



INFECTIOUS DISEASE

Knowledge, attitudes, and practices (KAP) of the Philippine general public towards human mpox (hMPX): a cross-sectional study

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Keywords

Human mpox • hMPX • Knowledge attitudes practices • General public • Philippines

Summary

Introduction. In the Philippines, research on knowledge, attitudes, and practices (KAP) regarding human mpox (hMPX) remains limited, despite rising case numbers. With vaccines unavailable locally, enhancing community awareness and promoting non-pharmaceutical interventions are crucial for reducing transmission risks.

Methods. This cross-sectional study utilized an anonymized online data collection tool to explore the general public's hMPX KAP and their relationships, and identify sociodemographic groups linked to low hMPX knowledge; 502 respondents were included in the analysis.

Results. Knowledge levels were evenly distributed across low, moderate, and high categories. Higher knowledge was associated with being female ($\beta = 0.130$, $p = 0.004$), higher educational attainment ($\beta = 0.134$, $p = 0.006$), and smaller household size ($\beta = -0.098$, $p = 0.028$). Knowledge was not significantly

associated with perceived disease susceptibility or severity, but strongly predicted perceived effectiveness of preventive measures. Perceived effectiveness, in turn, consistently emerged as the strongest predictor of preventive practices. Full mediation of the effect of knowledge by perceived effectiveness was observed with protective sexual practices and avoiding crowded places, but only partial with hand hygiene and fomite/high-touch surface disinfection.

Conclusion. This study highlights the complex interplay between knowledge, attitudes, and practices in shaping public health behavior toward hMPX in the Philippines. Significant knowledge gaps and the mediating role of attitudes in influencing preventive practices underscore the need for targeted, stigma-free health communication strategies. Strengthening public understanding and perception through tailored interventions will be critical in mitigating hMPX transmission.

Introduction

Human mpox (hMPX), formerly called monkeypox, is a reemerging viral zoonotic infection caused by an enveloped double-stranded DNA orthopoxvirus (family Poxviridae) related to variola (causing smallpox) and vaccinia (used in smallpox vaccine) [1]. It has two main clades: clade I, associated with more severe disease in central and east Africa, with subclade Ia causing traditional outbreaks and subclade Ib emerging during the 2023 Democratic Republic of Congo outbreak that has since spread beyond Africa [2, 3]; and clade II, a less virulent lineage from west Africa that lacks several genes present in clade I [2]. The 2022 global outbreak – driven by subclade IIb, a newer variant of clade II [3] – was initially recognized in Europe, with the first cases detected in the United Kingdom [4]. From there, it rapidly spread to all six World Health Organization regions, prompting the declaration of a public health emergency of international concern in July 2022 [5]. In the Philippines, the first hMPX case was detected that same month [6, 7]. Since then, 911 confirmed hMPX cases (with 1 death) were reported, including both

imported and locally acquired infections, none of which have an established epidemiological link [8, 9]. Despite the rise in cases, the Philippine government did not declare a national public health emergency.

The majority of identified hMPX cases were among men who have sex with men (MSM), leading to the hypothesis that the virus spreads primarily through close contact during sexual activity within these networks (though not exclusively) [10, 11], and notably not linked to recent travel to endemic areas or close contact with known hMPX cases [4]. Most diagnosed cases reported high-risk sexual behavior as potential risk factors. But while many initial cases during the outbreak were linked to close contact within sexual activity, anyone in the general population who has direct skin-to-skin contact with an infected person or contaminated fomites, or lives with someone who has hMPX, is also at risk [12].

