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# Assessing catastrophic health expenditure and impoverishment in adult asthma care: a cross-sectional study of patients attending six public health clinics in Klang District, Malaysia

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## Abstract

**Background** In Malaysia, asthma is a common chronic respiratory illness. Poor asthma control may increase out-of-pocket payment for asthma care, leading to financial hardships Malaysia provides Universal Health Coverage for the population with low user fees in the public health system to reduce financial hardship. We aimed to determine out-of-pocket expenditure on outpatient care for adult patients with asthma visiting government-funded public health clinics. We examined the catastrophic impact and medical impoverishment of these expenses on patients and households in Klang District, Malaysia.

**Methods** This is a cross-sectional face-to-face questionnaire survey carried out in six government-funded public health clinics in Klang District, Malaysia. We collected demographic, socio-economic profile, and outpatient asthma-related out-of-pocket payments from 1003 adult patients between July 2019 and January 2020. Incidence of catastrophic health expenditure was estimated as the proportion of patients whose monthly out-of-pocket payments exceeded 10% of their monthly household income. Incidence of poverty was calculated as the proportion of patients whose monthly household income fell below the poverty line stratified for the population of the Klang District. The incidence of medical impoverishment was estimated by the change in the incidence of poverty after out-of-pocket payments were deducted from household income. Predictors of catastrophic health expenditure were determined using multivariate regression analysis.

**Results** We found the majority (80%) of the public health clinic attendees were from low-income groups, with 41.6% of households living below the poverty line. About two-thirds of the attendees reported personal savings as the main source of health payment. The cost of transportation and complementary-alternative medicine for asthma

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were the main costs incurred. The incidences of catastrophic expenditure and impoverishment were 1.69% and 0.34% respectively. The only significant predictor of catastrophic health expenditure was household income. Patients in the higher income quintiles (Q2, Q3, Q4) had lower odds of catastrophic risk than the lowest quintile (Q1). Age, gender, ethnicity, and poor asthma control were not significant predictors.

**Conclusion** The public health system in Malaysia provides financial risk protection for adult patients with asthma. Although patients benefited from the heavily subsidised public health services, this study highlighted those in the lowest income quintile still experienced financial catastrophe and impoverishment, and the risk of financial catastrophe was significantly greater in this group. It is crucial to ensure health equity and protect patients of low socio-economic groups from financial hardship.

**Keywords** Asthma, Catastrophic expenditure, Impoverishment, Financial risk protection

## Background

Asthma is a chronic respiratory illness with a global prevalence of 4.3% [1]. Asthma costs have increased globally, driven by the costs of emergency care and medications [2]. In Malaysia, the prevalence of asthma among adults is approximately 6.4% [3]. The Malaysian National Health and Morbidity Survey reported that every year, 20% of adults with asthma visited the emergency department for acute exacerbations [4]. A recent local study conducted in six public health clinics in Malaysia reported that 66% of clinic attendees still had poorly controlled asthma [5]. Most patients in this study reported regular clinic follow-ups and those with poor control were associated with frequent emergency visits [5]. Although asthma is a treatable condition, the high prevalence of suboptimal asthma control and frequent clinic visits has a substantial impact both on the use of public health care resources and individual health expenditure [3] as out-of-pocket payments may impose considerable financial burden on patients and families. An earlier study carried out at a tertiary centre in Malaysia reported that the mean monthly direct cost to individuals of asthma-related care was USD23 [6]. Another local study reported the cost of asthma-related care was mainly on medications and hospital admissions [7]. These studies were conducted in hospital settings. There is limited information on the direct cost of asthma on patients encountered at the primary care level.

