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# Knowledge, Perceptions, and Preventive Practices Towards Human Metapneumovirus Among Malaysian Adults: A Cross-Sectional Study

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# Abstract

**Background:** Human metapneumovirus (hMPV) is a globally circulating respiratory virus that contributes to acute respiratory tract infections, particularly among vulnerable populations. Despite its clinical relevance, population-level evidence on public understanding of hMPV remains limited in Malaysia. This study aimed to assess Malaysian adults' knowledge, perceptions, preventive practices, concerns, and sources of health-related information regarding hMPV, and to examine sociodemographic factors associated with knowledge.

**Methods:** A cross-sectional online survey was conducted among Malaysian adults between May and June 2025. The questionnaire assessed sociodemographic characteristics, hMPV-related knowledge, perceptions, preventive practices, concerns, and information sources. Knowledge scores (range 0–22) were categorised as good (≥17) or low–moderate (<17). Associations were examined using univariate and multivariate logistic regressions.

**Results:** Among the 680 respondents, 173 (25.4%) demonstrated good knowledge. Although 353 participants (51.9%) correctly identified hMPV as a respiratory infection, fewer recognised its potential for serious complications (121/680, 17.8%), the possibility of reinfection (332/680, 48.8%), or supportive care as the mainstay of management (143/680, 21.0%). Engagement in preventive behaviours, including hand hygiene (434/680, 63.8%) and mask use when symptomatic (287/680, 42.2%), was common and was significantly associated with higher knowledge levels ($p < 0.05$). In contrast, perceived disease severity and personal susceptibility were not significantly associated with knowledge. Female sex (adjusted odds ratio [aOR] = 1.64, 95% CI: 1.03–2.62) and older age, specifically 30–49 years (aOR = 3.30, 95% CI: 2.02–5.39) and ≥ 50 years (aOR = 3.36, 95% CI: 1.62–6.95), were independently associated with higher knowledge. Conversely, having no history of respiratory infection (aOR = 0.55, 95% CI: 0.36–0.84) and not being in health-related work or study (aOR = 0.17, 95% CI: 0.11–0.27) were independently associated with lower knowledge levels. Social media was the predominant source of information, reported by 581 respondents (85.4%).

**Conclusion:** Despite engagement in general respiratory preventive behaviours, Malaysian adults exhibited limited disease-specific knowledge of hMPV. Targeted risk communication addressing misconceptions and misinformation is needed to improve public preparedness for under-recognised respiratory infections.


# Introduction

Human metapneumovirus (hMPV) is an established respiratory virus first identified in 2001 in the Netherlands and is now recognised as a globally circulating cause of acute respiratory tract infections. It belongs to the family *Paramyxoviridae*, subfamily *Pneumovirinae*, and genus *Metapneumovirus* [1]. Although identified relatively recently, seroepidemiological evidence indicates that hMPV circulated in human populations for several decades prior to its discovery [2, 3]. The delayed identification of hMPV has been largely attributed to technical challenges in laboratory detection, particularly slow viral growth in cell culture and restricted permissiveness of commonly used cell lines [4, 5]. Structurally and clinically, hMPV shares key similarities with respiratory syncytial virus (RSV), including a related pneumovirus genomic framework,

comparable transmission pathways, and overlapping clinical manifestations, positioning hMPV as a clinically relevant pneumovirus within the spectrum of respiratory viral infections [1, 2].

hMPV demonstrates global circulation with seasonal patterns that vary by geographic region and climate. In temperate regions, infections typically peak in late winter and often occur following the RSV season, whereas in tropical and subtropical regions seasonality is less clearly defined and may be associated with wetter periods, with transmission influenced by rainfall and humidity [6]. Molecular surveillance studies classify hMPV into two major genetic groups (A and B) with multiple co-circulating lineages and sub-clusters, and shifts in predominant strains have been observed across seasons [7].

Among young children with acute respiratory illness, hMPV detection has been reported at approximately 6–7% across hospital, outpatient clinic, and emergency department settings, while community-based surveillance of influenza-like illness has identified hMPV in approximately 2% of influenza- and RSV-negative cases [8, 9]. Globally, hMPV is estimated to account for approximately 5–10% of hospitalisations among children with acute respiratory tract infections [10].

Clinically, hMPV infection spans a broad spectrum of severity, ranging from mild upper respiratory tract illness to lower respiratory tract disease, including bronchiolitis and pneumonia that may require hospitalisation or intensive care in severe cases [11, 12]. Mild infections commonly present with symptoms resembling a self-limiting viral illness, such as cough, fever, nasal congestion, and sore throat [13]. Wheezing has been reported in paediatric cases, and hMPV has been associated with asthma exacerbations [12]. Currently, no licensed vaccine or targeted antiviral therapy is available, and management relies primarily on supportive care [11, 12].

The burden of severe hMPV disease is disproportionately borne by vulnerable populations, particularly young children, older adults, and immunocompromised individuals. Infants and young children are more likely to develop severe lower respiratory tract disease and may require hospitalisation or intensive care [11, 12]. Older adults also experience an increased risk of severe disease and adverse outcomes, particularly in the presence of underlying comorbidities [11, 14]. In immunocompromised patients, including those with haematological malignancies and haematopoietic stem cell transplant recipients, hMPV infection is associated with progression to lower respiratory tract disease and measurable short-term mortality [15].

Despite its clinical relevance, hMPV remains under-recognised compared with other respiratory viruses such as influenza, COVID-19, and RSV [16, 17]. Limited public awareness, inconsistent diagnostic emphasis, and fragmented risk communication may hinder timely care-seeking and adoption of appropriate preventive behaviours, particularly in the absence of licensed vaccines or targeted antiviral therapies. Increasing reliance on online and social media platforms for health information may further contribute to misunderstanding through the spread of misleading or incomplete content, with implications for public perceptions and behaviours related to recommended preventive measures [18]. Within the Malaysian context, population-level evidence on public knowledge, perceptions, and preventive practices related to hMPV remains limited.

