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ORIGINAL ARTICLE

The Trend of the Burden of Allergic Rhinitis Pre- and Post-COVID-19 Pandemic in the Urban Population of Perak, Malaysia

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Abstract

Aims This study aims to determine the trend of allergic rhinitis (AR) prevalence in a tertiary hospital between 2017 and 2022, and to compare its prevalence pre- and post-COVID-19 pandemic.

Methods This was a cross-sectional study involving the extraction of all Malaysian patients' medical records who were diagnosed with AR and attended the otorhinolaryngology outpatient clinic of a government-funded tertiary hospital in Malaysia between 2017 and 2022.

Results 3,744 cases out of the 57,968 first-encounter outpatient visits to the otorhinolaryngology clinic were extracted for analysis. Overall, the prevalence of AR cases ranged from 1.83 to 9.23% between 2017 and 2022. There was a significant drop of 21.38 to 70.22% between the pre- and post-COVID-19 pandemic ($p < 0.001$). Males (0.34 to 1.60%) were more prevalent in the 6 to 18 year old than females (0.09 to 1.23%). The trend shifted with age, whereby females (0.50 to 2.45%) experienced a higher prevalence than males (0.21 to 1.77%) as they aged from 19 to 59. The Malay (1.01 to 4.59%) demonstrated a two-time higher prevalence than the Chinese (0.30 to 2.01%) and Indian (0.40 to 2.14%) ethnicities. After stratifying by gender and ethnicity, Indian women (0.17 to 1.09%) had a higher rate of AR than their Chinese counterparts (0.12 to 0.99%) across all years.

Conclusion The AR prevalence consistently ranged from 8.14 to 9.23% pre-pandemic. A remarkable drop was observed post-pandemic, ranging from 1.83 to 6.40%. A gender shift from male to female predominance as age progressed. The Malay had the highest prevalence of AR.

Keywords Allergic rhinitis · Prevalence · Trends · Malaysia

Introduction

The World Allergy Organization (2013) reports a worldwide frequency of allergic rhinitis (AR) occurring among 10 to 40% of adults and 2 to 60% of children [1–4]. In the last two decades, the burden of AR has increased, with a prevalence ranging from 10 to 23.2% affecting all age groups in the USA, Europe, and China [5, 6]. This increased the burden of direct and indirect healthcare costs [7–9].

The types of AR are phenotypic according to geographical locations; the distribution of disease prevalence has varied across different parts of the world. In Europe, the cumulative reported prevalence has been bertween 9 and 20% over the past 20 years [1]. Specifically, in Italy, 60% of the patients reported having uncontrolled AR in 2018 [10]. The child population in Hungary aged 6 to 12 reported a prevalence of 36.2%. [11]. In Ukraine, Kazakhstan, and Azerbaijan, the prevalence reported from 2013 to 2015 was 3.4, 92.1, and 82.7 per 1,000 people, respectively [12].

In recent years, from 2010 to 2017, the prevalence of AR in Asian countries has ranged from 5.5 to 53% [13, 14]. The prevalence was 6.2% in the general population of Guangzhou, China, 16% in Turkey, 27% in South Korea, 32% in

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the United Arab Emirates, 20.4% in Kuwait [14], and 42.7% in Taipei [15].

The outbreak of COVID-19 prompted a lockdown to contain the virus's spread. The lockdown restricts public travel and forces people to stay indoors. Indirectly, this minimises human contact with outdoor allergens and, in turn, may reduce the incidence of AR symptoms. In addition, imposing rules that mandate wearing a face mask in public areas during the pandemic was suggested to reduce inhalation of allergens. A face mask is suggested to act as a physical barrier for filtering allergens, potentially reducing atopic responses, and thus benefiting patients with AR by reducing the severity of their symptoms. A study conducted during the COVID-19 pandemic shows that nurses wearing either a surgical or N95 mask had significant improvements in mild (42.3% to 29.3–25.1%) and severe (20.5% to 13.0-12.6%) overall symptom burdens when compared with those not wearing masks in one week [16]. The decreasing trend of AR in the COVID pandemic (January to July 2020) is demonstrated in a tertiary hospital in India, with a significant reduction in the incidence of AR in all age groups (5 to 65 years old) and of different levels of severity. The decrease in pollutant levels seen in the reduction of PM 2.5 concentration by 43% and regular use of a face mask were proposed as significant causes of the declining number of cases of AR in the study [17].