Suboptimal asthma control potentially increases the need for urgent health care that patients have to pay for out-of-pocket. The World Health Organization (WHO) defines 'out-of-pocket payments' as direct payments made by households for health care [8]. High out-of-pocket payments are associated with catastrophic and impoverished spending and can potentially lead to financial hardship, especially among the poor [8]. Some low-income countries have poor financial health systems in healthcare or do not provide adequate financial protection, resulting in a high risk of catastrophic health expenditures [9, 10]. The Malaysian national healthcare system provides financial risk protection through universal access to a comprehensive package of government-guaranteed healthcare services and charging low user fees in the public health system [11, 12]. Malaysia has a dual health sector with public and private health systems [13]. The public health system, which comprises the public health clinics, is government-funded with a fee per clinic visit capped at Malaysia Ringgit MYR1 (USD 0.24) that covers consultation, basic investigations, and medications [14]. Government employees and pensioners, school-going children, and people aged 60 years and above are eligible to receive free health services in public health clinics [14]. All other groups, including the poor, are required to pay the MYR1 fee. In instances where medications are not available in public health clinics, patients (including those eligible for free health services) are required to buy prescribed medications from private pharmacies. The private health system comprises private hospitals or clinics that operate on a fee-for-service payment system in which patients pay out-of-pocket themselves or through their private health insurance purchased individually or through an employer-sponsored health scheme (6). Each individual is free to choose the public or private health services that they wish to use. In addition, some individuals choose complementary-alternative-medicine (CAM) for asthma treatment [15, 16], which is not subsidised by the government. These co-payments, albeit small in amount, and despite the financial risk protection provided for all patients could result in catastrophic expenses and impoverishment for vulnerable households especially in people with chronic and/or relapsing conditions. The equity in financial protection could also differ for different levels of socio-economic groups [12]. We therefore aimed to estimate the incidence of catastrophic health expenditure and medical impoverishment among adult patients with asthma in primary care settings and to examine factors associated with the risk of financial catastrophe.

## Methods

### Design, setting and participants

We undertook a cross-sectional questionnaire survey as part of the baseline data collection of patients recruited

to an asthma cohort from six public health clinics in the Klang District, Selangor state, Malaysia [5]. The clinics were selected because they are part of the government-funded national healthcare provision where the consultation and treatment fees are capped at affordable levels. These clinics cater for 80% of the population in the district, the majority of whom are in the low and middle-income groups [12]. The prevalence of asthma in this area was reported to be 5.9% in 2011 [17]. The sample size of the cohort was calculated to enable the assessment of an improvement initiative using estimates from a meta-review of supported asthma self-management [18]. We recruited 1280 patients aged 5 years and above who had physician-diagnosed asthma and/or received asthma treatment in the previous year, allowing for an estimated dropout rate of 40% [19]. For this paper, we only analysed data for adults (≥18 years old).

### Data collection

We recruited patients during their scheduled or unscheduled visits to the clinics between July 2019 - January 2020 and used a questionnaire administered face-to-face [5] to collect baseline data. The questionnaire was developed based on a literature review and views from expert panels in primary care respiratory medicine [5]. The questionnaire consists of sociodemographic characteristics, healthcare use and related payments, current asthma status, comorbidities, and asthma treatment. It was given to six Family Medicine Specialists, two respiratory physicians, and five medical officers for face and content validity and several revisions were made to make items clearer and easier to comprehend [5]. All patients provided written informed consent. Data collected included patients' demographic and socio-economic profile: age, gender, ethnicity, education level, working status, occupation, number of households, personal and household monthly income, main source of health payment, monthly out-of-pocket payment for direct costs of asthma-related care in outpatient clinics and asthma control using Global Initiative for Asthma (GINA) assessment of asthma control [20]. Patients self-reported their expenses on asthma-related costs in the one month preceding recruitment to the study. All costs were collected in Malaysia Ringgit (MYR) and converted to USD for reporting (currency exchange rate 4.203 for MYR to USD in 2019 [21]).

### Operational terminologies

- Direct costs of asthma-related care in outpatient clinics are out-of-pocket payments incurred for registration and consultation, medications, investigations, and any devices, and costs for transportation [22].
- Household income is the overall income earned by household members aged 18 years and above. Household income in Malaysia is classified into B40, M40, and T20, which refers to the Bottom 40%, Middle 40%, and Top 20% of the household income groups. B40, M40 and T20 refers to a household income of < MYR4850 (< USD1174.33), MYR4850–10,959 (USD1174.33–2653.51) and > MYR10959 (> USD2653.51) respectively [12].
- Incidence of poverty is the proportion of patients whose monthly household income falls below the poverty line. Malaysia has developed poverty lines for urban and rural populations in different states of the federation. This study used the poverty line of the urban population, MYR2022 (USD481.08), for the state of Selangor [12]. A household is considered poor if its total monthly income falls below the poverty line.
- Catastrophic health expenditure is the proportion of patients whose monthly out-of-pocket payments spent on direct medical costs exceeds 10% of their monthly household income. Catastrophic expenditure is health spending not covered by any public or private health scheme when the health cost spent is higher than the household income [12, 23].
- Medical impoverishment is calculated based on the poverty line of the state or country. It occurs when a household that is above the poverty line is pushed below the line after incurring household expenditures for healthcare. We used the Malaysian Poverty Line Income for 2019 stratified for urban and rural areas in the Selangor state [12, 23].
- Quintiles is a way of measuring income inequality. It ranks all households by income, from lowest to highest, and divides all households into five quintiles. This calculation measures the distribution of income among the five groups compared to the total. The first quintile (Q1) is the lowest fifth, the second quintile (Q2) is the next lowest, and so on [24].