When hMPX gained international attention in mid-2022, it coincided with already strained COVID-19 responses. Although Southeast Asian countries have made progress in health preparedness, persistent challenges such as poor governance, weak surveillance,

limited laboratory capacity, disrupted supply chains, and low community engagement from inadequate funding could hinder the hMPX response should the situation get worse [13]. Such therefore warrants a thorough understanding of prevention and control measures on the part of the citizens. COVID-19 public health campaigns have already increased awareness of infectious diseases, making people more attentive to threats like hMPX. [14]. Greater familiarity with symptoms, transmission, and hygiene was expected to raise baseline knowledge of hMPX. However, pooled prevalences of good levels of knowledge about hMPX are reported at only 33% (95% CI: 22%, 45%) and 26% (95% CI: 17.8%, 34.2%) in two systematic reviews and meta-analyses [15, 16], with participants that included healthcare professionals, university students, and individuals from the general population. Additionally, country-based subgroup analysis showed Philippines having the lowest prevalence of good knowledge levels (5%; 95% CI: 3%, 7%) [15], though only one study was available [17]. Key factors influencing knowledge levels include education, accessibility to health information, and previous outbreaks in the region. Public health campaigns and access to accurate information have improved understanding in some areas, but misinformation remains a challenge [18]. Misinformation and stigmatized language have fueled hMPX-related stigma [19], with studies showing that incorrect social media narratives, biased news framing, and misconceptions in healthcare lead to harmful stereotypes [20-22]. Media portrayals inadvertently stigmatized entire regions – first China for COVID-19 and then Africa for hMPX – and have falsely associated hMPX with LGBTQ+ individuals, particularly MSM [21]. The knowledge gap stemming from misconceptions and stigmatization could potentially complicate public health responses by exacerbating existing barriers to healthcare access, resulting in reduced testing and case underreporting [23, 24]. Moreover, existing health communication efforts may not adequately reach all segments of the population, highlighting the need for tailored interventions. Thus, assessment of knowledge, attitudes, and practices (KAP) surrounding hMPX in the general public is critical for effective public health responses. In the Philippine setting, KAP among the general public remains inadequately explored despite increasing hMPX prevalence. While hMPX vaccines effectively prevent infection and reduce symptom severity [25], they are not yet legally available and approved by the Philippine Food and Drug Administration (FDA) [7, 26], stressing the importance of improving community awareness and engagement in non-pharmaceutical interventions (NPI) to reduce transmission risk. However, to effectively promote and maintain preventive behaviors through NPIs, it is essential to understand how social, cognitive, and psychological factors influence these behaviors [27]. While various statistical models and approaches exist in analyzing KAP research, a model that integrates mediation might be a better approach when incorporating

these factors. Mediation analysis is a statistical approach used to understand the mechanism through which an independent variable (knowledge) influences a dependent variable (practices) via a mediator variable (attitudes) [28]. In addition to direct effects of knowledge on practices, mediation analysis helps identify indirect effects where the influence of knowledge on behavior operates through attitudes. It also helps provide a clearer understanding of how interventions might work by targeting not just knowledge but also shaping attitudes to influence behavior. In this study, we aimed to describe the level of knowledge, attitudes, and practices of a sample of the Philippine general population towards hMPX and the recent outbreaks, and investigate how hMPX knowledge influences practices and whether this relationship is mediated by attitudes. By identifying mediators, public health efforts can focus not just on improving knowledge but also on addressing barriers to behavior change, such as negative perceptions or fear. Additionally, we aimed to identify sociodemographic groups associated with low levels of knowledge regarding hMPX. From the public health perspective, identifying these groups is vital for designing effective interventions that help improve outbreak control, reduce stigma and misinformation, and create equitable, impactful strategies to manage the disease.

Methods

STUDY DESIGN

This is a cross-sectional study that was conducted from April 2023 to June 2023 using an anonymized online data collection tool. Ethics approval of the study (reference number: CMERC 2022-CM-001) was granted by the College of Medicine Ethics Review Committee of the De La Salle Medical and Health Sciences Institute (DLSMHSI) in accordance with the institution's ethical guidelines for observational studies.