The risk factors triggering AR have been changing over time, and these factors are different between Western and Asian countries. The variation between Asian and Western countries could be due to cultural or climatic differences. Nevertheless, the common risk factors in both regions are pet adoption and family history, suggesting their pervasiveness in inducing AR manifestations worldwide. In Asian countries, demographic characteristics, including age, gender, race, and nationality, are linked to a higher risk of AR [14]. A recent study in Turkey reports that the prevalence of AR is higher in males in childhood, but females are affected more from 15 years of age onwards [18]. The child population of Hungary aged 6 to 12 years, male gender, family history, constant heavy vehicle traffic, living in a weedy area, and living near an air-polluting factory are risk factors of AR [11]. Children in Taipei aged 6 to 8 years who are male were associated with an increased risk of AR [15]. Living in cities is one of the most common trigger factors, while family history and current living place are significant risk factors for AR in China [19].

In Malaysia, the prevalence of AR reported in the two most recent studies ranged from 21 to 24% in office workers [20] and 18.8% in high school adolescents [21]. According to a study conducted among Malaysian office workers, an increase in age by ten years is associated with 0.72 times lower odds of rhinitis. Meanwhile, patients with house dust mite allergies have significantly higher odds of developing rhinitis in the previous 12 months. Gender was, however, not associated with the odds of rhinitis [20]. Following these studies, limited information on the prevalence and demography of risk factors for AR in recent years has been reported. This study aims to describe the trend of AR in a tertiary hospital in Malaysia over 6 years starting from 2017 to 2022, and the change in the trend of occurrence pre- and post-pandemic.

Methods

Study Design and Population

This cross-sectional study was conducted by extracting data from medical records of patients diagnosed with AR and followed up in the otorhinolaryngology outpatient clinic of Hospital Raja Permaisuri Bainun in Malaysia. This hospital is the third largest government-funded tertiary state hospital with 990 beds and offers specialists in all core disciplines and subspecialties. The retrospective data of patients from January 2017 to December 2022 were extracted from the hospital information system. Malaysian patients of all ages who are newly diagnosed with AR or have pre-existing AR and have been followed up in the otorhinolaryngology outpatient clinic were collected. The prevalence of patients with AR who visited the otorhinolaryngology clinic after the COVID-19 outbreak (January 2020 to December 2022) was compared to the preceding three years (January 2017 – December 2019).

Data Source and Extraction

We used electronic health records from the hospital information system from Jan 1, 2017, to Oct 31, 2022. We identified the cases by searching the hospital information system using the keywords of "allergic rhinitis, "rhinitis", "A.R" "A Rhinitis", "A. Rhinitis" or "AR". The data on age, gender, ethnicity and date of hospital visit were also extracted.

Statistical Analysis

The data were analysed using IBM SPSS Statistics version 20.0. Descriptive data were expressed as mean and standard deviation (SD), while categorical data were presented in frequency and percentage. The burden of AR was calculated by determining the prevalence, that is, by calculating the proportion of patients with AR over the total number of first-encountered outpatient visits to the otorhinolaryngology clinic each year. A comparison was made for the number of cases that occurred pre- and post-pandemic. A

p-value of less than 0.05 is deemed statistically significant. The patterns of each selected indicator and their change were described numerically and graphically with a bar chart plotted using points on the X-Y axis, where X is the time in years (from 2017 to 2022), and Y is the value of the selected indicator for each year in percent.

Results

Data were extracted from the records of 57,968 first-encounter visits to the otorhinolaryngology outpatient clinic, and 3,744 cases were included for data analysis. Overall, the prevalence of AR cases ranged from 1.83 to 9.23% between 2017 and 2022. There was a slight decrease from 2017 to 2018 of 5.30% (9.23 to 8.74, $p=0.202$), and a continued decline in 2019 of 6.83% (8.14 to 8.74%; $p=0.087$). When compared to pre-pandemic levels, the prevalence of cases fell significantly in 2020, with a 21.38% reduction in 2020 (8.14 to 6.40%; $p<0.001$) and a 70.22% (6.40 to 1.91%; $p<0.001$) reduction in 2021. There was a slight declination of 4.08% in 2022 (1.91 to 1.83%; $p=0.709$) despite the number of cases demonstrating an increasing trend over the preceding year.