Accordingly, this study aimed to assess knowledge, perceptions, preventive practices, concerns, and sources of health-related information regarding hMPV among Malaysian adults, and to examine associations between knowledge and sociodemographic factors.

# Methods

### Study design

This cross-sectional study assessed public knowledge, perceptions, and preventive practices related to hMPV among Malaysian adults. Data were collected from 21 May to 21 June 2025 using a self-administered online questionnaire. Ethical approval was obtained from the Research Ethics Committee, Universiti Teknologi MARA (UiTM) (REC/04/2025 [ST/MR/59]), and the study is reported in accordance with the *Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)* guidelines [19].

### Study participants

Eligible participants were Malaysians aged 18 years or older who were able to read and understand either English or Malay. Participants were excluded if they provided incomplete responses to the online survey or indicated that they did not consent to participate.

### Study tool

Data were collected using a self-administered online questionnaire developed specifically for this study. The questionnaire was informed by a review of the literature on hMPV and related respiratory infections, with selected items adapted from previously published survey instruments assessing knowledge, perceptions, and preventive practices related to respiratory infectious diseases [1, 17, 20, 21]. It was prepared in both English and Malay to maximise accessibility.

The instrument comprised five sections. Section A captured sociodemographic information, including age, sex, education level, employment status, area of residence, health background, and history of respiratory illness.

Section B assessed knowledge of hMPV across topics such as disease characteristics, severity, reinfection, at-risk populations, symptoms, transmission routes, preventive strategies, and treatment. Each item required a response of *Yes*, *No*, or *Unsure*. Correct answers were scored as 1, while incorrect or unsure responses were scored as 0.

Section C explored perceptions of risk, preventive measures, and community preparedness. Items were rated using a five-point Likert scale from *Strongly Disagree (1)* to *Strongly Agree (5)*. Section D assessed preventive practices against respiratory infections using a five-point Likert scale from *Never (1)* to *Always (5)*. Section E examined concerns about hMPV infection and its potential consequences; both used five-point Likert scales from *Strongly Disagree (1)* to *Strongly Agree (5)*. Section F identified sources of health-related information, with each source assessed using *Yes* or *No* responses.

The questionnaire underwent expert review to ensure content validity, clarity, and alignment with the study objectives. A panel of five researchers with expertise in pharmacy and public health evaluated each item for relevance (four-point scale: 1 = Not Relevant, 4 = Highly Relevant), essentiality (three-point scale: 1 = Not Essential, 3 = Essential), clarity (three-point scale: 1 = Not Clear, 3 = Very Clear), and adequacy (three-point scale: 1 = Not Adequate, 3 = Very Adequate). The Content Validity Index (CVI) was calculated as the proportion of reviewers rating an item 3 or 4 on relevance. With five reviewers, items achieving a CVI of 1.00 were retained [22]. For essentiality, clarity, and adequacy, mean scores were computed, and a threshold of ≥2.5 was considered acceptable. All items met the predefined criteria, and only minor modifications were made to enhance precision and readability.

Following refinement, the survey was digitised and hosted on Google Forms. A pilot test with ten participants was conducted to assess clarity, usability, technical functionality, and estimated completion time. On average, the questionnaire required about 10 minutes to complete. Data from the pilot test were excluded from the final analysis.

**Data collection**

The finalised questionnaire was administered electronically using Google Forms in both English and Malay. Dissemination was conducted through social media platforms, institutional mailing lists, emails, digital posters, and advertisements. Individuals who received the invitation could participate by following the survey link or scanning a QR code.

Upon accessing the survey, participants were provided with detailed information about the study, including its objectives, the research team members, and their rights as participants. They were reminded of confidentiality, anonymity, and their right to withdraw or discontinue participation at any time without consequences. Those willing to proceed gave electronic informed consent before being directed to the screening questions. Participants who met the eligibility criteria were directed to complete the full questionnaire, whereas those who did not meet the criteria were exited from the survey.

Responses were anonymous, no personally identifiable information was collected, and duplicate submissions were minimised through platform settings. Only fully completed questionnaires were included in the final dataset.

**Data analysis**

Data were exported from Google Forms into IBM SPSS Statistics version 27 (IBM Corp., Armonk, NY, USA) for analysis. Descriptive statistics were used to summarise participant characteristics, knowledge, perceptions, preventive practices, concerns, and sources of health-related information. Categorical variables were presented as frequencies and percentages, while continuous variables were summarised as means and standard deviations or medians and interquartile ranges, as appropriate.

Knowledge scores were calculated by summing correct responses, with a total score range of 0–22. Scores were dichotomised into good knowledge (≥ 17) and low to moderate knowledge (< 17), corresponding to an approximate threshold of 75% correct responses. This cut-off is consistent with commonly adopted

practices in previous knowledge-based studies, which have used 75% as the benchmark for good knowledge [23, 24]. Associations between sociodemographic characteristics and knowledge categories were examined using univariate logistic regression. Variables with a p-value < 0.05 in the univariate analysis were included in a multivariate logistic regression model to identify independent predictors. Odds ratios (ORs) and adjusted ORs (aORs) with 95% confidence intervals (CIs) were reported.

For perceptions, practices, and concerns, responses on Likert scales were collapsed into three categories for analysis (e.g., strongly disagree/disagree, neutral, strongly agree/agree). Chi-square tests were used to examine associations between these categorical variables and knowledge categories. A p-value of <0.05 was considered statistically significant.

# Results

### Sociodemographic Characteristics of Participants

Overall, 680 adults completed the survey. Table 1 summarises the characteristics of the participants. The majority were female (504/680, 74.1%). Half were younger than 30 years (343/680, 50.4%), while 263/680 (38.7%) were aged 30–49 years and 74/680 (10.9%) were 50 years or older. Almost half held a bachelor's degree (312/680, 45.9%), and 293/680 (43.1%) were students. Most participants resided in urban areas (379/680, 55.7%). More than half (360/680, 52.9%) reported studying or working in health-related fields. A smaller proportion reported chronic medical conditions (87/680, 12.8%), previous respiratory diseases (40/680, 5.9%), or a prior hMPV infection (17/680, 2.5%).