STUDY PARTICIPANTS

By the start of 2023, there were 85.16 million internet users in the Philippines, 84.45 million of whom were social media users [29]. While this number equated to only 73.1% internet penetration, a total of 168.3 million cellular mobile connections were active, surpassing the total population by 144.5% [29]. Considering this, we opted to leverage social media to facilitate data collection and engagement. GO Philippines (<http://www.gophilippines.org>) is a community-driven social enterprise designed to promote the implementation of a smart-nation program. This initiative aims to deliver essential services, including education, healthcare, finance, employment, technology, and other critical sectors, through an integrated e-commerce platform, with the goal of enhancing Filipino citizens' quality of life while fostering Philippine economic growth and development. GO Cavite is a localized initiative under the broader umbrella of GO Philippines, focusing specifically on the province of Cavite, where

our base institution (DLSMHSI) is located. While GO Cavite does not have an official website, a Facebook® page (<https://www.facebook.com/gocavite>) and a Facebook® community page (<https://www.facebook.com/groups/gocavitecommunity>) exist, both bearing the same name, with approximately 1.2 million and 390,000 followers, respectively, by the time of this writing. Given the large number of followers of both online platforms, we anticipate that their sociodemographic characteristics are representative of and have similar distributions as those of the Philippine general public at large.

MINIMUM SAMPLE SIZE COMPUTATION

G*Power version 3.1 (Universität Düsseldorf) [30, 31] was used to compute the minimum sample size requirement. We employed multiple linear regression (fixed model, R^2 deviation from zero) as basis on the premise that a set of predictors collectively explains a significant amount of variance in knowledge about hMPX. Of the studies included in both aforementioned meta-analyses, only 3 studies [32-34] treated knowledge as a quantitative continuous dependent variable using multiple linear regression analysis. Of these 3 studies, only one [32] reported the adjusted coefficient of determination (adj. $R^2 = 0.055$) of the linear regression model. This translates to an effect size f^2 of 0.058. Using this f^2 , assuming an α of 0.05 and a power ($1 - \beta$) of 0.80, and fixing the maximum number of predictors at 18 (10 sociodemographic variables, 1 variable representing knowledge level, and 7 variables for attitudes), the calculated minimum sample size requirement is 362.

DATA COLLECTION TOOL

We employed an anonymized online data collection tool composed of two parts. The first part contains questions pertaining to respondents' sociodemographic characteristics (age, sex, citizenship, socioeconomic status, educational attainment, employment status, area of residence, household size, religion, sexual orientation, and medical comorbidities). The second part consists of three sections that respectively measure their knowledge, attitudes, and practices regarding hMPX.

Knowledge was assessed using a 17-item questionnaire that was drafted under supervision, so it reflects current general information on hMPX (basic epidemiology, mode of transmission, clinical manifestations, treatment, and preventive measures) [35, 36]. These questions are answerable by "Yes," "No," or "I don't know." Knowledge scores were determined by awarding one point for each correct response, and a total score was calculated, with higher scores reflecting greater knowledge about hMPX. For the section on attitudes regarding hMPX, we constructed questions assessing perceptions on disease susceptibility ("What do you think is your risk of contracting hMPX?") and severity ("How sick/unwell do you think you would get if you get infected with hMPX?"), and effectiveness of preventive measures (avoiding close skin-to-skin contact with individuals

who have characteristic hMPX rash, avoiding contact with animals thought to transmit hMPX, avoiding contact with fomites, handwashing or hand sanitation, vaccination against hMPX) in reducing transmission risk based on the risk perception attitude framework [37]. Responses were rated using a Likert-type scale ranging from 1 to 5 (for susceptibility: 1 = extremely unlikely, 2 = unlikely, 3 = neither likely nor unlikely, 4 = likely, 5 = extremely likely; for severity: 1 = very low, 2 = low, 3 = neither high nor low, 4 = high, 5 = very high; for prevention effectiveness: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree).

Practices on preventive behavior were assessed using questions inquiring how often the respondents observe proper hand hygiene, avoiding crowded places/large gatherings, disinfecting fomites/high-touch surfaces, and protective sexual practices. As with attitudes, responses were rated using a 5-point Likert-type scale (1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always).

The data collection tool underwent content validation by three infectious disease specialists, all unaffiliated with our institution to maintain objectivity. The questions were edited accordingly based on their comments and recommendations. Pretesting was then carried out by administering the edited tool to a separate sample of 10 people to provide feedback on question clarity and redundancy. Based on their feedback, with guidance by someone with expertise on questionnaire construction, the questions were further reviewed and edited for contextual sensitivity and appropriateness of language. The Cronbach's alpha, measured to assess internal consistency, was 0.84, indicating that the tool has good reliability for measuring the intended construct.

