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# Incidence and prevalence of psoriasis in multiethnic Johor Bahru, Malaysia: a population-based cohort study using electronic health data routinely captured in the Teleprimary Care (TPC<sup>®</sup>) clinical information system from 2010 to 2020

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## Summary

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**Background** There are no population-based epidemiological data on psoriasis in Southeast Asia, including Malaysia.

**Objectives** To determine the incidence and prevalence of psoriasis over 11 years in multiethnic Johor Bahru, Malaysia.

**Methods** A population-based cohort study was made using the Teleprimary Care database between January 2010 and December 2020. Cases of psoriasis, identified by ICD-10 diagnostic codes, were validated by dermatologists. Annual prevalence and incidence were estimated and stratified by age, sex and ethnicity.

**Results** We identified 3932 people with dermatologist-confirmed psoriasis, including 1830 incident cases, among 1 164 724 Malaysians, yielding an 11-year prevalence of 0.34% [95% confidence interval (CI) 0.33–0.35] and incidence of 34.2 per 100 000 person-years (95% CI 32.6–35.8). Rates were higher in Indian patients; the prevalences were 0.54% (0.50–0.58) in Indian, 0.38% (0.36–0.40) in Chinese and 0.29% (0.28–0.30) in Malay patients, and the respective incidences per 100 000 person-years were 52.5 (47.3–57.7), 38.0 (34.1–41.8) and 30.0 (28.2–31.8). Rates were higher in males; the prevalence was 0.39% (0.37–0.41) in males and 0.29% (0.27–0.30) in females, and the respective incidences per 100 000 person-years were 40.7 (38.2–43.2) and 28.3 (26.4–30.3). Between 2010 and 2020, annual psoriasis prevalence and incidence increased steadily from 0.27% to 0.51% and from 27.8 to 60.9 per 100 000 person-years, respectively. Annual rates were consistently higher in male and Indian patients. Overall, psoriasis was significantly more common in males than females [odds ratio (OR) 1.37, 95% CI 1.29–1.46] and in Indian and Chinese patients vs. Malay (OR 1.85, 1.71–2.01 and OR 1.30, 1.20–1.41, respectively). Prevalence increased with age, with the highest rates in the groups aged 50–59 and 60–69 years at 0.67% and 0.66%, respectively. A modest bimodal trend in age of psoriasis onset was observed, with first and second peaks at 20–29 and 50–59 years. Disease onset was significantly earlier in females than males [mean (SD) 36.8 (17.3) vs. 42.0 (17.2) years,  $P < 0.001$ ] and in Malay vs. Indian and Chinese patients [mean (SD): Malay 36.4 (17.5), Indian 40.8 (15.2), Chinese 47.4 (16.9) years,  $P < 0.001$ ].

**Conclusions** We found that psoriasis incidence and prevalence are increasing and varied by age, sex and ethnicity. Our findings should help inform healthcare planning and management for patients with psoriasis in Malaysia.

#### What is already known about this topic?

- The incidence and prevalence of psoriasis are generally lower in Asian populations and children.
- There is a lack of agreement on sex-specific differences in psoriasis incidence and prevalence.
- There has been no population-based study on the incidence and prevalence of psoriasis in Southeast Asia, including Malaysia.
- There is no information on differences in psoriasis prevalence and incidence by sex, age and ethnicity in Malaysia.

#### What does this study add?

- Psoriasis incidence and prevalence are increasing in the multiethnic population of Johor Bahru, Malaysia.
- Incidence and prevalence rates were higher in male than female patients and were consistently highest among Indian patients, followed by Chinese and Malay.
- A modest bimodality in the age of psoriasis onset was observed among the groups aged 20–29 and 50–59 years.
- Psoriasis onset was significantly later in male than female patients and in Chinese vs. Indian and Malay patients.

Psoriasis is a genetically determined, systemic immune-mediated inflammatory disease that affects predominantly the skin and joints.<sup>1,2</sup> It is now recognized as a systemic disease, which is associated with multiple comorbidities including diabetes, hypertension, obesity and major cardiovascular adverse events. These can shorten the lifespan of patients by up to 5 years in those with severe disease.<sup>3–6</sup> There is emerging evidence that controlling the chronic inflammation of psoriasis with methotrexate or biologics may reduce cardiovascular comorbidities and mortality.<sup>7–10</sup> Psoriasis has a considerable impact on patients' quality of life and causes as much disability as other major medical diseases such as cancer, heart disease, diabetes, hypertension, arthritis and depression.<sup>11</sup>

In 2014, the World Health Organization declared and recognized psoriasis as a serious and disabling, noncommunicable chronic disease, which highlighted the need to determine the global burden of this disease.<sup>12</sup> However, the epidemiology of psoriasis in most countries is largely unknown. A recent systematic review on the national, regional and worldwide epidemiology of psoriasis concluded that 81% of countries in the world lack information on the epidemiology of psoriasis.<sup>13</sup> The prevalence of psoriasis varied greatly among different geographical populations and age groups. Psoriasis is less common in Asian populations and children. The prevalence in the adult population ranges from a low of 0.14% in East Asia to about 2% in Australasia and Europe.<sup>13</sup> In children, prevalence ranged from 0.02% in East Asia to 0.22% in Australia and

0.21% in Western Europe.<sup>13</sup> Studies on the incidence of psoriasis are few and have been conducted mainly in Europe and North America.