When comparing different age groups, children aged 5 and below had the lowest prevalence, ranging from 0.11 to 0.43% between 2017 and 2022. Within the same period, the age group with the highest prevalence was between 19 and 59 years old, occurring at a rate of 0.70 to 4.23%. The AR prevalence fell drastically across all age groups except among those aged 5 and less which showed an increase of 41.38% (0.29 to 0.42%, $p=0.160$). The greatest drop occurring in the age group of 6 to 18 in 2020, by 36.76% (2.53 to 1.60; $p<0.001$); and the smallest drop occurring in the age group of 19 to 59, by 14.37% (3.55 to 3.04; $p=0.083$).

In general, females had a higher prevalence of having AR than males across all years, ranging from 0.77 to 4.65% vs. 0.77 to 4.58%. The Malay population had the highest rate of AR (1.01 to 4.59%), followed by the Indians (0.40 to 2.14%) and Chinese (0.30 to 2.01%) (Table 1).

Trends in Prevalence of AR by Age and Gender

A similar pattern of distribution was observed in comparisons of different age groups between the two genders for the younger group (age 5 years old and below) and the older age group (age 60 and above) (Fig. 1A and D). Males aged 6 to 18 had a higher prevalence distribution (Fig. 1B), but the trend shifted with age. The female population was observed

Table 1 The prevalence of AR cases from 2017 to 2022

Year	2017	2018	2019	2020	2021	2022
Prevalence of AR	9.23	8.74	8.14	6.40	1.91	1.83
cases *[95% CI]*	[8.67–9.81]	[8.25–9.25]	[7.68–8.62]	[5.76–7.09]	[1.61–2.24]	[1.57–2.12]
Total number of AR cases	937	1071	1078	341	148	169
Total new cases in otorhinolaryngology outpatient clinic	10,152	12,253	13,237	5326	7761	9239
Age group (year)						
≤ 5	44 (0.43)	31 (0.25)	38 (0.29)	22 (0.41)	9 (0.12)	10 (0.11)
n (%) [95%CI]	[0.32–0.58]	[0.17–0.36]	[0.20–0.39]	[0.26–0.62]	[0.05–0.22]	[0.05–0.20]
6 to 18	284 (2.80)	329 (2.69)	335 (2.53)	85 (1.60)	33 (0.43)	56 (0.61)
n (%) [95%CI]	[2.49–3.14]	[2.41–2.99]	[2.27–2.81]	[1.28–1.97]	[0.29–0.60]	[0.46–0.79]
19 to 59	429 (4.23)	492 (4.02)	470 (3.55)	162 (3.04)	76 (0.98)	65 (0.70)
n (%) [95%CI]	[3.84–4.64]	[3.67–4.38]	[3.24–3.88]	[2.60–3.54]	[0.77–1.22]	[0.54–0.90]
≥ 60	180 (1.77)	219 (1.79)	235 (0.67)	72 (1.35)	30 (0.39)	38 (0.41)
n (%) [95%CI]	[1.53–2.05]	[1.56–2.04]	[0.58–0.76]	[1.06–1.70]	[0.26–0.55]	[0.29–0.56]
Gender						
Male	465 (4.58)	514 (4.19)	527 (3.98)	165 (3.10)	88 (1.13)	71 (0.77)
n (%) [95%CI]	[4.18–5.01]	[3.85–4.57]	[3.65–4.33]	[2.65–3.60]	[0.91–1.40]	[0.60–0.97]
Female	472 (4.65)	557 (4.55)	551 (4.16)	176 (3.30)	60 (0.77)	98 (1.06)
n (%) [95%CI]	[4.25–5.08]	[4.18–4.93]	[3.83–4.52]	[2.84–3.82]	[0.59–0.99]	[0.86–1.29]
Ethnicities						
Malay	466 (4.59)	549 (4.48)	573 (4.33)	200 (3.76)	87 (1.12)	93 (1.01)
n (%) [95%CI]	[4.19–5.02]	[4.12–4.86]	[3.99–4.69]	[3.26–4.30]	[0.90–1.38]	[0.81–1.23]
Chinese	204 (2.01)	223 (1.82)	227 (1.71)	70 (1.31)	23 (0.30)	35 (0.38)
n (%) [95%CI]	[1.75–2.30]	[1.59–2.07]	[1.50–1.95]	[1.03–1.66]	[0.19–0.44]	[0.26–0.53]
Indian	217 (2.14)	251 (2.05)	232 (1.75)	60 (1.13)	31 (0.40)	40 (0.43)
n (%) [95%CI]	[1.86–2.44]	[1.81–2.31]	[1.54–1.99]	[0.86–1.45]	[0.27–0.57]	[0.31–0.59]
Others (e.g., *Orang Asli*)	50 (0.49)	48 (0.39)	46 (0.35)	11 (0.21)	7 (0.09)	1 (0.01)
n (%) [95%CI]	[0.37–0.65]	[0.29–0.52]	[0.25–0.46]	[0.10–0.37]	[0.04–0.19]	[0.00-0.06]