### Data analysis

Statistical analysis was done using SPSS version 25.0. Descriptive statistics were used to analyse demographic and socio-economic data, and out-of-pocket payments for asthma-related care. All results, where appropriate, are presented as proportions (%), mean (standard deviation or standard error), and confidence intervals. The proportion of households that were below the poverty line and occurrences of catastrophic health expenditure and medical impoverishment across the different levels of quintile were calculated. Multivariate regression analysis was used to identify associations between demographic (age, gender and ethnicity), household income

by quintiles, level of asthma control, and financial catastrophic risk. In this analysis, the Chinese ethnicity was grouped with 'others' as the numbers were small. We compared the outcome of catastrophic health expenditure risk for out-of-pocket payments, with and without the cost of transportation, to explore the impact of non-medical direct costs on health expenditure.

## Results

### Demographic and socio-economic profile

A total of 1,280 patients with asthma were recruited, 85% ($N$=1092) were adults. All 1092 completed the face-to-face questionnaire. However, 8% of patients ($n$=89) had missing data mainly in out-of-pocket payments ($n$=22) and household incomes ($n$=72), because they chose not to complete these questions. Hence, we analysed a total of 1003 patients. Table 1 shows patients' demographic and socio-economic profile. The profile of the sub-group analysed ($N$=1003) was similar to 1092 of the whole adult population. In the analysed group ($N$=1003), the majority (81%) were from low-income households (B40 category). About half of the patients were working of which 88% worked in the private sector or were self-employed. More than half (65%) reported personal (patient's and household's) savings as their main source of health payment. The mean personal income was MYR1,317.90 (USD313.56) while the mean household income was MYR3,181.66 (USD756.99). Each household had an average of four people.

### Out-of-pocket payment for outpatient asthma-related care

Table 2 reports the direct costs of outpatient asthma care for the study population. The total mean monthly direct cost for asthma-related care was MYR22.33 (USD5.32). The mean monthly direct medical cost incurred by patients and households was MYR7.53 (USD1.79) and the mean direct non-medical cost, transportation cost was MYR6.37 (USD1.52). For patients who used CAM as a treatment for their asthma, the additional mean monthly cost spent was the highest at MYR8.43 (USD 2.01).

**Table 1** Demographic and socio-economic profile of the overall adult population ($N$=1092) and study population ($N$=1003)

| Profile | | $N$=1092 | $N$=1003 |
|---|---|---|---|
| Age in years, mean (SD) | | 48.8 (15.5) | 48.3 (15.1) |
| Gender, n (%) | Male | 376 (34.4) | 344 (34.3) |
| | Female | 716 (65.6) | 659 (65.7) |
| Ethnicity, n (%) | Malay | 590 (54.0) | 551(55.0) |
| | Chinese | 111 (10.2) | 90 (8.9) |
| | Indian | 374 (34.2) | 346 (34.5) |
| | Others | 17 (1.6) | 16 (1.6) |
| Level of education, n (%) | No formal | 49 (4.5) | 38 (3.8) |
| | Primary | 292 (26.7) | 262 (26.1) |
| | Secondary | 505 (46.3) | 473 (47.1) |
| | Tertiary | 246 (22.4) | 230 (22.9) |
| Occupation, n (%) | Not working | 418 (38.4) | 374 (37.3) |
| | Retired | 132 (12.1) | 113 (11.3) |
| | Working | 542 (49.5) | 516 (51.4) |
| Working sector, n (%) | Public | 65 (12.0) | 60 (11.6) |
| | Private | 398 (73.4) | 380 (73.6) |
| | Self-employed | 79 (14.6) | 76 (14.7) |
| *Household income category, n (%) (Classification in Malaysia) | B40 | 824 (75.5) | 819 (80.9) |
| | M40 | 178 (16.3) | 175 (17.3) |
| | T20 | 18 (1.7) | 18 (1.8) |
| #Main source of health payment, n (%) | Personal savings | 667 (61.1) | 654 (65.2) |
| | Employment benefit | 165 (15.1) | 159(15.8) |
| | Private insurance | 56 (5.1) | 55 (5.5) |
| | Others | 132 (12.1) | 131 (13.1) |
| Household size mean (SD) | | 4 (1.85) | 4.58 (1.63) |
| Personal monthly income, mean (SD) in MYR | | 1,258.00 (1,542.00) | 1,317.90 (1,565.54) |
| Household monthly income, mean (SD) in MYR | | 3,168.00 (2,558.00) | 3,181.66 (2,570.10) |
| +Asthma control | | 372 (34.1) | 338 (33.6) |
| Well-controlled | | 720 (65.9) | 665 (66.4) |
| Poorly controlled | | | |