Reliable data on the epidemiology of psoriasis are important to ensure adequate resource allocation for optimal management of patients with psoriasis. To date, there have been no population-based epidemiological studies on psoriasis in Southeast Asia. In this study, we aimed to investigate the epidemiology of psoriasis in multiethnic Malaysian individuals in the Johor Bahru district. The primary objective was to analyse trends in the incidence and prevalence of psoriasis over an 11-year period from 2010 to 2020, and the secondary objective was to determine whether there were any variations in the prevalence and incidence by sex, age and ethnicity.

## Patients and methods

### Study design

This population-based cohort study used electronic health data routinely captured in the Teleprimary Care (TPC®) clinical information system from 2010 to 2020. This study was approved by the Malaysian Ministry of Health Institutional Review Board and Medical Research Ethics Committee (NMRR 20-57880) and was conducted in accordance with the STROBE and RECORD guidelines.

## Setting and data source

Malaysia has a population of 32.4 million, with a male-to-female ratio of 1.1 : 1, and comprises 69.4% Malay, 23.2% Chinese and 6.7% Indian inhabitants, based on the 2020 population census.<sup>14</sup> The population of Johor Bahru district in the state of Johor, located at the southern tip of the Malay Peninsula (Figure S1; see Supporting Information), was estimated to be 1.71 million in 2020.<sup>14</sup> TPC is a locally developed clinical information system that links public primary and secondary care facilities (Appendix S1; see Supporting Information). TPC enables registration of all patients, including healthy individuals who seek routine medical examinations required for work or education, and point-of-care documentation of every patient encounter, including laboratory, radiology and pharmacy services.<sup>15</sup> Diagnosis is mandatory and coded based on the International Classification of Diseases, 10<sup>th</sup> Revision, Clinical Modification.

Documentation of care has been fully electronic in the department of dermatology of Hospital Sultanah Aminah Johor Bahru since 2005, and patients with psoriasis accounted for 6–7% of the annual dermatology workload (Table S1; see Supporting Information). From 1 January 2005 to 31 December 2020, 1 677 369 individuals had been registered in TPC, which represented around 98% of the estimated population in Johor Bahru.<sup>14</sup> The ethnic composition of the TPC population was 62.8% Malay, 20.6% Chinese and 13.1% Indian, with a male-to-female ratio of 0.98 : 1. This was broadly representative of the population in Malaysia, except for a higher proportion of Indian individuals. We extracted data on TPC number, National Registration Identity Card, sex, ethnicity, citizenship, birthdate, name of clinic, date of first registration into TPC and date the patient was last seen within the TPC system, filtered by Johor Bahru district from January 2005 to December 2020.

## Study population

We identified 5707 patients with a diagnosis of psoriasis from 2005 to 2020. Diagnosis of psoriasis was validated by either a confirmatory documentation of the diagnosis in the medical record by at least one dermatologist or subsequent confirmation of diagnosis by a dermatologist after reviewing patients' medical notes and contacting doctors in primary care centres and a nearby hospital that provides dermatology services. Among the 2799 patients initially diagnosed by primary healthcare providers, 814 patients did not have enough documentation to confirm a diagnosis of psoriasis, leaving a total of 4893 patients with dermatologist-confirmed psoriasis. We excluded non-Malaysian patients and patients with only pustular psoriasis without associated plaque psoriasis. The index date was defined as the first recorded diagnosis of psoriasis regardless of the phenotypes or where the diagnosis was first documented in either primary or secondary care. The study period 2010–2020 was chosen as the TPC data were more mature and to ensure that prevalent cases of psoriasis were not misclassified as incident ones.

## Statistical analysis

The denominator comprised any patient who contributed at least 1 day in TPC in the year of interest. Prevalent cases were all patients with dermatologist-confirmed psoriasis prior to the end of the year of interest, and included patients who were registered for the first time in TPC with prior psoriasis. Incident cases were patients with first presentation of psoriasis in the year of interest. Patients with prior psoriasis before the start of each year of interest were excluded from both the numerator and denominator for calculating incidence. The index date was defined as the date of the first confirmed diagnosis, and patients were considered prevalent from that date onward. The person-time at risk was calculated for each denominator case from the start of each calendar year of interest or the day of registration until the index date, death or end of each calendar year, whichever came first.