### Knowledge of hMPV Among Participants

Table 2 demonstrates participants' knowledge of hMPV. Knowledge of hMPV as a respiratory infection was reported by 353/680 (51.9%). Fewer participants recognised that the infection may cause serious complications (121/680, 17.8%) or that reinfection can occur (332/680, 48.8%). Knowledge of vulnerable groups was comparatively higher, with 535/680 (78.7%) identifying immunocompromised individuals, 521/680 (76.6%) the elderly, and 496/680 (72.9%) children. Frequently recognised symptoms included breathing difficulties (534/680, 78.5%), cough (501/680, 73.7%), and fever (385/680, 56.6%), while fatigue was less commonly identified (280/680, 41.2%).

With respect to the mode of transmission, the majority of participants correctly identified droplet transmission (529/680, 77.8%), whereas fewer recognised direct contact (265/680, 39.0%) or contaminated surfaces (263/680, 38.7%) as potential routes of transmission. Preventive strategies were more widely known, including mask use (568/680, 83.5%), handwashing (519/680, 76.3%), and avoiding crowded places (504/680, 74.1%). Nevertheless, 278/680 (40.9%) incorrectly believed that vaccination is available. Regarding treatment, the majority of participants demonstrated appropriate awareness that antibiotics are not indicated (610/680, 89.7%). In contrast, only a minority recognised that antiviral therapy is ineffective (208/680, 30.6%), and an even smaller proportion correctly identified supportive care as the primary management approach (143/680, 21.0%).

### Association of Sociodemographic Characteristics of Participants with Knowledge Categories

Overall, 173 of 680 participants (25.4%) demonstrated good knowledge of hMPV (score ≥ 17). In univariate analyses, female gender (OR = 1.67, 95% CI: 1.09–2.55, p = 0.019), age 30–49 years (OR = 1.86, 95% CI: 1.29–2.69, p < 0.001), and postgraduate education (OR = 1.90, 95% CI: 1.18–3.06, p = 0.009) were significantly associated with higher knowledge levels. In contrast, not working or studying in health-related fields (OR = 0.24, 95% CI: 0.16–0.36, p < 0.001) and having no previous history of hMPV (OR = 0.37, 95% CI: 0.14–0.98, p = 0.046) or other respiratory infections (OR = 0.38, 95% CI: 0.26–0.55, p < 0.001) were associated with lower odds of good knowledge.

In the multivariate analysis, female gender (adjusted OR = 1.64, 95% CI: 1.03–2.62), age 30–49 years (adjusted OR = 3.30, 95% CI: 2.02–5.39), age ≥50 years (adjusted OR = 3.36, 95% CI: 1.62–6.95), working or studying in health-related fields (adjusted OR = 0.17, 95% CI: 0.11–0.27), and prior infection with other respiratory illnesses (adjusted OR = 0.55, 95% CI: 0.36–0.84) were significant independent predictors of hMPV knowledge (Table 1).

**Table 1. Sociodemographic Characteristics of Participants and Their Association with Knowledge Categories**

| Characteristics | Total (n = 680) | Good knowledge (score ≥ 17) (n = 173) | Low – moderate knowledge (score < 17) (n = 507) | Univariate | | Multivariate | |
|---|---|---|---|---|---|---|---|
| | n (%) | | | Odds ratio (95 % CI) | *p*-value | Adjusted odds ratio (95 % CI) | *p*-value |
| Gender | | | | | | | |
| Male | 176 (25.9) | 33 (18.8) | 143 (81.3) | Reference | | Reference | |
| Female | 504 (74.1) | 140 (27.8) | 364 (72.2) | 1.67 (1.09–2.55) | ***0.019*** | 1.64 (1.03–2.62) | ***0.038*** |
| Age group (years) | | | | | | | |
| Less than 30 | 343 (50.4) | 70 (20.4) | 273 (79.6) | Reference | | Reference | |
| 30–49 | 263 (38.7) | 85 (32.3) | 178 (67.7) | 1.86 (1.29–2.69) | ***< 0.001*** | 3.30 (2.02–5.39) | ***< 0.001*** |
| 50 and above | 74 (10.9) | 18 (24.3) | 56 (75.7) | 1.25 (0.69–2.27) | 0.455 | 3.36 (1.62–6.95) | ***0.001*** |
| Highest education level | | | | | | | |
| Diploma and lower | 232 (34.1) | 48 (20.7) | 184 (79.3) | Reference | | Reference | |
| Bachelor's | 312 (45.9) | 80 (25.6) | 232 (74.4) | 1.32 (0.88–1.99) | 0.179 | 1.18 (0.75–1.84) | 0.480 |
| Postgraduate (Master's/Doctorate) | 136 (20.0) | 45 (33.1) | 91 (66.9) | 1.90 (1.18–3.06) | ***0.009*** | 1.09 (0.62–1.92) | 0.771 |
| Employment status | | | | | | | |
| Employed | 355 (52.2) | 99 (27.9) | 256 (72.1) | Reference | | | |
| Unemployed | 32 (4.7) | 8 (25.0) | 24 (75.0) | 0.86 (0.38–1.98) | 0.727 | | |
| Students | 293 (43.1) | 66 (22.5) | 227 (77.5) | 0.75 (0.53– | 0.119 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1.08) | | | |
| Working or studying in health fields | | | | | | | |
| Yes | 360 (52.9) | 133 (36.9) | 227 (63.1) | Reference | | Reference | |
| No | 320 (47.1) | 40 (12.5) | 280 (87.5) | 0.24 (0.16–0.36) | ***< 0.001*** | 0.17 (0.11–0.27) | ***< 0.001*** |
| Area of residence | | | | | | | |
| Urban | 379 (55.7) | 91 (24.0) | 288 (76.0) | Reference | | | |
| Suburban | 216 (31.8) | 65 (30.1) | 151 (69.9) | 1.36 (0.94–1.98) | 0.105 | | |
| Rural | 85 (12.5) | 17 (20.0) | 68 (80.0) | 0.79 (0.44–1.42) | 0.430 | | |
| Had chronic medical conditions | | | | | | | |
| Yes | 87 (12.8) | 28 (32.2) | 59 (67.8) | Reference | | | |
| No | 593 (87.2) | 145 (24.5) | 448 (75.5) | 0.68 (0.42–1.11) | 0.124 | | |
| Had respiratory disease(s) e.g. COPD/Asthma | | | | | | | |
| Yes | 40 (5.9) | 9 (22.5) | 31 (77.5) | Reference | | | |
| No | 640 (94.1) | 164 (25.6) | 476 (74.4) | 1.19 (0.55–2.55) | 0.660 | | |
| Had ever infected with hMPV | | | | | | | |
| Yes | 17 (2.5) | 8 (47.1) | 9 (52.9) | Reference | | Reference | |
| No | 663 (97.5) | 165 (24.9) | 498 (75.1) | 0.37 (0.14–0.98) | ***0.046*** | 0.55 (0.18–1.74) | 0.310 |
| Had ever infected with other respiratory infections (e.g., | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| pneumonia, influenza | | | | | | | |
| Yes | 159 (23.4) | 65 (40.9) | 94 (59.1) | Reference | | Reference | |
| No | 521 (76.6) | 108 (20.7) | 413 (79.3) | 0.38 (0.26–0.55) | ***< 0.001*** | 0.55 (0.36–0.84) | ***0.006*** |
| Had ever attended awareness programme on respiratory infections | | | | | | | |
| Yes | 386 (56.8) | 107 (27.7) | 279 (72.3) | Reference | | | |
| No | 294 (43.2) | 66 (22.4) | 228 (77.6) | 0.76 (0.53–1.07) | 0.118 | | |
| Good knowledge was defined as a score ≥17; low–moderate knowledge as <17. Odds ratios (OR) with 95% confidence intervals (CI) are reported. “Reference” indicates the comparison category in each variable. Variables with $p < 0.05$ in univariate analysis were entered into multivariate logistic regression. Model fit for the multivariable logistic regression model: Omnibus $\chi^2 = 109.572$ (df = 9, $p < 0.001$); Nagelkerke $R^2 = 0.219$; Hosmer and Lemeshow $\chi^2 = 15.640$ (df = 8, $p = 0.048$). | | | | | | | |