*B40, M40 and T20 refers to household income of < MYR4850 (< USD1174.33), MYR4850–10,959 (USD1174.33–2653.51) and > MYR10959 (> USD2653.51) respectively [17]

# Main source of health payment: Personal savings refers to savings from personal and households; employment benefit refers to government, private and social security organisation (SOCSO) health scheme; others include free treatment, charity, non-government organisation

+GINA: Global Initiative for Asthma 2017

All currency in Table 1 in Malaysia Ringgit (MYR)

**Table 2** Out-of-pocket payment for outpatient asthma-related care in the previous one month (*N* = 1003)

| | Mean (MYR) (%) | SE (95% CI) |
|---|---|---|
| Total monthly direct cost | 22.33 | 4.41 (13.67-31.00) |
| Outpatient clinic visit (s) | 3.94 (17.65%) | 0.63 (2.71–5.17) |
| Prescribed asthma medication(s) | 1.68 (7.53%) | 0.40 (0.90–2.47) |
| Over-the-counter asthma medication(s) | 1.59 (7.12%) | 0.31 (0.97–2.21) |
| Devices for asthma | 0.32 (1.43%) | 0.06 (5.87–6.88) |
| Transportation | 6.37 (28.52%) | 0.26 (5.87–6.88) |
| CAM for asthma | 8.43 (37.75%) | 4.28 (0.03–16.82) |

All currency in Table 2 in Malaysia Ringgit (MYR)

### Catastrophic health expenditure and medical impoverishment

Table 3 shows the incidence of poverty among the patients and households. Even before considering healthcare payments, 41.6% were in the 'poor' category. Seventeen households (1.69%) reached the threshold for catastrophic healthcare payments none of whom were in the highest income quintile. The direct out-of-pocket payment for asthma-related care shifted three households from mid/high income (quintiles 3 and 4) below the poverty line, classifying them as meeting the threshold for medical impoverishment. Note that the estimation of impoverishment does not apply to households who were already below the poverty line. Excluding the cost of transportation (Table 4), overall, 14 households (1.40%) were catastrophic, however, patients who were in the lowest quintile (Q1) were the most affected.

### Predictors of catastrophic health expenditure

Table 5 shows independent variables associated with catastrophic health expenditure.

The multivariate regression analysis showed that the only significant predictor of catastrophic health expenditure was household income (with or without including transportation costs). The higher income quintiles (Q2, Q3, Q4 & Q5) had lower odds of financial catastrophe than Q1; (OR 0.06; 95% CI 0.01–0.50), (OR 0.12; 95% CI 0.03–0.57) and (OR 0.04; 95% CI 0.00-0.31) respectively taking into account the confounders including transportation costs. Similarly, when adjusting for confounders excluding transportation costs. the higher income quintile (Q2, Q3, Q4 & Q5) had lower odds of financial catastrophe than Q1; (OR 0.08; 95% CI 0.01–0.62), (OR 0.14; 95% CI 0.03–0.68) and (OR 0.04; 95% CI 0.01–0.36) respectively. Age, gender, ethnicity, and poor asthma control were not significant predictors. When the cost of transportation was included for out-of-pocket payments, patients who were 65 years old and above had higher odds of catastrophic risk (OR 1.05; 95% CI 0.32–3.48) as compared to transportation costs were excluded (OR 0.57; 95% CI 0.13–2.47).