Annual prevalence (presented as percentage values) and incidence [rate per 100 000 person-years and 95% confidence interval (CI)] were estimated and stratified by age, sex and ethnicity. To estimate age-, sex- and ethnicity-adjusted incidence rates per 100 000 person-years for each year we collapsed the total population across the age, sex and ethnic groups, calculated crude age-, sex- and ethnicity-specific rates, weighted the rates by the proportion within each group and summed across the groupings. To investigate the distribution of age of psoriasis onset, and sex and ethnic variations, we plotted psoriasis incidence against age at disease onset by sex and ethnicity. We constructed logistic regression models to assess the associations between the presence of psoriasis, type 1 psoriasis and type 2 psoriasis with sex and ethnicity. All analyses were carried out using Stata, version 16.1 (StataCorp LP, College Station, TX, USA).

## Results

### Annual incidence and prevalence

During 2010–2020, 1 164 724 Malaysian individuals were registered in TPC and 3932 had dermatologist-confirmed psoriasis (Table 1). The period prevalence rate of psoriasis was 0.34% (95% CI 0.33–0.35): male 0.39% (0.37–0.41) and female 0.29% (0.27–0.30); Malay 0.29% (0.28–0.30), Chinese 0.38% (0.36–0.40) and Indian 0.54% (0.50–0.58). The period incidence was 34.2 (95% CI 32.6–35.8) per 100 000 person-years: male 40.7 (38.2–43.2) and female 28.3 (26.4–30.3); Malay 30.0 (28.2–31.8), Chinese 38.0 (34.1–41.8) and Indian 52.5 (47.3–57.7) (Table 1; and Table S2; see Supporting Information).

The standardized prevalence and incidence rates of psoriasis increased steadily between 2010 and 2020 from 0.27% to 0.51% and from 27.8 to 60.9 per 100 000 person-years, respectively (Table S2). This increasing trend in psoriasis prevalence was observed across the different sex, age and ethnic groups (Figure 1; and Tables S2 and S3; see Supporting Information). The annual prevalence and incidence of psoriasis

**Table 1** Demographics, period prevalence and incidence rate (IR) of psoriasis in Johor Bahru, Malaysia between 2010 and 2020

Population with psoriasis		Age (years) at onset, median (IQR)	Population without psoriasis	Total population	Prevalence (%)	No. of incident cases	Person-years of follow-up	IR (95% CI) <sup>b</sup>	Adjusted IR (95% CI) <sup>c</sup>
n (%)	Age (years) at onset, median (IQR)								
Overall <sup>a</sup>	3932	39 (26–53)	1 164 792	1 164 724	0.34	1830	5 407 249	33.8 (32.3–35.4)	34.2 (32.6–35.8)
Sex									
Male	2249 (57.2)	42 (29–55)	573 165 (49.4)	575 414 (49.4)	0.39	1034	2 570 474	40.2 (37.8–42.7)	40.7 (38.2–43.2)
Female	1683 (42.8)	34 (24–50)	587 627 (50.6)	589 310 (50.6)	0.29	796	2 836 775	28.1 (26.1–30.0)	28.3 (26.4–30.3)
Ethnicity									
Malay	2141 (54.5)	34 (23–50)	729 915 (62.9)	732 056 (62.9)	0.29	1039	3 506 006	29.6 (27.8–31.4)	30.0 (28.2–31.8)
Chinese	914 (23.2)	48 (36–60)	239 544 (20.6)	240 458 (20.6)	0.38	371	987 080	37.6 (33.8–41.4)	38.0 (34.1–41.8)
Indian	821 (20.9)	41 (30–51)	151 067 (13.0)	151 888 (13.0)	0.54	397	761 010	52.2 (47.0–57.3)	52.5 (47.3–57.7)
Other	56 (1.4)	28 (24–38)	40 266 (3.5)	40 322 (3.5)	0.14	23	153 154	15.0 (8.9–21.2)	15.3 (9.0–21.5)

The data are presented as n (%) unless stated otherwise. CI, confidence interval; IQR, interquartile range. <sup>a</sup>11-year period prevalence and incidence. <sup>b</sup>IR per 100 000 person-years. <sup>c</sup>IR per 100 000 person-years, adjusted for age, sex and ethnicity.

were consistently higher in male than female individuals (Figures 1 and 2) and in adults than in younger people aged < 20 years (Table S3).

Prevalence rates from 2010 to 2020 were consistently highest among the Indian population, followed by Chinese and Malay (Figure 1). A similar pattern was observed with incidence (Figure 2); however, between 2013 and 2017, rates in Chinese and Malay individuals overlapped (Figure S2; see Supporting Information).

Overall, psoriasis was significantly more common in male than female (OR 1.37, 95% CI 1.29–1.46) and in Indian and Chinese than Malay individuals (OR 1.85, 95% CI 1.71–2.01 and OR 1.30, 95% CI 1.20–1.41, respectively) (Figure 3). Psoriasis was also more common in the Indian vs. Chinese groups: OR 1.42 (95% CI 1.29–1.56).