**Table 2. Knowledge of hMPV Among Participants (n = 680)**

| Item [a] | Correct answer | Incorrect or Uncertain |
|---|---|---|
| | n (%) | |
| 1. hMPV is a respiratory infection | 353 (51.9) | 327 (48.1) |
| 2. hMPV infection can lead to serious complications (such as respiratory failure, hospitalisation, and death) | 121 (17.8) | 559 (82.2) |
| 3. A person can be reinfected with hMPV after recovering from it | 332 (48.8) | 348 (51.2) |
| 4. Population that is at risk of severe hMPV infection | | |
| 1. Individuals with low immunity | 535 (78.7) | 145 (21.3) |
| 2. Elderly | 521 (76.6) | 159 (23.4) |
| 100. Children | 496 (72.9) | 184 (27.1) |
| 5. Symptoms of hMPV | | |
| 1. Breathing difficulties | 534 (78.5) | 146 (21.5) |
| 2. Coughs | 501 (73.7) | 179 (26.3) |
| 100. Fever | 385 (56.6) | 295 (43.4) |
| 500. Sore throats | 384 (56.5) | 296 (43.5) |
| 5. Fatigue | 280 (41.2) | 400 (58.8) |
| 6. Flu-like symptoms | 371 (54.6) | 309 (45.4) |
| 6. Methods of hMPV transmission | | |
| 1. Droplets from coughing or sneezing | 529 (77.8) | 151 (22.2) |
| 2. Direct contact with an infected person | 265 (39.0) | 415 (61.0) |

| | | |
|---|---|---|
| 100. Touching contaminated surfaces (then touching the mouth, nose, or eyes) | 263 (38.7) | 417 (61.3) |
| 7. Strategies to prevent hMPV infection | | |
| 1. Handwashing with soap | 519 (76.3) | 161 (23.7) |
| 2. Putting on face masks | 568 (83.5) | 112 (16.5) |
| 100. Avoiding crowded places during outbreaks | 504 (74.1) | 176 (25.9) |
| 500. Vaccination [b] | 278 (40.9) | 402 (59.1) |
| 8. Treatment for hMPV infections | | |
| 1. Antiviral medications [b] | 208 (30.6) | 472 (69.4) |
| 2. Supportive care (e.g., rest, fluids) | 143 (21.0) | 537 (79.0) |
| 100. Antibiotics [b] | 610 (89.7) | 70 (10.3) |

[a] Unless otherwise indicated, the correct response for each knowledge item was “Yes.”

[b] For items relating to vaccination, antiviral medications, and antibiotics, the correct response was “No,” reflecting the current absence of a hMPV vaccine or specific antiviral treatment, and the inappropriateness of antibiotics for viral infections.

**Perceptions of Risk, Preventive Measures, and Community Preparedness Towards hMPV**

Table 3 summarises participants’ perceptions of risk, preventive measures, and community preparedness towards hMPV. Most participants perceived hMPV as a serious infection (537/680, 78.9%), and nearly half believed they were personally at risk (310/680, 45.6%); however, neither perception was significantly associated with knowledge level ($p = 0.145$ and $p = 0.128$, respectively). The majority agreed that preventive measures such as mask wearing and hand hygiene could reduce infection risk (619/680, 91.0%), and this belief was significantly associated with good knowledge ($p = 0.011$).