PARTICIPANT RECRUITMENT

We contacted and collaborated with the administrators of the GO Cavite Facebook® profile page and community page to seek permission for linking our study on these platforms, and to request their assistance in advertising the study to facilitate target population outreach and study participation. After the appropriate arrangements have been made between the researchers and the administrators, study advertisements were posted by the latter in the newsfeeds of both GO Cavite online platforms, effectively extending the participation invitation to all its online followers/members. These advertisements/posts show the Google Forms™ uniform resource locator (URL) that interested participants can click on. Participation was on a voluntary basis. To ensure data privacy, we edited the Google Forms™ settings so that only respondents with Gmail® accounts can gain access to the online data collection tool. Before proceeding to the data collection tool itself, the respondents were first introduced to the informed consent page containing a brief overview and explanation of the study objective and procedures, as well as its potential risks, benefits, and impacts. It likewise stressed the voluntary and non-coercive nature of the study, with the

assurance that anonymity is maintained at all times in accordance with data privacy laws in effect. They are then presented the option to tick a box corresponding to giving their informed consent if they understand the study-related information and are willing to participate. Ticking the box allows them to proceed to the data collection tool, otherwise they are redirected to an exit page and are excluded from the study accordingly. Additionally, respondents were excluded if they were less than 18 years of age, had missing data, do not have Filipino citizenship or are not physically residing in the Philippines at the time of recruitment. Each included respondent was assigned a unique numeric code for the purpose of anonymization. The informed consent and the data collection tool were made available in both English and Filipino languages. No incentives were offered for participation.

STATISTICAL ANALYSIS

All statistical analyses were performed using Stata version 17 (StataCorp, College Station, TX). Basic descriptive statistics were computed for all variables. Categorical variables were reported using frequencies and percentages, while quantitative variables were reported as mean and standard deviation. For purpose of describing the respondents' knowledge level, knowledge scores were treated as both categorical, using modified Bloom's cutoff points (high for scores $>80\%$, moderate for scores from 60% to 80% , and low for scores $<60\%$) [38], and quantitative continuous. Responses to attitudes and practices were treated as quantitative continuous. Multiple linear regression analyses were performed regressing knowledge, attitudes, and practices on respondent sociodemographic characteristics. Mediation analysis was performed using the *medsem* package of Stata [39], which generates estimates of effect sizes in the form of coefficients to judge the magnitude of the direct effect of knowledge on practices, and the total indirect effect as mediated through attitudes. To maintain model parsimony and avoid overfitting, a single composite score to quantify the perceived effectiveness of preventive measures in reducing hMPX transmission risk (under attitudes) was used in the mediation analysis, and was obtained by summing the scores for avoiding close skin-to-skin contact, avoiding contact with animals thought to transmit hMPX, avoiding contact with fomites, handwashing or hand sanitation, and vaccination against hMPX (total = 25). We referred to Zhao, Lynch and Chen's approach (with Monte Carlo resampling) [40] for inferential testing for indirect effects instead of the Baron and Kenny ordinary least squares regression-based approach. The parallel multiple mediator model [41] was used, wherein the indirect effects of the individual perceptions listed under attitudes (the designated mediators) were estimated with the constraint that no mediator is modeled as influencing another mediator (*i.e.*, there are no unidirectional arrows linking any mediator to any other mediator). Bias-corrected 95%

confidence intervals (95% CI) were calculated for all estimates. Results were considered statistically significant if $p < 0.05$.

Results

SOCIODEMOGRAPHIC INFORMATION

A total of 502 individuals were included in the final analysis (Tab. I). The average age of the respondents was 26.06 years (SD = 9.17); most were female (67.13%), identifying as heterosexual (87.05%), urban residents (72.71%), and college-educated (89.44%). Household size was typically 4 to 6 members (64.54%). Employment and medical comorbidity status were nearly evenly distributed.