### Age-specific incidence and prevalence

The mean (SD) age of psoriasis onset was 39.8 (17.4) years. Onset of psoriasis was significantly earlier in females than males: mean (SD) age 36.8 (17.3) vs. 42.0 (17.2) years,  $P < 0.001$ . Chinese people had a significantly later disease onset than Malay and Indian: mean (SD) age for Chinese 47.4 (16.9), Malay 36.4 (17.5) and Indian 40.8 (15.2) years,  $P < 0.001$ . Overall, a modest bimodal trend in age of psoriasis onset was observed, with first and second peaks at 20–29 and 50–59 years of age, respectively (Figure 4). This bimodal age distribution was seen in women and the Malay group but not in men or the other ethnic groups (Figure 4). Slightly more than half of the incident cases (2074, 52.7%) had type 1 psoriasis (disease onset before 40 years of age), with a female and Malay predominance (Figure 3). Type 2 psoriasis was more likely in male than female patients (OR 1.70, 95% CI 1.49–1.95) and in Chinese and Indian vs. Malay patients (OR 2.92, 95% CI 2.48–3.44 and OR 1.49, 95% CI 1.27–1.76, respectively) (Figure 3).

Age-specific incidence rates of psoriasis fluctuated within the various age strata between 2010 and 2020 (Table S3 and Figure S3a; see Supporting Information). From 2018 onwards, an increasing trend in incidence was seen in all age groups, except for age 70 years and above (Table S3 and Figure S3a). Incidence rates were comparable between boys and girls (age groups 1–9 and 10–19); however, in adults, the incidence was consistently higher in men than in women (Table S3). Except for age group 1–9 years, incidence rates were consistently higher for the Indian group than for Chinese and Malay (Table S3). In Malay and Indian patients, there was an increasing trend in incidence with age; however, in Chinese patients, incidence peaked at age 50–59 years and decreased for those aged 60–69 years and  $\geq 70$  years (Table S3). Across all age strata and ethnicities, incidence increased steadily from 2010 to 2019, with a slight drop observed in 2020 (Table S3).

Across the study period there was an increasing trend in prevalence with age, up to age  $\geq 70$  years (Table S3). The highest prevalence rates were observed in the groups aged 50–59 and 60–69 years, at 0.67% and 0.66%, respectively