Perceptions of others’ precautionary behaviour were mixed, with similar proportions disagreeing (181/680, 26.6%), remaining neutral (257/680, 37.8%), or agreeing (242/680, 35.6%). The association with knowledge approached but did not reach statistical significance ($p = 0.052$). Approximately one-quarter of participants

felt they had sufficient information to protect themselves (169/680, 24.9%), and this perception was strongly associated with good knowledge ($p < 0.001$).

Confidence in the healthcare system's response was moderate (385/680, 56.6%) and not associated with knowledge ($p = 0.564$). In contrast, most participants disagreed that the public was adequately informed (409/680, 60.1%), and fewer than one-quarter perceived their community as prepared (158/680, 23.2%) or felt safe with community measures (199/680, 29.3%); none of these perceptions were associated with knowledge ($p > 0.05$).

**Table 3. Perceptions of Risk, Preventive Measures, and Community Preparedness Towards hMPV (n = 680)**

| Item | Total (n = 680) | Good knowledge (score ≥ 17) (n = 173) | Low – moderate knowledge (score < 17) (n = 507) | *p*-value [a] |
|---|---|---|---|---|
| | | n (%) | | |
| **I believe hMPV is a serious infection** | | | | |
| Strongly disagree and disagree | 45 (6.6) | 17 (37.8) | 28 (62.2) | 0.145 |
| Neutral | 98 (14.4) | 24 (24.5) | 74 (75.5) | |
| Strongly agree and agree | 537 (78.9) | 132 (24.6) | 405 (75.4) | |
| **I think I am at risk of getting infected with hMPV** | | | | |
| Strongly disagree and disagree | 118 (17.4) | 33 (28.0) | 85 (72.0) | 0.128 |
| Neutral | 252 (37.1) | 53 (21.0) | 199 (79.0) | |
| Strongly agree and agree | 310 (45.6) | 87 (28.1) | 223 (71.9) | |
| **I believe preventive measures (e.g., wearing face masks and handwashing with soap) can protect me from hMPV** | | | | |
| Strongly disagree and disagree | 16 (2.4) | 4 (25.0) | 12 (75.0) | ***0.011*** |
| Neutral | 45 (6.6) | 3 (6.7) | 42 (93.3) | |
| Strongly agree and agree | 619 (91.0) | 166 (26.8) | 453 (73.2) | |
| **I think people around me are taking precautions against hMPV infection** | | | | |
| Strongly disagree and disagree | 181 (26.6) | 57 (31.5) | 124 (68.5) | 0.052 |
| Neutral | 257 (37.8) | 65 (25.3) | 192 (74.7) | |
| Strongly agree and agree | 242 (35.6) | 51 (21.1) | 191 (78.9) | |
| **I feel I have sufficient information to protect myself from hMPV** | | | | |

| | | | | |
|---|---|---|---|---|
| Strongly disagree and disagree | 259 (38.1) | 48 (18.5) | 211 (81.5) | ***< 0.001*** |
| Neutral | 252 (37.1) | 61 (24.2) | 191 (75.8) | |
| Strongly agree and agree | 169 (24.9) | 64 (37.9) | 105 (62.1) | |
| **I believe the healthcare system in my country can effectively respond to an hMPV outbreak** | | | | |
| Strongly disagree and disagree | 52 (7.6) | 14 (26.9) | 38 (73.1) | 0.564 |
| Neutral | 243 (35.7) | 56 (23.0) | 187 (77.0) | |
| Strongly agree and agree | 385 (56.6) | 103 (26.8) | 282 (73.2) | |
| **I believe the public is adequately informed about hMPV prevention** | | | | |
| Strongly disagree and disagree | 409 (60.1) | 104 (25.4) | 305 (74.6) | 0.963 |
| Neutral | 177 (26.0) | 46 (26.0) | 131 (74.0) | |
| Strongly agree and agree | 94 (13.8) | 23 (24.5) | 71 (75.5) | |
| **I believe my community is prepared to handle an hMPV outbreak** | | | | |
| Strongly disagree and disagree | 294 (43.2) | 72 (24.5) | 222 (75.5) | 0.645 |
| Neutral | 228 (33.5) | 63 (27.6) | 165 (72.4) | |
| Strongly agree and agree | 158 (23.2) | 38 (24.1) | 120 (75.9) | |
| **I feel safe with the preventive measures being implemented in my community** | | | | |
| Strongly disagree and disagree | 168 (24.7) | 45 (26.8) | 123 (73.2) | 0.763 |
| Neutral | 313 (46.0) | 81 (25.9) | 232 (74.1) | |
| Strongly agree and agree | 199 (29.3) | 47 (23.6) | 152 (76.4) | |

[a] *p*-values were obtained using Chi-square tests comparing knowledge categories (good knowledge defined as score ≥17; low–moderate knowledge as <17). Response options were collapsed into three categories: strongly disagree and disagree; neutral; strongly agree and agree.

### Personal and Household Preventive Practices Against Respiratory Infections

Table 4 details participants' personal and household preventive practices against respiratory infections. Hand hygiene was commonly reported, with 434/680 (63.8%) participants indicating that they always or often washed their hands after sneezing, coughing, or touching public surfaces. This practice was significantly associated with knowledge level ($p = 0.030$), with higher knowledge more frequent among regular handwashers.

Routine mask use in daily life was uncommon, reported as always or often by 73/680 (10.7%) participants. This behaviour showed a strong association with knowledge ($p < 0.001$), with good knowledge observed in 35/73 (47.9%) of frequent mask users compared with 79/372 (21.2%) among those who rarely or never used masks. Mask use when experiencing respiratory symptoms was more prevalent, reported by 287/680 (42.2%) participants, and was also significantly associated with knowledge ($p < 0.001$).

Keeping face masks or hand sanitiser at home or in bags was reported by 331/680 (48.7%) participants, while frequent use of hand sanitiser was reported by 241/680 (35.4%). Both practices were significantly associated with knowledge ($p = 0.002$ and $p = 0.001$, respectively). In contrast, self-isolation when symptomatic (358/680, 52.6%), seeking medical advice when symptomatic (498/680, 73.2%), and regular disinfection of commonly touched surfaces (276/680, 40.6%) were not significantly associated with knowledge ($p > 0.05$).