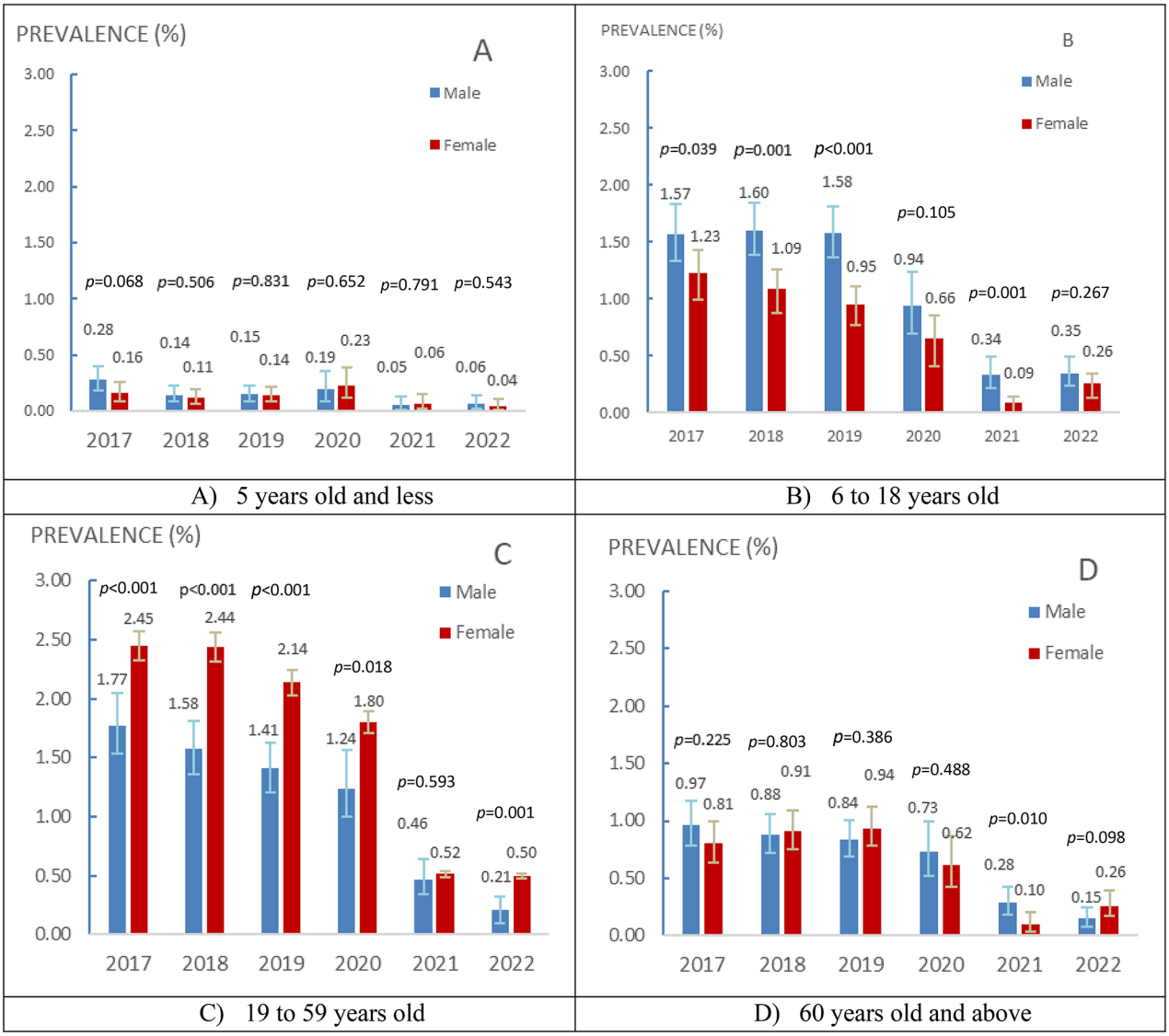

Fig. 1 (**A** to **D**) Trends in prevalence of AR among patients visiting an otorhinolaryngology outpatient clinic stratified by age and gender, 2017 to 2022

to have a higher prevalence of AR between the ages of 19 and 59 (Fig. 1C).