**Table 3** Catastrophic health expenditure and medical impoverishment in households by income quintile (including transportation costs)

| | Out-of-pocket payment (including transportation costs) | | | | | |
|---|---|---|---|---|---|---|
| **Quintiles of household income** | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** | **Total** |
| Complete data (N) | 204 | 213 | 232 | 155 | 199 | 1,003 |
| **Proportion meeting criteria for poverty at baseline** | | | | | | |
| mean | 100.0 | 100.0 | 0 | 0 | 0 | 41.5 |
| SE | | | | | | 1.56 |
| 95% CI lower bound | | | | | | 38.5 |
| 95% CI upper bound | | | | | | 44.6 |
| **Out-of-pocket payment as % of household income** | | | | | | |
| mean | 3.02 | 1.03 | 0.67 | 1.07 | 0.29 | 1.21 |
| SE | 0.80 | 0.23 | 0.09 | 0.65 | 0.04 | 0.20 |
| 95% CI lower bound | 1.45 | 0.58 | 0.48 | -0.20 | 0.22 | 0.82 |
| 95% CI upper bound | 4.58 | 1.49 | 0.85 | 2.35 | 0.36 | 1.60 |
| **Proportion meeting criteria for catastrophic health expenditure** (10% income threshold) | | | | | | |
| mean | 6.37 | 0.47 | 0.86 | 0.65 | 0.00 | 1.69 |
| SE | 1.71 | 0.47 | 0.61 | 0.65 | | 0.41 |
| 95% CI lower bound | 3.01 | -0.45 | -0.33 | -0.62 | | 0.89 |
| 95% CI upper bound | 9.74 | 1.39 | 2.06 | 1.91 | | 2.50 |
| **Proportion meeting criteria for medical impoverishment** | | | | | | |
| mean | *NA | *NA | 0.43 | 0.65 | 0.00 | 0.34 |
| SE | | | 0.43 | 0.65 | | 0.24 |
| 95% CI lower bound | | | -0.42 | -0.62 | | -0.13 |
| 95% CI upper bound | | | 1.28 | 1.91 | | 0.81 |

*NA not applicable, patients in Q1 and Q2 were already below poverty line

**Table 4** Catastrophic health expenditure and medical impoverishment in households by income quintile (excluding transportation costs)

| | Out-of-pocket payment (excluding transportation costs) | | | | | |
|---|---|---|---|---|---|---|
| **Quintiles of household income** | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** | **Total** |
| Complete data (N) | 204 | 213 | 232 | 155 | 199 | 1,003 |
| **Proportion meeting criteria for poverty at baseline** | | | | | | |
| mean | 100.0 | 100.0 | 0 | 0 | 0 | 41.5 |
| SE | | | | | | 1.56 |
| 95% CI lower bound | | | | | | 38.5 |
| 95% CI upper bound | | | | | | 44.6 |
| **Out-of-pocket payment as % of household income** | | | | | | |
| mean | 1.98 | 0.65 | 0.41 | 0.93 | 0.19 | 0.82 |
| SE | 0.74 | 0.23 | 0.09 | 0.65 | 0.03 | 0.19 |
| 95% CI lower bound | 0.53 | 0.20 | 0.23 | -0.34 | 0.12 | 0.45 |
| 95% CI upper bound | 3.44 | 1.09 | 0.59 | 2.21 | 0.25 | 1.19 |
| **Proportion meeting criteria for catastrophic health expenditure** (10% income threshold) | | | | | | |
| mean | 4.90 | 0.47 | 0.86 | 0.65 | 0.00 | 1.40 |
| SE | 1.52 | 0.47 | 0.61 | 0.65 | | 0.37 |
| 95% CI lower bound | 1.93 | -0.45 | -0.33 | -0.62 | | 0.67 |
| 95% CI upper bound | 7.88 | 1.39 | 2.06 | 1.91 | | 2.12 |
| **Proportion meeting criteria for medical impoverishment** | | | | | | |
| mean | *NA | *NA | 0.43 | 0.65 | 0.00 | 0.34 |
| SE | | | 0.43 | 0.65 | | 0.24 |
| 95% CI lower bound | | | -0.42 | -0.62 | | -0.13 |
| 95% CI upper bound | | | 1.28 | 1.91 | | 0.81 |