KNOWLEDGE, ATTITUDES, AND PRACTICES REGARDING hMPX

Knowledge scores were evenly distributed across low (32.67%; 95% CI 28.57%, 36.77%), moderate (32.27%; 95% CI 28.18%, 36.36%), and high (35.06%; 95% CI 30.89%, 39.23%), with a mean score of 11.46 (SD = 3.76). Respondents were generally aware of symptomatology and skin-to-skin transmission, but knowledge gaps remained regarding animal reservoirs, sexual transmission, and case fatality rates (Tab. II). Fewer than half (48.80%) were aware that vaccines exist, although not yet licensed locally.

Perceptions of susceptibility were generally low (mean score = 2.16, SD = 1.07) while disease severity was perceived as moderate (mean score = 3.06, SD = 1.12) (Tab. III). Preventive measures were widely perceived as effective, particularly hand hygiene and vaccination. Preventive practices were variably adopted, with hand hygiene most frequently reported (mean score = 4.63, SD = 0.68) and avoidance of crowded places least practiced (mean score = 3.84, SD = 1.09).

SOCIODEMOGRAPHIC DETERMINANTS OF KNOWLEDGE

Multiple regression analysis (Tab. IV) showed higher knowledge among females ($\beta = 0.130$, $p = 0.004$) and those with higher education ($\beta = 0.134$, $p = 0.006$), while larger household size predicted lower knowledge ($\beta = -0.098$, $p = 0.028$). No significant associations were observed with income, residence, religion, orientation, or comorbidities.

EFFECT OF KNOWLEDGE ON ATTITUDES

Knowledge was not associated with perceived susceptibility or severity (Tab. V). However, higher knowledge significantly predicted stronger beliefs in the effectiveness of preventive measures (Tab. VI), including avoiding skin-to-skin contact ($\beta = 0.175$, $p < 0.001$), avoiding contact with animals ($\beta = 0.224$, $p < 0.001$), avoiding contact with fomites ($\beta = 0.253$, $p < 0.001$), practicing hand hygiene ($\beta = 0.251$, $p < 0.001$), and vaccination against hMPX ($\beta = 0.183$, $p < 0.001$).

Tab. I. Respondents' sociodemographic characteristics

Sociodemographic characteristic	Total (n = 502)	
	n	%
Sex		
Male	165	32.87%
Female	337	67.13%
Age		
18-24 years	337	67.13%
25-34 years	105	20.92%
35-44 years	20	3.98%
45-54 years	26	5.18%
55-64 years	14	2.79%
Educational attainment		
High school	53	10.56%
College/Bachelor level ^a	400	79.68%
Masters/Graduate school level ^b	49	9.76%
Monthly household income		
Less than Php 10000	121	24.10%
Php 10000 to Php 29999	120	23.90%
Php 30000 to Php 49999	81	16.14%
Php 50000 to Php 79999	50	9.96%
Php 80000 and above	130	25.90%
Currently employed		
No ^c	265	52.79%
Yes	237	47.21%
Residence		
Rural	137	27.29%
Urban	365	72.71%
Household size		
1-3 people	124	24.70%
4-6 people	324	64.54%
≥7 people	54	10.76%
Religious affiliation		
Not affiliated	7	1.39%
Affiliated	495	98.61%
Orientation		
Heterosexual	437	87.05%
LGBTQIA+	65	12.95%
Comorbidities		
No	262	52.19%
Yes ^d	240	47.81%

^a Includes those who are currently attending college and those who left college before completing their degree. ^b Includes those who are currently attending graduate school and those who left graduate school before completing their degree. ^c Includes non-working students and retirees. ^d Comorbidities include allergy/atopy, bronchial asthma, gout, diabetes mellitus, hypertension, cardiovascular disease, hyperthyroidism, cancer, hematologic disorders, neurological disorders, orthopedic disorders, and psychiatric disorders. One respondent may have more than one comorbidity.