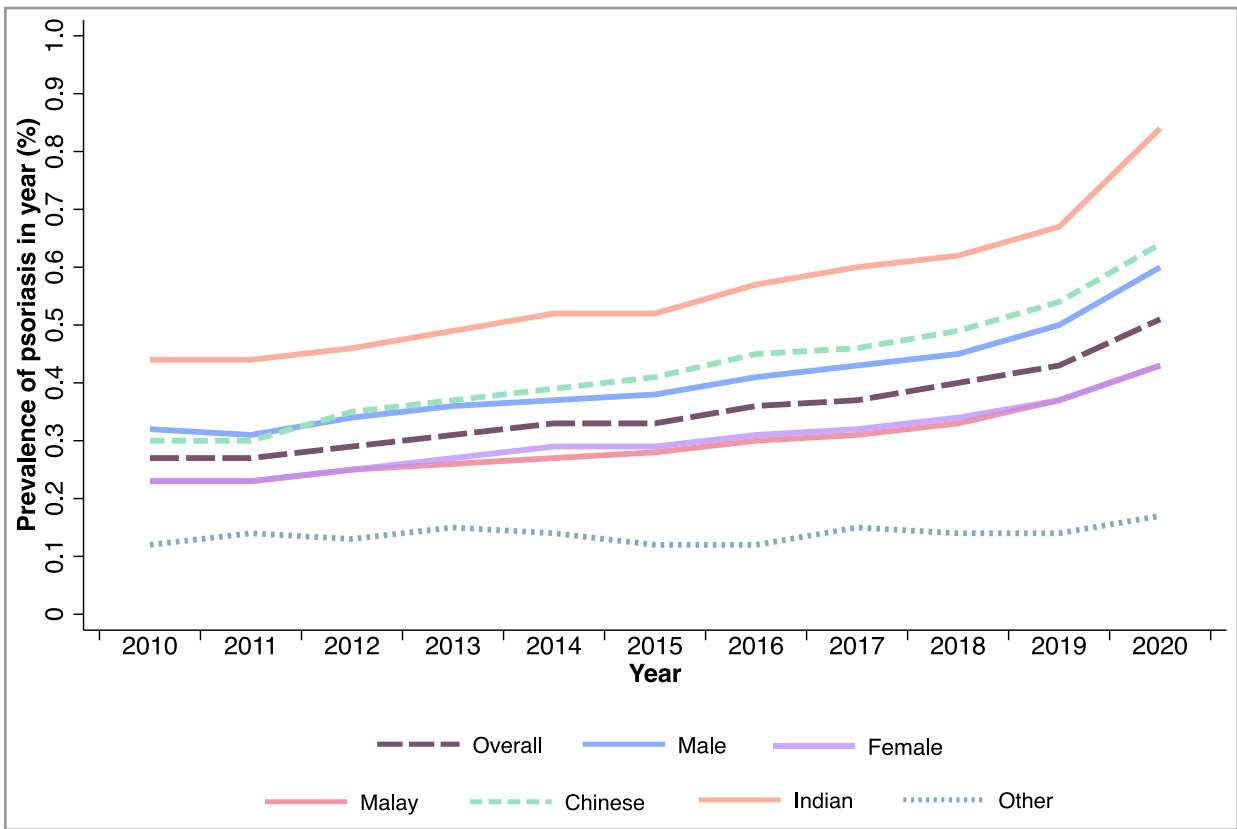


Figure 1 Annual prevalence of psoriasis by sex and ethnicity in Johor Bahru, Malaysia between 2010 and 2020

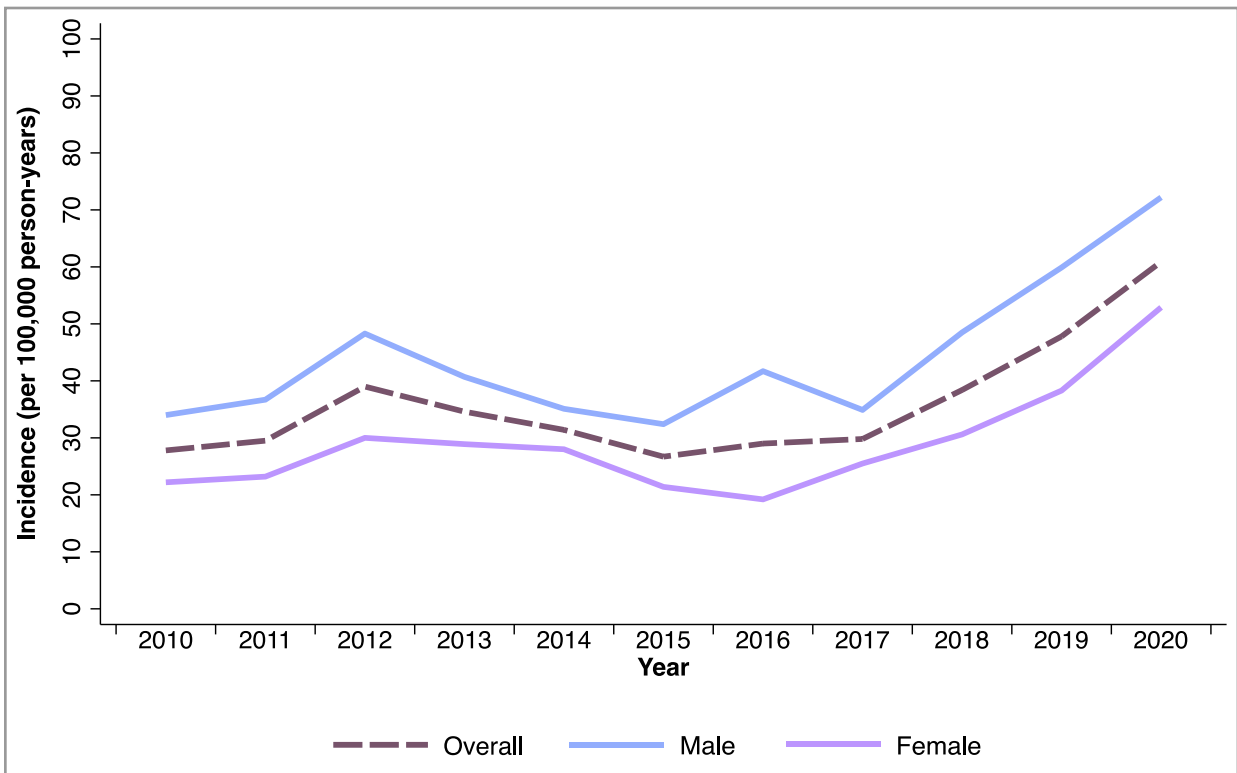


Figure 2 Annual incidence of psoriasis by sex in Johor Bahru, Malaysia between 2010 and 2020