*NA not applicable, patients in Q1 and Q2 were below poverty line

**Table 5** Predictors of catastrophic health expenditure calculated with out-of-pocket payment (including and excluding the cost of transportation)

| | Risk of catastrophic health expenditure (including the cost of transportation) | | Risk of catastrophic health expenditure (excluding the cost of transportation) | |
|---|---|---|---|---|
| **Variable** | **Odds ratio** | **95% CI** | **Odds ratio** | **95% CI** |
| Age (years) | | | | |
| 18–65 | 1 | 0.32–3.48 | 1 | 0.13–2.47 |
| 65 and above (elderly) | 1.05 | | 0.57 | |
| Gender | | | | |
| Female | 1 | 0.15–1.68 | 1 | 0.21–2.54 |
| Male | 0.50 | | 0.74 | |
| HH income Quintiles | | | | |
| Q1 | 1 | 0.01-0.50-2 | 1 | 0.01–0.62 |
| Q2 | 0.06 | 0.03–0.57 | 0.08 | 0.03–0.68 |
| Q3 | 0.12 | 0.00-0.31 | 0.14 | 0.01–0.36 |
| Q4 and Q5 | 0.04 | | 0.04 | |
| Ethnicity | | | | |
| Malay | 1 | 0.19–1.76 | 1 | 0.17–2.04 |
| Indian | 0.58 | 0.19–5.20 | 0.60 | 0.28–8.24 |
| Others | 1.01 | | 1.53 | |
| Asthma control | | | | |
| Poorly controlled | 1 | 0.15–1.60 | 1 | 0.13–1.76 |
| Well-controlled | 0.50 | | 0.47 | |

## Discussion

The World Health Organization (WHO) states that "direct payments or costs made to obtain health services should not expose people to financial hardship and should not threaten living standards" [25]. Protecting households against financial hardship has been conceptualised as ensuring financial protection [25]. Malaysia is committed to delivering the mission of the United Nations Sustainable Development Goals in achieving and sustaining universal health coverage [26] and this is

illustrated by the findings of this study. It provides a free service for those working or retirees from the public sector, while others obtain treatment from public health clinics are heavily subsidised with just needing to pay a very minimal fee [26]. Asthma is a common chronic respiratory condition in Malaysia, with most patients seeking care at outpatient clinics either at the primary or secondary care level [27]. We looked at a sample of patients attending six government-funded public health clinics to determine if they had been provided with financial risk protection. Most of the patients in our study were from low-income groups (B40 category in Malaysia classification). Almost half (41.6%) of this population lived below the poverty line as defined locally. Half of these patients were working either in the private sector or self-employed. Personal savings were the main source of health payment in two-thirds of the studied population. The mean out-of-pocket payment was low at MYR22.34 (USD5.29) per month. The mean monthly out-of-pocket payments for CAM treatment were the highest at MYR8.43 (USD 1.99) among the direct costs. Although there is no or limited evidence to support its effectiveness, CAM is increasingly popular as a self-care medicine complementary to evidence-based asthma treatment [15]. A study in Malaysian health clinics revealed almost half of patients with asthma used CAM to complement their asthma medications [28]. CAM is regarded as a patient's choice and is not subsidised in government-funded facilities, but interventions that acknowledge health beliefs on CAM could minimise out-of-pocket spending. The cost of transportation was the major direct non-medical cost incurred in a month. Previous studies have reported the bulk of catastrophic risk comes from the direct non-medical costs involving transportation and lodging [29–31]. Transportation is often cited as a major barrier to healthcare access and reducing the costs of transportation has been shown to help better access care, especially in low-income populations [32]. A strategy to improve transportation to health facilities could further assist in protecting those patients in lower income quintile from financial catastrophic risks. This study has demonstrated that catastrophic health expenditure and impoverishment due to asthma care were infrequent. We found 17 of the 1,003 patients in our study experienced catastrophic impact. After the incursion of direct health costs for asthma, three households (0.34%) were pushed into poverty. Although these findings could be considered low, there was already a considerably larger proportion of patients (41.6%) living below the poverty line. The proportion of household income used for out-of-pocket payment amongst those in the lower quintiles was greater compared to higher-income households, demonstrating a potential risk of financial hardship. This is evidenced by the regression analysis that showed patients who were in the higher income quintiles had lower odds of financial catastrophe. The findings of catastrophic health expenditure and impoverishment for asthma in this study were similar to earlier reports of the national household survey that stated a low incidence (2%) of catastrophic expenditure in Malaysia overall [33]. However, the level of poverty in our study was much lower at 0.34% compared to the World Bank report for Malaysia in 2009 which estimated it at 3.8% of the population [34]. Other countries in Asia, for example, Vietnam, have a relatively higher catastrophic expenditure and impoverishment for chronic non-communicable diseases overall, 14.6 and 7.6%, respectively [35]. Korea reported a catastrophic health expenditure of 7.6% for chronic disease [36]. However, these differences could be due to the socio-economic background of the studied population, differences in the provision of healthcare, and variations in the costs of resources (e.g., medications and investigations). Life expectancy in Malaysia has increased to about 75 years in recent years. Hence, the burden of non-communicable diseases is expected to rise [37] challenging the highly subsidised public health care system. Government policy will need to evolve to ensure that patients with low income and living in poverty are protected from financial catastrophic risks.