EFFECT OF KNOWLEDGE AND ATTITUDES ON PRACTICES

Perceived effectiveness of preventive measures emerged as the strongest predictor of preventive practices (Tab. VII). It was positively associated with protective sexual practices ($\beta = 0.567$, $p < 0.001$), crowd avoidance ($\beta = 0.190$, $p < 0.001$), hand hygiene ($\beta = 0.302$, $p < 0.001$), and disinfection behaviors ($\beta = 0.190$, $p < 0.001$). Knowledge directly influenced hand hygiene ($\beta = 0.119$, $p = 0.007$) and disinfection practices ($\beta = 0.107$, $p < 0.021$), but not protective sexual practices or crowd avoidance. Perceived susceptibility and severity have not shown statistically significant direct effects on practices.

RELATIONSHIPS BETWEEN KNOWLEDGE, ATTITUDES, AND PRACTICES

Mediation analysis (Tabs. VIII, IX) confirmed that perceived effectiveness of preventive measures fully mediated the effect of knowledge on preventive sexual practices and crowd avoidance, and partially mediated its effect on hand hygiene and disinfection practices. No significant mediation was observed through perceived susceptibility or severity.

Discussion

Our study investigated the knowledge, attitudes, and practices related to hMPX among Filipino adults using a cross-sectional design and online recruitment via social media platforms. By leveraging the digital reach of GO Cavite, an online community with substantial public engagement, we were able to access a substantial and diverse sample of the Philippine general population. Against the backdrop of a global reemergence of orthopoxviruses and limited vaccine access in low- and middle-income countries, including the Philippines, understanding the public's KAP is crucial for informing NPIs, mitigating stigma, and guiding targeted public health responses.

Our findings showed that knowledge levels were evenly distributed across low, moderate, and high categories, reflecting patterns seen internationally during early hMPX outbreaks [32–34]. Respondents were familiar with symptoms and skin-to-skin transmission but less informed about animal reservoirs, sexual transmission, similarities to smallpox, and vaccine availability. Incomplete understanding of key transmission routes and vaccine access can translate to underestimated risk perception, causing individuals to ignore health guidance or forgo protective behaviors, especially if they don't see themselves as vulnerable [42]. Despite widespread internet access, information on hMPX may not have been sufficiently targeted in the Philippines, limiting public awareness of zoonotic diseases [43]. While this is expected given the disease's relatively low domestic profile, this highlights persistent weaknesses in adaptive health literacy (specifically the ability to rapidly absorb and act on information in a fast-moving outbreak landscape) [44] and the tendency toward "alert fatigue," where new health threats are downplayed after prolonged exposure to crises like COVID-19 [45].

Awareness of hMPX vaccine availability was low (48.80%), even though such vaccines are not yet FDA-approved in the Philippines. Such knowledge gaps may foster hesitancy and weaken readiness for future vaccination programs [46]. In a country where vaccine confidence remains fragile following the Dengvaxia controversy, which led to mistrust and declining immunization rates [47, 48], transparent and evidence-based communication is essential. In light of this prior experience, careful introduction of hMPX vaccines, once available, will be critical to avoid repeating past failures in public trust.

Tab. II. Responses to knowledge items.

