some air pollutants in the urban locations.⁴⁶ Comparing two national surveys in 1995-96 and 2001 for a long term cross-sectional follow-up, the rising trend of asthma was not associated with municipal-level air pollutants, but rather with the increasing climactic temperatures. It was estimated that a 1.31°C elevation of temperature would indicate a 1.7% prevalence change in physician-diagnosed asthma and 4.9% in questionnaire-determined asthma.⁴⁷ In the same study, incense burning at home was not a risk factor, nor was daily cigarette consumption in the family a major reason contributing to its increasing prevalence.⁴⁷

The indoor humidity level is associated with the growth of mites and their numbers in the house. In a temperate climate, it is practical to maintain an indoor humidity of less than 51% during the humid summer season, and this results in significant reductions in mite and allergen levels.⁴⁸ In a control study, of the many indoor environmental factors that we investigated, only home dampness showed an association with asthma (adjusted Odds ratio=1.77-2.65).^{49,50} Indoor dampness may not only lead to the development of asthma or other respiratory diseases but may exacerbate the symptoms.⁵¹ Furthermore, the relation between dampness and the asthma exacerbation or disease development might be associated with dust mites. To control dust mite exposure, it is preferable to reduce indoor dampness using a dehumidifier instead of air cleaner. In a region of humid climate like Taiwan, using air conditioning or a dehumidifier can maintain an indoor relative humidity of around 50% that leads to control of dampness and mite growth.

Regarding physician-diagnosed asthma, the risk of developing it was significantly associated with parental atopy and outdoor air pollution; however, parental atopy contributed more to childhood asthma than indoor or outdoor environmental factors.⁵²

Quality of life

One of the treatment goals of allergic diseases is to improve the quality of life. A study using

the Childhood Asthma Questionnaire-Form B (CAQ-FORMB) to evaluate the quality of life of 62 asthmatic school children revealed that their active quality of life reached 80.2% satisfactory degree and passive quality of life reached 80.2% satisfactory degree. But simultaneously the severity of an attack could attain 54.7% and in distress it could reach as high as 74.8%.⁵³

Physical stress was the greatest contributing factor for impairment of quality of life in adult patients.⁴¹ Most studies about the dimensions of quality of life based on studies in western viewpoints may not be appropriate for asthmatic patients in Taiwan. A version suitable for the Taiwanese considering the different health and cultural beliefs was developed.⁵⁴ Six themes relevant to the children's QOL with asthma were identified: 1) physical disturbances of signs/symptoms, 2) limitations of activity, 3) emotional distress, 4) discord in parent-child relationships, 5) restrictions in school social life, and 6) daily inconvenience of managing the disease. These findings highlight the ways in which the overall quality of life of children is impacted by asthma including the physiological and psychosocial domains.⁵⁴ Furthermore, a concise, 35-item questionnaire was developed which could be applied to further investigations.⁵⁵ Through nursing instructions to asthmatic patients on asthma knowledge and care, they would experience significant improvements in their active quality of life and decreasing distress.⁵⁶

DISCUSSION

Asthma and associated allergic disease are common in Taiwan. Although corticosteroids, especially inhaled corticosteroids, are the cornerstone in treating allergic diseases, misunderstanding its effects and clinical use is still common. Since asthma is a chronic disease, people often try alternative therapies to modulate their physical constitution. This is despite the fact that almost all new medications are available and accessible, since the majority of the population takes advantage of the cheap and comprehensive national insurance system. There existed a huge gap between the prescription patterns and physicians' response to questionnaire or asthma treatment guidelines, as well as the patients' compliance. Education on asthma should be more emphasized for patients and healthcare professionals alike.

Since 1999, an asthma education course was developed and conducted to all school nurses in Taiwan. This was shown to have greatly improved their asthma knowledge.⁵⁷ The program, supported and funded by the government, was also extended to public health nurses and teachers in kindergarten in the past five years. It was also shown to improve the participants' competence on asthma care.⁵⁸ Till now, there have been more than 2,000 school nurses and 500 community nurses who have taken the asthma education course. One of the purposes of the course is to be able to recognize the symptoms of asthma and have the patients receive appropriate treatment as early as possible. Asthma education is much more emphasized than ever.

It is concluded that most allergic diseases are not fetal except for asthma and rare occasions of anaphylaxis. Nevertheless they influence patients' quality of life for a long time. Lots of formulations or health products declare their preventive or therapeutic effect on allergic diseases, but they require scientific evidences instead of commercial advertisement to support their efficacy. It is an obligation and responsibility of physicians to deliver accurate and scientific-based information to patients. Asthma education should be delivered to patients, health care providers, school nurses and parents. Environmental control, inhalation techniques, asthma knowledge and care should be included in education materials, and should be an integral part of treatment.

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