**Table 4. Personal and Household Preventive Practices Against Respiratory Infections (n = 680)**

| Item | Total (n = 680) | Good knowledge (score ≥ 17) (n = 173) | Low – moderate knowledge (score < 17) (n = 507) | *p*-value [a] |
|---|---|---|---|---|
| **Washing hands after sneezing, coughing, or touching public surfaces** | | | | |
| Always and often | 434 (63.8) | 123 (28.3) | 311 (71.7) | ***0.030*** |
| Sometimes | 217 (31.9) | 47 (21.7) | 170 (78.3) | |
| Rarely and never | 29 (4.3) | 3 (10.3) | 26 (89.7) | |
| **Wearing a face mask in daily life** | | | | |
| Always and often | 73 (10.7) | 35 (47.9) | 38 (52.1) | ***< 0.001*** |
| Sometimes | 235 (34.6) | 59 (25.1) | 176 (74.9) | |
| Rarely and never | 372 (54.7) | 79 (21.2) | 293 (78.8) | |
| **Wearing a face mask when experiencing respiratory symptoms** | | | | |
| Always and often | 287 (42.2) | 95 (33.1) | 192 (66.9) | ***< 0.001*** |
| Sometimes | 228 (33.5) | 50 (21.9) | 178 (78.1) | |
| Rarely and never | 165 (24.3) | 28 (17.0) | 137 (83.0) | |
| **Keeping face masks or hand sanitiser at home or in bags** | | | | |
| Always and often | 331 (48.7) | 104 (31.4) | 227 (68.6) | ***0.002*** |
| Sometimes | 192 (28.2) | 40 (20.8) | 152 (79.2) | |
| Rarely and never | 157 (23.1) | 29 (18.5) | 128 (81.5) | |
| **Using hand sanitiser** | | | | |
| Always and often | 241 (35.4) | 81 (33.6) | 160 (66.4) | ***0.001*** |
| Sometimes | 295 (43.4) | 62 (21.0) | 233 (79.0) | |

| | | | | |
|---|---|---|---|---|
| Rarely and never | 144 (21.2) | 30 (20.8) | 114 (79.2) | |
| **Self-isolate when experiencing respiratory symptoms** | | | | |
| Always and often | 358 (52.6) | 102 (28.5) | 256 (71.5) | 0.086 |
| Sometimes | 232 (34.1) | 55 (23.7) | 177 (76.3) | |
| Rarely and never | 90 (13.2) | 16 (17.8) | 74 (82.2) | |
| **Seek medical advice or treatment when experiencing respiratory infection symptoms** | | | | |
| Always and often | 498 (73.2) | 127 (25.5) | 371 (74.5) | 0.799 |
| Sometimes | 141 (20.7) | 34 (24.1) | 107 (75.9) | |
| Rarely and never | 41 (6.0) | 12 (29.3) | 29 (70.7) | |
| **Regularly disinfecting commonly touched surfaces at home or work** | | | | |
| Always and often | 276 (40.6) | 81 (29.3) | 195 (70.7) | 0.135 |
| Sometimes | 277 (40.7) | 61 (22.0) | 216 (78.0) | |
| Rarely and never | 127 (18.7) | 31 (24.4) | 96 (75.6) | |

[a] *p*-values were obtained using Chi-square tests comparing knowledge categories (good knowledge defined as score ≥17; low–moderate knowledge as <17). Response options were grouped into three categories: always and often; sometimes; rarely and never.

### Participant Concerns About hMPV Infection and Its Impact

Table 5 summarises participants' concerns regarding hMPV infection and its potential impact. Most participants expressed concern about becoming infected (477/680, 70.1%) and about the infection affecting loved ones (609/680, 89.6%). Neither concern was significantly associated with knowledge level ($p = 0.137$ and $p = 0.635$, respectively). Concern about access to appropriate treatment in the event of infection was reported by 449/680 (66.0%) participants and was significantly associated with knowledge ($p < 0.001$). A good knowledge score was more common among participants who disagreed with this concern (48/103, 46.6%) compared with those who agreed (92/449, 20.5%). Concern about the possibility of another outbreak or pandemic was also common (441/680, 64.9%) but was not associated with knowledge (p =

0.274). Economic concerns were reported by 371/680 (54.6%) participants and were significantly associated with knowledge levels (p = 0.007). Higher knowledge was observed among participants who disagreed with the statement that they would lose income due to quarantine if infected with hMPV (44/120, 36.7%). Concern about receiving inaccurate information was expressed by 437/680 (64.3%) participants and was also found to be significantly associated with knowledge (p = 0.011).

**Table 5. Participant Concerns About hMPV Infection and Its Impact (n = 680)**

| Item | Total (n = 680) | Good knowledge (score ≥ 17) (n = 173) | Low – moderate knowledge (score < 17) (n = 507) | *p*-value [a] |
|---|---|---|---|---|
| **Concern about becoming infected with hMPV** | | | | |
| Strongly disagree and disagree | 49 (7.2) | 17 (34.7) | 32 (65.3) | 0.137 |
| Neutral | 154 (22.6) | 44 (28.6) | 110 (71.4) | |
| Strongly agree and agree | 477 (70.1) | 112 (23.5) | 365 (76.5) | |
| **Concern that hMPV infection could affect loved ones** | | | | |
| Strongly disagree and disagree | 17 (2.5) | 6 (35.3) | 11 (64.7) | 0.635 |
| Neutral | 54 (7.9) | 14 (25.9) | 40 (74.1) | |
| Strongly agree and agree | 609 (89.6) | 153 (25.1) | 456 (74.9) | |
| **Concern about not having access to appropriate treatment if infected with hMPV** | | | | |
| Strongly disagree and disagree | 103 (15.1) | 48 (46.6) | 55 (53.4) | ***< 0.001*** |
| Neutral | 128 (18.8) | 33 (25.8) | 95 (74.2) | |
| Strongly agree and agree | 449 (66.0) | 92 (20.5) | 357 (79.5) | |
| **Concern about the possibility of another outbreak or pandemic caused by hMPV** | | | | |
| Strongly disagree and disagree | 71 (10.4) | 23 (32.4) | 48 (67.6) | 0.274 |
| Neutral | 168 (24.7) | 45 (26.8) | 123 (73.2) | |
| Strongly agree and agree | 441 (64.9) | 105 (23.8) | 336 (76.2) | |
| **Concern about losing income due to quarantine if infected with hMPV** | | | | |
| Strongly disagree and disagree | 120 (17.6) | 44 (36.7) | 76 (63.3) | ***0.007*** |