Trends in Prevalence of AR by Ethnicity and Gender

In comparing different ethnicities by gender, both genders among the Malay population had the highest prevalence, nearly two times higher than the Chinese and Indian ethnicities. Our results indicate that the prevalence of AR among Indian differed by gender. Among females, the prevalence of AR was higher among Indian ethnicity than among Chinese and other ethnicity. However, among males, Chinese was higher than Indian.

Trends in Prevalence of AR Pre- and Post-pandemic

There was no statistical difference in gender ($p=0.864$), in comparing genders across four different age groups ($p=0.363$, 0.556, 0.948, 0.456 for the ages of ≤ 5, 6–18, 19–59, and ≥ 60, respectively), as well as in comparing genders across different ethnicities ($p=0.909$, 0.772, 1.000, 1.000 for the Malay, Chinese, Indian, and other ethnicities, respectively) in the pre-pandemic (years 2017–2019) and post-pandemic (years 2020–2022) periods. In comparing ethnicities for each age group, only those aged 60 and above had significant associations with the ethnicity pre- and post-pandemic. During the pre-pandemic, 75.4 to 87.5% of those

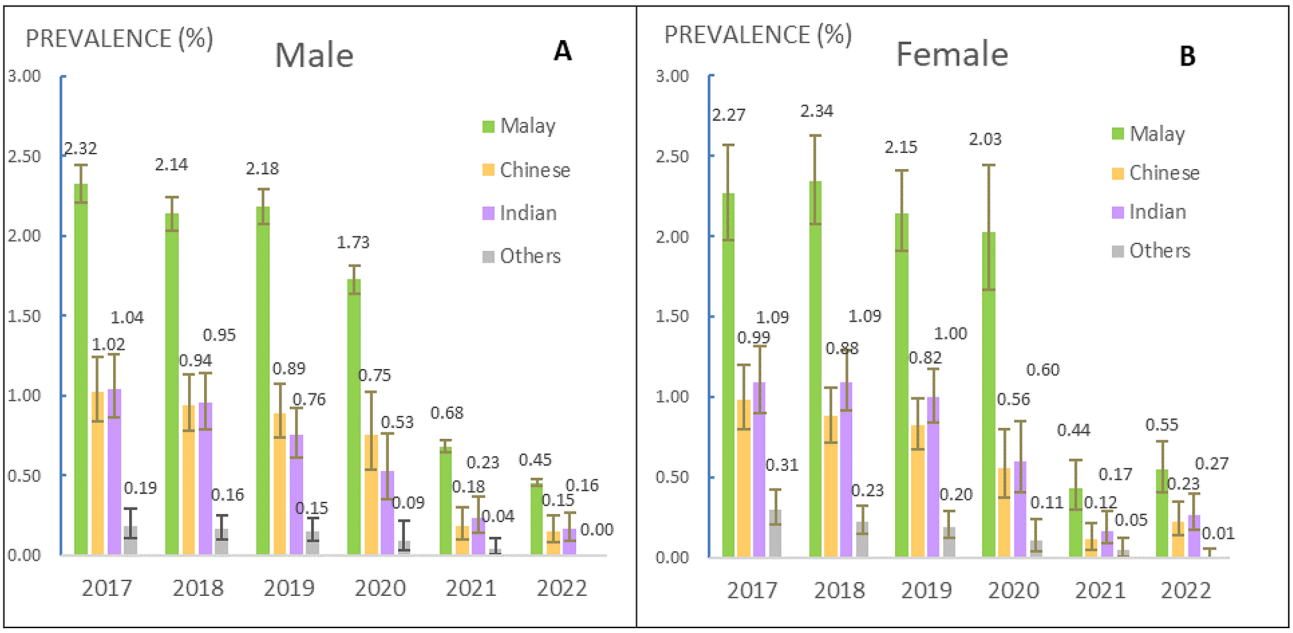

Fig. 2 (A) & 2 (B) Trends in prevalence of AR among patients visiting an otorhinolaryngology outpatient clinic stratified by ethnicity and gender, 2017 to 2022