Statement	Total (n = 502)					
	Answered correctly		Answered incorrectly		Answered 'do not know'	
	n	%	n	%	n	%
1. hMPX is a disease caused by a viral infection.	466	92.83%	11	2.19%	25	4.98%
2. The main clinical symptoms of hMPX are fever, headache, muscle aches, fatigue, and vesicular rashes.	435	86.65%	9	1.79%	58	11.55%
3. Currently, a vaccine against hMPX exists, however, it is not yet licensed for use in the Philippines.	245	48.80%	69	13.75%	188	37.45%
4. Not everyone who contracts hMPX will develop severe disease. Those who have underlying comorbidities, immune deficiencies, or in the extremes of age may be at higher risk of more serious complications and death.	353	70.32%	50	9.96%	99	19.72%
5. Contact with wild animals or exposure to their bodily fluids would pose higher risk of hMPX infection.	269	53.59%	96	19.12%	137	27.29%
6. The hMPX virus spreads via person-to-person through skin-to-skin or close contact with someone who has the characteristic vesicular rash.	428	85.26%	20	3.98%	54	10.76%
7. Ordinary citizens can prevent hMPX infection by avoiding contact with wild animals or exposure to their bodily fluids.	325	64.74%	52	10.36%	125	24.90%
8. Ordinary citizens can prevent hMPX spread by avoiding skin-to-skin contact with people who have suspected or confirmed hMPX.	454	90.44%	9	1.79%	39	7.77%
9. Smallpox and hMPX have similar signs and symptoms.	279	55.58%	57	11.35%	166	33.07%
10. Contact with open blisters/lesions increase the risk of hMPX transmission.	357	71.12%	29	5.78%	116	23.11%
11. hMPX is acquired only by men who have sex with men (MSM).	362	72.11%	34	6.77%	106	21.11%
12. hMPX can be transmitted during sexual contact.	278	55.38%	61	12.15%	163	32.47%
13. Currently, the global case fatality rate of hMPX is higher than 10%.	59	11.75%	141	28.09%	302	60.16%
14. hMPX infection cannot be confirmed by symptoms alone. A laboratory test (<i>i.e.</i> , polymerase chain reaction, PCR) using fluid sample from an open blister is needed for confirmation.	352	70.12%	52	10.36%	98	19.52%
15. The characteristic blisters/vesicles of hMPX are typically found over the face, chest, hands and feet.	411	81.87%	9	1.79%	82	16.33%
16. The blisters/vesicles caused by hMPX may also be seen in the groin, genitals and/or anus if spread through sexual contact.	321	63.94%	16	3.19%	165	32.87%
17. Individuals who contracted hMPX should quarantine themselves for 21 days.	360	71.71%	7	1.39%	135	26.89%

Tab. III. Responses of knowledge, attitudes, and practices.

Variable	Range	Mean	SD
Knowledge score	0-17	11.46	3.76
Attitudes			
Perceived susceptibility	1-5	2.16	1.07
Perceived severity	1-5	3.06	1.12
Perceived effectiveness of preventive measures	1-25	22.48	3.30
Avoiding close skin-to-skin contact with individuals who have characteristic hMPX rash.	1-5	4.37	0.94
Avoiding contact with animals thought to transmit hMPX.	1-5	4.41	0.93
Avoiding contact with fomites.	1-5	4.36	0.94
Handwashing or hand sanitation.	1-5	4.74	0.71
Vaccination against hMPX.	1-5	4.61	0.84
Practices			
Protective sexual practices.	1-5	4.55	0.92
Avoiding crowded places/large gatherings.	1-5	3.84	1.09
Proper hand hygiene.	1-5	4.63	0.68
Disinfecting fomites/high-touch surfaces.	1-5	4.44	0.89

Sociodemographic factors played a significant role in knowledge levels. Knowledge was significantly

higher among women and those with higher education, consistent with patterns in prior infectious disease KAP studies on emerging infectious diseases, including COVID-19 [49]. Urban respondents also showed greater awareness, likely reflecting better access to information and services, as seen during COVID-19 [50]. These findings suggest that rural populations may remain underserved in health communication, underscoring the need for tailored outreach.

Most respondents perceived low personal susceptibility to hMPX despite ongoing global and local transmission, reflecting a disconnect between awareness of disease spread and perceived risk, likely due to limited local case numbers. In the health belief model, low perceived risk reduces motivation for preventive behavior [51]. Perceived disease severity was rated as moderate, possibly reflecting media portrayals of hMPX as largely self-limiting, despite its potential for serious outcomes in vulnerable groups.

Interestingly, despite only moderate knowledge, respondents generally viewed preventive measures as effective, and such attitudes were strongly linked with practice, suggesting that trust in health messaging (possibly reinforced by pandemic experience) may

Tab. IV. Multiple regression analysis of knowledge score on sociodemographic characteristics.