| | | | | |
|---|---|---|---|---|
| Neutral | 189 (27.8) | 41 (21.7) | 148 (78.3) | |
| Strongly agree and agree | 371 (54.6) | 88 (23.7) | 283 (76.3) | |
| **Concern about receiving inaccurate information about hMPV** | | | | |
| Strongly disagree and disagree | 79 (11.6) | 31 (39.2) | 48 (60.8) | ***0.011*** |
| Neutral | 164 (24.1) | 40 (24.4) | 124 (75.6) | |
| Strongly agree and agree | 437 (64.3) | 102 (23.3) | 335 (76.7) | |

[a] *p*-values were obtained using Chi-square tests comparing knowledge categories (good knowledge defined as score ≥17; low–moderate knowledge <17). Response options were collapsed into three categories: strongly disagree and disagree; neutral; strongly agree and agree.

### Sources of Health-Related Information

Multiple sources of health-related information were reported by participants. Social media was the most frequently cited source (581/680, 85.4%), followed by websites (345/680, 50.7%) and healthcare providers (331/680, 48.7%). Friends and family were also commonly mentioned (293/680, 43.1%). Traditional media were less frequently used, with 239/680 (35.1%) reporting television and 133/680 (19.6%) radio.

## Discussion

This study provides a comprehensive assessment of Malaysian adults' knowledge, perceptions, and preventive practices regarding hMPV and identifies several important findings. Engagement with general respiratory preventive behaviours, particularly hand hygiene and selective mask use, was relatively common. However, disease-specific knowledge of hMPV was limited, with substantial gaps observed across disease severity, reinfection, transmission pathways, and clinical management. Only one-quarter of respondents demonstrated good overall knowledge. Although higher knowledge was associated with selected preventive practices and perceived sufficiency of information, it was not associated with perceived disease severity or personal susceptibility. This suggests a potential disconnect between factual knowledge and individual risk appraisal.

Although approximately half of the respondents correctly identified hMPV as a respiratory infection, recognition of its potential severity was low, with fewer than one-fifth aware of serious complications. Knowledge of reinfection was similarly limited. These findings suggest that hMPV may be perceived as a relatively mild or routine respiratory illness, which may reduce the perceived urgency of preventive behaviours and timely care-seeking. Only a small proportion of respondents reported a prior hMPV

infection, indicating limited recognised or recalled exposure within the sample. Such limited exposure may further reduce disease salience and contribute to gaps in understanding of clinical significance.

Although this study did not assess hMPV prevalence, epidemiological evidence indicates that hMPV is less frequently detected or publicly recognised than other common respiratory viruses, which may partly explain its low visibility at the population level [25, 26]. Comparable patterns have been reported for other emerging or less-publicised respiratory infections, where general awareness exists without a corresponding understanding of clinical significance [17, 27]. For example, among older adults in the United States at high risk of severe RSV infection, fewer than half reported having heard of the virus, and only a minority considered themselves knowledgeable [17]. Similar gaps in knowledge of monkeypox have been reported among university students in Pakistan and among adults in Palestine, with awareness largely confined to common symptoms [27, 28]. These findings suggest that awareness alone may be insufficient to support accurate risk appraisal and highlight the need for public health communication strategies that place more emphasis on disease severity and vulnerable populations.

Beyond limited awareness, this study identified misconceptions related to transmission and clinical management. While droplet transmission was widely recognised, fewer respondents identified direct contact or contaminated surfaces as potential transmission routes. Such incomplete understanding may limit the effectiveness of preventive behaviours in household and community settings, where contact transmission remains relevant [29]. Misunderstandings surrounding clinical management were also evident. A substantial proportion of respondents believed that a vaccine for hMPV is available, and only a minority correctly identified supportive care as the primary management approach.

Inaccurate expectations regarding vaccination or specific antiviral treatment may reduce engagement with non-pharmaceutical preventive measures and complicate interactions with healthcare providers. This pattern is consistent with the principle of risk compensation, as described by the Peltzman effect, whereby perceived protection may attenuate adherence to precautionary behaviours due to a false sense of security [30]. In the context of hMPV, misconceptions regarding biomedical interventions may therefore undermine sustained preventive practices, particularly in the absence of effective vaccines or targeted antiviral therapies.

Given the relatively high educational attainment of the sample and the predominance of urban and suburban respondents, the persistence of knowledge gaps suggests that limited understanding is more likely related to insufficient exposure to hMPV-specific information rather than general health illiteracy. This observation indicates that current public health messaging may inadequately address less prominent respiratory viruses that do not attract sustained media attention or institutional emphasis.

Selective associations between knowledge, preventive beliefs and behaviours were observed. Respondents with higher knowledge levels were more likely to perceive preventive measures as effective, report feeling adequately informed, and engage in behaviours such as hand hygiene after exposure and mask use when symptomatic. However, knowledge was not associated with perceived disease severity or personal susceptibility. This pattern aligns with health behaviour research indicating that risk perception is shaped not only by factual knowledge but also by affective, social, and contextual influences [31]. These findings

suggest that information-based interventions alone may be insufficient without complementary risk communication strategies that enhance personal relevance and improve interpretation of health information.