Table 2 Comparison of prevalence of AR between pre- and post-pandemics by age group and ethnicity

Age group	Ethnic	Pre-Pandemic (2017–2019) n = 3086, n (%)	Post-Pandemic (2020–2022) n = 658, n (%)	χ^2(df)	*p*-value
≤ 5	Malay	80 (70.8)	33 (29.2)	1.401*	0.715*
	Chinese	11 (78.6)	3 (21.4)		
	Indian	19 (79.2)	5 (20.8)		
	Others	3 (100.0)	0 (0.0)		
6 to 18	Malay	629 (83.0)	129 (17.0)	4.525 (3)	0.208
	Chinese	117 (89.3)	14 (10.7)		
	Indian	174 (86.6)	27 (13.4)		
	Others	28 (87.5)	4 (12.5)		
19 to 59	Malay	750 (81.0)	176 (19.0)	3.479 (3)	0.327
	Chinese	234 (83.6)	46 (16.4)		
	Indian	343 (82.5)	73 (17.5)		
	Others	64 (88.9)	8 (11.1)		
≥ 60	Malay	129 (75.4)	42 (24.6)	8.507 (3)	**0.037**
	Chinese	292 (81.8)	65 (18.2)		
	Indian	164 (86.3)	26 (13.7)		
	Others	49 (87.5)	7 (12.5)		

The *p*-value was analysed using the Chi-square test. *analysed with Fisher's Exact test

aged 60 and up had AR, while in the post-pandemic, it decreased to 12.5 to 24.6% ($p = 0.037$) (Table 2).

Discussion

This study describes the trend of AR in the past six years, encompasses all age groups, and informs the gap in prevalence data beyond 2016 in an urban region in Malaysia. Additionally, the result showed the trend of AR case distribution pre- and post-pandemic. The information derived from the comparison of genders, age groups, and ethnicities adds knowledge about the demographic characteristics of AR patients.

In general, our findings showed that the prevalence of AR was higher in the pre-pandemic period (2017–2019) than in the post-pandemic period (2020–2022). These three years recorded a prevalence ranging from 8.14 to 9.23% among patients visiting the otorhinolaryngology outpatient clinic. The pre-pandemic prevalence trend is consistent with

findings in other countries. An epidemiology study of AR in Asia shows a wide range of prevalence, ranging from 1.4 to 32% [14]. The prevalence varied mainly due to differences in terms of geographical location, study design, and the populations being studied between 1994 and 2017. The findings of our study suggested the relation between AR and COVID-19 in terms of epidemiology. The reduction trend of prevalence was also demonstrated in other studies [17, 22]. This phenomenon could be explained by the social changes driven by COVID-19. The changes are innumerable and should be considered, as those factors may have contributed to the decrease in allergic diseases. These factors may include increased vigilance about sanitation and hygiene, increased awareness of medical conditions and vulnerability to disease, improved compliance with medications, decreased spread of respiratory infection, and decreased exposure to inhaled irritants because of reduced socioeconomic activities [23, 24].

Our study shows that those aged 6 to 18 represented nearly one-third of the cases yearly from 2017 to 2019. This finding is similar to two studies in Budapest. First, the prevalence of primary school children aged 6 to 12 increased significantly from 14.9 to 23.5% between 2007 and 2013 [25]. Secondly, in 2019, about one-third (36.2%) of primary school children had AR [11]. A significant rise is observed among Korean school-age children (6 to 18 years old), from 24.3 to 27.6% between 2013 and 2017 [26]. According to the findings of this study, males aged 6 to 18 had a higher prevalence than females. A similar distribution pattern is seen in Korea and Budapest in 2017 and 2019, for 52.6% vs. 47.4%, 37.9% vs. 31.2%, and 38.4% vs. 29.5%, respectively [11, 25, 26].