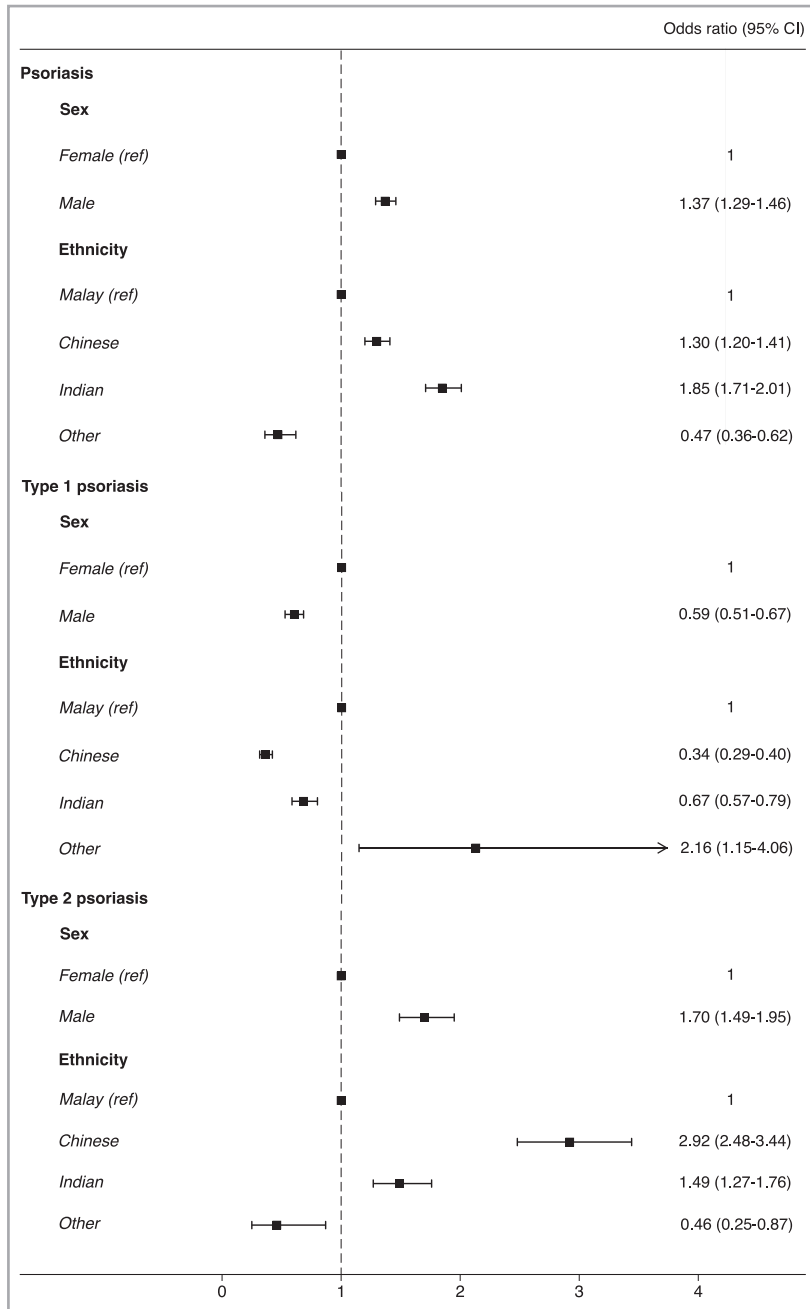


Figure 3 Variation in psoriasis by sex and ethnicity in Johor Bahru, Malaysia. CI, confidence interval

(Table S3). The age-specific prevalence of psoriasis increased steadily in all age groups from 2010 to 2020, except for the 10–19-year age group, where the prevalence dropped from 0.23% in 2010 to 0.09% in 2020 (Table S3 and Figure S3b). The prevalence rate among children aged < 10 years remained low throughout the years (0.01% in 2010 to 0.05% in 2020). Prevalence rates were comparable in male and female patients up to age 30 years (Table S3). From age 30 years and above, men had consistently higher prevalence than women (Table S3). The prevalences among children from the Malay, Chinese and Indian ethnic groups were similar, whereas in

adults, the Indian group had considerably higher prevalence rates than the other ethnic groups (Table S3).

### Discussion

In this first population-based epidemiological study of psoriasis in Southeast Asia, the observed upward trend in the prevalence of psoriasis from 0.27% in 2010 to 0.51% in 2020 is consistent with the increasing prevalence of psoriasis reported worldwide, which was mainly explained by the persistence of a chronic disease in populations with prolonged lifespan.<sup>16–22</sup>