### Strengths and limitations of the study

Of the population in our study, 8% declined to provide financial information. These data may not have been missing at random as patients with very low incomes may have preferred not to divulge their poverty status. Nevertheless, this is representative of the population served by the public health clinics in this area. As this study recruited patients who visited the public health clinics for outpatient care, we may have missed some who were hospitalised and attending secondary care clinics – a group potentially more prone to catastrophic costs. Equally patients unable to afford transport may not receive care because they are unable to attend clinics even if the care is almost free. We may therefore have underestimated the incidence of catastrophe in the population. Another limitation is the accuracy in cost determination for types of out-of-pocket payment costs and the variation in the price of the medications bought from private pharmacies as data were self-reported. In addition, the indirect costs and cost of productivity loss were not captured in this analysis. Although this was not calculated, the findings of direct costs in this study reflect the impact of health spending on asthma care for poor patients.

## Conclusion

The financial risk protection provided by the Malaysian government lessens the financial burden for this population of people with asthma who are mostly in the lower

socio-economic group. In general, patients and households in the Klang District have benefitted from the heavily subsidised public health services that are almost free. However, there was still a small proportion of patients in the lowest income quintile who still experienced financial catastrophe and impoverishment. Further steps are needed to ensure health equity so that patients in the low socio-economic group are protected from financial health risks at all times.

**Abbreviations**

| | |
|---|---|
| MYR | Malaysian Ringgit |
| USD | United States Dollar |
| B40 | Bottom 40% |
| M40 | Middle 40% |
| T20 | Top 20% |
| Q | Quintile |
| N/A | Not applicable |
| CAM | Complementary Alternative Medicine |

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**Author contributions**
All authors (Norita Hussein, Chiu Wan Ng, Rizawati Ramli, Su May Liew, Nik Sherina Hanafi, Ping Yein Lee, Ai Theng Cheong, Sazlina Shariff Ghazali, Hilary Pinnock, Andrew Stoddart, Jürgen Schwarze and Ee Ming Khoo) have made contribution to the work in conceptualization, conception, design of work and analysis. Norita wrote the original draft, and all authors reviewed and edited critically for intellectual content. All authors have read and approved the final version of the manuscript. The views expressed in this manuscript are those of the author(s) and not necessarily those of the NIHR or the UK Department of Health and Social Care.

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

## Declarations

**Ethics approval and consent to participate**
Ethical approval was obtained from the National Medical Research Ethics Committee, Ministry of Health, Malaysia (NMRR-18-2707-42719) and the sponsor, the Academic and Clinical Central Office for Research and Development, University of Edinburgh, United Kingdom (AC19040). A written informed consent was obtained from all adult patients upon recruitment. All methods in this study were performed in accordance with guidelines and regulations as stated in Good Clinical Practice.

**Consent for publication**
Consent to publish was obtained from the participants of this study to publish de-identified data.

**Competing interests**
Authors EMK, PYL, ATC and HP declare no competing non-financial interest but the following competing financial interests: grants from the National Institute for Health Research (NIHR) Global Health Research Unit on Respiratory Health (RESPIRE). EMK reports personal fees from AstraZeneca; and is the President of the International Primary Care Respiratory Group and the Primary Care Respiratory Group Malaysia. All other authors declare no competing financial or non-financial interests.

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## Publisher's Note