A shift in the prevalence from male predominance in the younger age group (6 to 18 years old) to female predominance in the older age group (19 to 59 years old) was observed in this study. Our findings were consistent with previous evidence that disease prevalence differed across gender and changed over the circle of life. A study by Fröhlich et al. (2017) found a gender shift in prevalence: the male-to-female ratio in adolescents is 0.80, and the prevalence of females increases as the age progresses to adulthood, with a male-to-female ratio of 0.98 among the population with allergic rhinitis only [27]. Disparities in the development of allergy reactions between males and females are determined by genes, hormones, immunology, and the environment [28]. Knowing the role of gender provides insights to drive exploration of the many aspects of this relationship that are yet unknown, which could improve preventive, diagnostic, and therapeutic approaches to allergic diseases [29]. Notably, there was no difference between the two genders across different age groups and ethnicities before and after the COVID-19 pandemic. In congruence with a recent study done in Korea, there is no significant change in the AR prevalence between genders when comparing the number of cases among adults between 2019 and 2020 [30].

The Malay population demonstrated approximately two times higher prevalence than the other ethnicities. The Bumiputra (Malay as the majority in Peninsular Malaysia) comprised 69.9%, the Chinese 22.8%, the Indians 6.6%, and others 0.7% of the Malaysian population. The ethnic composition of the country is nearly identical to that of Malaysia's Perak State [31]. In this state, in 2020, the Malay constituted 59.6%, the Chinese 28.2%, and the Indian 11.9% [32]. Ethnicity is shown to have an influence on symptom manifestations and degrees of severity. Significantly, Chinese people have the mildest symptoms, while Malay people have the worst [33], and our study showed a consistent result with those findings, where the Malays had the highest prevalence of the three ethnicities. Despite the fact that Indians comprise about 10% of the Malaysian population, the prevalence of AR in this study is comparable to that of the Chinese population, implying that the Chinese population is the least affected by AR. This finding was also consistent with a previous local study [33]. However, there is a paucity of published material on the relationship between local population ethnicity and AR, and the causative mechanism. More attention to this characteristic may help in the understanding of scientific and clinical research findings, as well as in the designing of future therapeutic strategies.

Study Limitations

This was a single-center study and may not represent the trend of AR distribution in other centres or regions of Malaysia. Nevertheless, the otorhinolaryngology department in this tertiary hospital is the main referral hospital in Perak, a state in the northwest of Peninsular Malaysia. Hospital Raja Permaisuri Bainun is a state hospital located in the Kinta District, with a population of one million. This hospital's epidemiology data is comparable to other referral hospitals with comparable population sizes.

This study investigated the trend and the association of age, gender, and ethnicity with the prevalence of AR; other demography factors, such as the location of residency (rural vs. urban), comorbidities, and other ethnic groups in East Malaysia (Sabah and Sarawak), are recommended to be explored in future studies.

Conclusion

The trend in the prevalence of AR in a tertiary referral hospital in Malaysia was 8.14 to 9.23% pre-pandemic and reduced to 1.83 to 6.40% post-COVID-19 pandemic. The

change in the prevalence of AR during the COVID-19 pandemic warrants public health attention. More research is needed to determine the association between the prevalence of AR and the social-cultural changes caused by COVID-19. The findings could lead to future recommendations to experts for assisting patients in preventing AR exacerbations. There was a substantial difference in the prevalence of allergic rhinitis based on ethnicity and age group. Our findings have significant clinical and research implications. Further research is required to understand the mechanisms underlying these disparities. Understanding the interface between an epidemiological approach and clinical and scientific research in this field may also provide tools for optimal allergic rhinitis management in different age groups and ethnicities. Providing accessible tools and resources, including materials appropriate for different literacy levels, languages, and cultures, will promote effective communication with diverse patient groups, given that these factors intersect and compound, leading to poorer therapeutic outcomes.

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Data availability The data are belonged to Clinical Research Centre and the Perak State Health Department under the Malaysian Ministry of Health. Hence, it cannot be shared publicly. However, with a reasonable request, should any party require the data, they can send their request to the corresponding author with permission from the Director General of Health prior to being shared with any party.

Declarations

Ethics approval and consent to participate to conduct this study has been obtained from the Malaysian Medical Research & Ethics Committee. This study has been registered with the Malaysian National Medical Research Register [NMRR ID-22-02200-FTJ (IIR)]. Obtaining informed consent is not required as this study involved the extraction of patient records. The unique identifier was not collected.

Consent for publication All authors agree to the submission of this article to the Allergy, Asthma & Clinical Immunology.

Competing interests The authors declared no conflict of interest.

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