An inverse association between concern and knowledge was also observed. Respondents expressing greater concern about treatment access, income loss, and misinformation were less likely to demonstrate good knowledge, which may reflect heightened uncertainty rather than informed risk appraisal. In this context, the high reliance on social media as a source of health information is noteworthy, as such platforms may expose users to fragmented, conflicting, or misleading content [32]. Improving the accessibility and clarity of reliable information may therefore help reduce uncertainty and support more informed understanding of health risks.

Age remained an independent predictor of knowledge, with older respondents demonstrating higher odds of good knowledge. This may reflect cumulative exposure to health information, heightened awareness of health risks, or experience with previous respiratory outbreaks. In contrast, individuals not studying or working in health-related fields had lower odds of good knowledge, highlighting the role of professional and educational environments in shaping disease-specific understanding [33].

Despite variation in individual knowledge, perceptions of community preparedness and adequacy of public information were generally low and were not associated with knowledge levels. This finding suggests a broader gap in confidence in institutional or community-level preparedness that is independent of personal understanding. Addressing this gap is likely to require visible institutional engagement, consistent public messaging, and clear guidance alongside individual-level education [34].

**Strengths and Limitations**

This study provides an early and comprehensive snapshot of Malaysian adults' knowledge, perceptions, preventive practices, and concerns related to hMPV, addressing a notable gap in population-level evidence for a relatively under-recognised respiratory virus. The inclusion of multiple domains beyond knowledge alone enabled a more integrated assessment of how awareness relates to preventive behaviours, perceived preparedness, and personal concerns. In addition, the relatively large sample size and the inclusion of participants across diverse age groups, educational levels, and residential settings enhance the descriptive strength of the findings.

Several limitations should nevertheless be considered. As a cross-sectional survey, the results reflect public understanding and behaviours at a single point in time and may change in response to shifts in media coverage, public discourse, or outbreak activity. Data were obtained using a self-administered online questionnaire, and all measures, including preventive practices, concerns, and prior experience with hMPV or other respiratory infections, were based on self-report. This approach is susceptible to recall bias and social desirability bias, particularly for behaviours that are widely promoted, such as hand hygiene and mask use.

Online dissemination may also have introduced selection bias. Individuals with higher digital literacy, greater engagement with online health information, or stronger interest in respiratory health topics may have been

more likely to participate. Similarly, those who had previously heard of hMPV or perceived it as relevant may have been more inclined to complete the survey, potentially leading to overestimation of awareness or engagement relative to the general population. These factors may limit the generalisability of the findings, particularly to groups with limited internet access or lower levels of digital engagement.

Furthermore, knowledge was assessed using structured items with predefined correct responses, which may not fully capture nuanced understanding or contextual interpretation of hMPV-related information. Although this approach supports standardised comparison across participants, it may oversimplify complex concepts such as disease severity or clinical management. Finally, the low proportion of respondents reporting prior hMPV infection suggests limited recognised exposure within the sample, which may have influenced risk perception and reduced the salience of the disease. Despite these limitations, the study offers valuable baseline insights into public understanding of hMPV and identifies important gaps in disease-specific knowledge and perceived preparedness that are relevant for future public health communication and surveillance efforts.

## Conclusion

This study provides an early population-level insight into Malaysian adults' understanding of hMPV, revealing a clear mismatch between engagement in general respiratory preventive behaviours and limited disease-specific knowledge. Substantial gaps were identified in awareness of hMPV severity, reinfection, transmission, and clinical management, with only one-quarter demonstrating good overall knowledge. Knowledge was selectively associated with certain preventive practices and perceived information sufficiency, but not with perceived personal risk or disease severity, underscoring a disconnect between knowledge and risk appraisal. These findings highlight the need for targeted risk communication that goes beyond awareness, addresses misinformation, and strengthens public confidence in preparedness for under-recognised respiratory threats

## Abbreviations

• hMPV: Human metapneumovirus.

• RSV: Respiratory syncytial virus.

• COVID-19: Coronavirus disease 2019.

• SARS: Severe acute respiratory syndrome.

• SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2.

• COPD: Chronic obstructive pulmonary disease.

Statistical and Analytical Terms

• OR: Odds ratio.

• aOR: Adjusted odds ratio.

• CI: Confidence interval.

• p: p-value, indicating statistical significance.

• SD: Standard deviation.

• IQR: Interquartile range.

Institutional and Methodological Terms

• UiTM: Universiti Teknologi MARA.

• UNAIR: Universitas Airlangga.

• CDDR: Collaborative Drug Discovery Research Group.

• STROBE: Strengthening the Reporting of Observational Studies in Epidemiology.

• REC: Research Ethics Committee.

• CVI: Content Validity Index.

• SPSS: Statistical Package for the Social Sciences.

# Declarations

Clinical trial number: not applicable

**Competing interests**

None declared.

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**Author Contributions Statement**

M.S.A.W. conceptualized and designed the study, and supervised the project. M.S.S. contributed to the study design, data collection, and analysis. M.I.Z. and N.A.N.N.M.S. performed the data collection and analysis, and drafted the manuscript. N.S.T., N.A.R.M.R., and S.A. contributed to the interpretation of data and reviewed the manuscript. Y.Y.W., F.F.I., and N.O. assisted with data collection, data analysis, and manuscript preparation. L.C.M. provided critical revisions to the manuscript and contributed to the study's conceptual framework. All authors read and approved the final manuscript.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author.

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**AI use statement** During the preparation of this work, the author used ChatGPT (free version) for brainstorming and Grammarly (free version) to refine and verify the grammar of the original manuscript. After using these tools, the author reviewed and edited the content as needed and takes full responsibility for the content of the published article.

**Ethics approval and consent to participate**

Ethical approval for this study was obtained from the Research Ethics Committee, Universiti Teknologi MARA (UiTM) (REC/04/2025 [ST/MR/59]. The study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent to participate was obtained from all participants prior to their inclusion in the study.

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