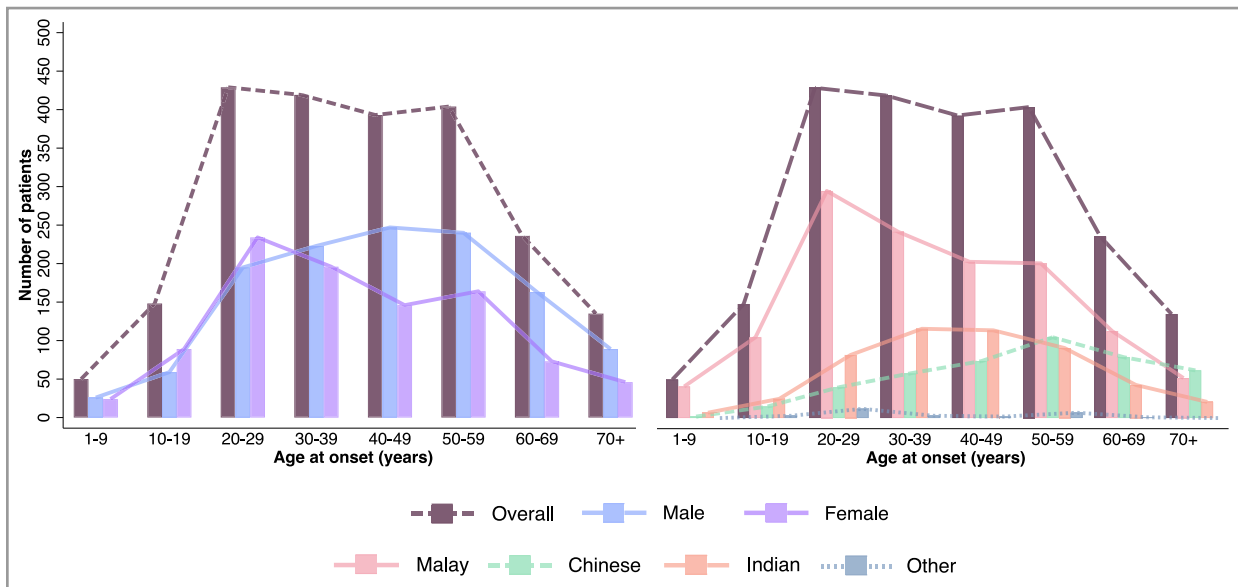


Figure 4 Age distribution of incident psoriasis in Johor Bahru, Malaysia between 2010 and 2020

Besides the steady improvement in life expectancy of Malaysian people over the past 10 years<sup>23</sup> and the accompanying increasing incidence rates, another reason for the rising prevalence of psoriasis seen in this study may be increased health seeking by patients with psoriasis, driven by a greater awareness of the disease and the emergence of highly effective new treatments in the past 10 years. However, the steeper rise in prevalence from 0.43% in 2019 to 0.51% in 2020 is likely to be due to reduced healthcare utilization attributable to the COVID-19 pandemic. The first SARS-CoV-2 infection in Malaysia was detected on 25 January 2020 and an exponential increase in cases in March triggered a national lockdown on 16 March 2020, which was slowly lifted by the end of 2021.<sup>24</sup> The 24% drop in the TPC population from 512 033 in 2019 to 385 791 in 2020 (Table S2), which was not balanced by the lower 10% drop in patients with psoriasis from 2208 in 2019 to 1979 in 2020 (Table S2), helps to explain the higher prevalence rate observed in 2020.

Our prevalence rates are comparable with rates reported in East Asia, which were lowest in Taiwan at 0.24–0.28%,<sup>25</sup> followed by Japan 0.34–0.44%,<sup>26,27</sup> Korea 0.45–0.62%<sup>28,29</sup> and China 0.47%,<sup>30</sup> confirming that psoriasis is less prevalent in Asia, including Southeast Asia, than Europe and North America. We observed a consistently higher annual prevalence and incidence of psoriasis in males than females, in Indian than Chinese and Malay populations, and in adults than young people below 20 years of age. These results are consistent with previous studies that showed psoriasis to be less prevalent in children<sup>13,16,31</sup> and confirmed the male preponderance reported in East Asia<sup>21,25–30</sup> and other regions.<sup>16,31</sup>

The incidence of psoriasis remained relatively stable between 2010 and 2017 (around 30 new cases per 100 000 person-years), and then increased from 2018 onwards, reaching a rate of 60.9 per 100 000 person-years in 2020. This

may be partly attributed to the increasing prevalence of obesity (body mass index  $> 30 \text{ kg m}^{-2}$ ), an important risk factor for incident psoriasis, from 15.1% in 2011 to 19.7% in 2019 in Malaysian adults based on the National Health and Morbidity Survey (NMHS).<sup>32</sup> NHMS also revealed that obesity levels were consistently higher in Indian individuals and those aged 50–59 years, explaining the higher incidence of psoriasis we observed in Indian people and the peak in the bimodal age distribution of psoriasis onset at age 50–59 years.<sup>32</sup> The higher incidence of psoriasis among Indian people may also be due to the closer genetic relationship that exists between European and Indian populations than with other Asian populations.<sup>33,34</sup> Healthcare utilization is high among Indian people, as evidenced by their higher representation in the TPC population at 13%, compared with about 7% in the general population in Johor and Malaysia.<sup>14</sup> Hence, better detection could be another potential reason for the higher incidence and prevalence of psoriasis observed in Indian individuals as they presented more readily to healthcare services.

We observed a modest bimodal distribution of age at psoriasis onset, peaking 10 years younger than the reported peaks at 30–39 and 60–69 years from a recent systemic review on the variation in the incidence and prevalence of psoriasis by age and sex.<sup>16</sup> Consistently with the findings of this systematic review, disease onset was significantly earlier in women than men (36.8 and 42.0 years respectively). This may be explained by reported perimenarchal increase in the prevalence of psoriasis.<sup>35</sup> The significantly later disease onset seen in the Chinese than the Malay and Indian groups (47.4, 36.4 and 40.8 years respectively) may explain why psoriasis was significantly more common in Malay and Indian children than in Chinese children in a previous study on paediatric psoriasis in Malaysia.<sup>36</sup> Ethnic variation in the age of disease onset may be due to differences in genetic, lifestyle and environmental factors.<sup>37</sup>



Our study has recognized strengths and limitations. To the best of our knowledge, this is the first population-based epidemiological study on psoriasis in Southeast Asia, which examines trends in the incidence and prevalence of psoriasis and variations by age, sex and ethnicity over a prolonged period. The incidence and prevalence of psoriasis are documented for the first time in a Malay population, the predominant ethnic group in Malaysia, who are also major inhabitants of certain parts of Indonesia, Southern Thailand, Brunei and Singapore. However, disparity in the incidence and prevalence of psoriasis among Malay people in Southeast Asian countries may be expected due to differences in lifestyle and environmental factors.

TPC captured both primary and secondary care data of 'healthy' individuals who sought routine medical examinations, maternal and childcare services, vaccination, healthy lifestyles and school health programmes, as well as individuals who sought medical care for diagnosed conditions. This methodology overcomes a known limitation of studies based on claims data or disease registries, which may overestimate healthcare seekers with a poorer health status. Psoriasis diagnoses were either made by dermatologists or validated by a dermatologist after reviewing the patients' medical notes and consulting with the primary care doctors, reducing the likelihood of misdiagnosis. Use of recent data (2010–2020) provides contemporary estimates of disease epidemiology and trends over time.

One limitation inherent to studies using electronic health databases, including our study, is the potential to underestimate prevalence as cases identified by diagnostic codes cannot capture undiagnosed patients and patients not actively seeking care. However, a previous study using the TPC database for predicting utilization of health services in Malaysia showed that Malaysian people with chronic diseases do not seek care for their chronic diseases in private clinics<sup>38</sup> due to the heavily subsidized cost of care through public facilities [1 and 5 Malaysian ringgit (equivalent to 0.18–0.90 GBP) per visit in primary care centres and specialist clinics, respectively], which includes consultations, investigations and medications. Fees for healthcare in public facilities for Malaysian people remain the same to this day. However, there is still the possibility of missing cases of psoriasis if these individuals have not sought medical care in public facilities, as well as undiagnosed cases of psoriasis being misclassified as other conditions. Another limitation is that prevalent cases of psoriasis could have been misclassified as incident, particularly at the generation of the TPC system in 2005. However, we limited the study period to 2010–2020, when the data had matured. These limitations are not likely to have biased our estimated temporal trends.

In conclusion, the epidemiology of psoriasis remains poorly characterized in Southeast Asia, including Malaysia. In this study, we estimated the incidence and prevalence of dermatologist-confirmed psoriasis in Malaysia over 11 years, adding valuable information to the global efforts to describe the epidemiology of this disease. We found increasing prevalence and incidence of psoriasis with sex, age and ethnic variations in

Johor Bahru, Malaysia. These findings have important implications for healthcare planning and resource allocation.

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## Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

**Appendix S1** Teleprimary Care (TPC®) clinical information system.

**Figure S1** Location of Johor Bahru in Malaysia.

**Figure S2** Annual incidence of psoriasis by ethnicity in Johor Bahru, Malaysia between 2010 and 2020.

**Figure S3** Age-specific incidence (a) and prevalence (b) of psoriasis in Johor Bahru, Malaysia between 2010 and 2020.

**Table S1** Annual workload of the department of dermatology, Hospital Sultanah Aminah Johor Bahru, Malaysia.

**Table S2** Annual prevalence and incidence of psoriasis in Johor Bahru, Malaysia.

**Table S3** Age-, sex- and ethnicity-stratified prevalence and incidence of psoriasis in Johor Bahru, Malaysia.

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Conflicts of interest: S.E.C. declares paid activities as an advisor, speaker or consultant for AbbVie, Boehringer Ingelheim, Eli Lilly, Janssen, LEO Pharma, MSD, Novartis, Pfizer, Sanofi and UCB. C.E.M.G. reports receiving honoraria or research grants from AbbVie, Almirall, Celgene, Eli Lilly, Galderma, Janssen, LEO Pharma, Novartis, Pfizer, Sandoz, Sanofi and UCB Pharma. D.M.A. reports research grants from AbbVie, Almirall, Celgene, Eli Lilly, Janssen, Novartis, UCB and the LEO Foundation. The other authors declare they have no conflicts of interest.

Data availability: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics statement: This study was approved by the Malaysian Ministry of Health Institutional Review Board and Medical Research Ethics Committee (NMRR 20-57880).

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