Sociodemographic characteristic	<i>B</i>	Std. error	β	<i>t</i>	<i>p</i> -value
(Intercept)	10.092	1.858	–	5.43	< 0.001
Sex ^a	1.039	0.358	0.130	2.90	0.004
Age	-0.361	0.197	-0.095	-1.83	0.067
Educational attainment	1.115	0.405	0.134	2.75	0.006
Monthly household income	0.156	0.112	0.063	1.39	0.166
Currently employed ^b	-0.190	0.372	-0.025	-0.51	0.610
Residence ^c	0.212	0.376	0.025	0.56	0.574
Household size	-0.633	0.286	-0.098	-2.21	0.028
Religious affiliation ^d	0.355	1.429	0.011	0.25	0.804
Orientation ^e	-0.629	0.502	-0.056	-1.25	0.210
Comorbidities ^f	0.077	0.334	0.010	0.23	0.818

^a $F_{(10, 499)} = 2.72$, $p = 0.003$; adjusted $R^2 = 0.033$. ^a Male: 0, Female: 1. ^b No: 0, Yes: 1. ^c Rural: 0, Urban: 1. ^d Not affiliated: 0, Affiliated: 1. ^e Heterosexual: 0, LGBTQIA+: 1. ^f No: 0, Yes: 1

Tab. V. Multiple regression analysis of perceived hMPX susceptibility and severity on knowledge score, controlling for sociodemographic characteristics.

Variable	Perceived disease susceptibility ^a			Perceived disease severity ^b		
	<i>B</i>	β	<i>p</i> -value	<i>B</i>	β	<i>p</i> -value
(Intercept)	3.096	–	<0.001	3.484	–	<0.001
Sex ^c	0.024	0.011	0.817	-0.085	-0.036	0.431
Age	-0.051	-0.047	0.368	-0.140	-0.123	0.019
Educational attainment	-0.164	-0.069	0.163	-0.177	-0.071	0.150
Monthly household income	-0.073	-0.105	0.024	0.014	0.019	0.686
Currently employed ^d	0.140	0.065	0.193	0.093	0.042	0.402
Residence ^e	-0.057	-0.024	0.597	-0.007	-0.003	0.951
Household size	-0.025	-0.014	0.759	-0.060	-0.031	0.487
Religious affiliation ^f	-0.181	-0.020	0.661	-0.272	-0.029	0.525
Orientation ^g	0.067	0.021	0.643	0.337	0.101	0.026
Comorbidities ^h	0.037	0.017	0.701	0.133	0.059	0.185
Knowledge score	-0.020	-0.070	0.124	0.005	0.018	0.694

^a $F_{(11, 490)} = 1.50$, $p = 0.128$; adjusted $R^2 = 0.011$. ^b $F_{(11, 490)} = 1.95$, $p = 0.031$; adjusted $R^2 = 0.021$. ^c Male: 0, Female: 1. ^d No: 0, Yes: 1. ^e Rural: 0, Urban: 1. ^f Not affiliated: 0, Affiliated: 1. ^g Heterosexual: 0, LGBTQIA+: 1. ^h No: 0, Yes: 1

drive compliance. However, this seeming paradox raises some questions. Is the public intuitively pro-prevention even without granular understanding? Or do favorable attitudes reflect a generic trust in health messaging, conditioned by recent pandemic experiences? If the latter, this trust is a valuable asset, but it requires careful stewardship by public institutions and communicators to prevent erosion through misinformation or apathy [52]. Nevertheless, recognizing the effectiveness of preventive measures, even when rooted in trust, does not guarantee consistent adoption. In our study, hand hygiene was practiced most consistently, while avoidance of crowded settings was least common, reflecting both habit-formation during COVID-19 and practical limitations in daily life [53, 54]. This highlights the complex nature of health behavior, which is shaped not only by knowledge and rational appraisal but also by contextual factors such as risk perception, social norms, behavioral feasibility, and emotional responses [55]. Earlier evidence that only 5% of Filipinos demonstrated good hMPX knowledge [29, 31] emphasizes the need for comprehensive education campaigns. Additionally, stigma may further hinder care-seeking, echoing challenges historically seen in HIV/AIDS and

COVID-19 responses [34–36], particularly when they intersect with existing social inequalities. Given limited vaccine access and weak health infrastructure, accurate and inclusive communication is essential. Campaigns must avoid reinforcing stereotypes, instead engaging communities through culturally appropriate, stigma-free strategies [56].

Mediation analysis offers a nuanced understanding of how knowledge influences preventive health behaviors, suggesting that this relationship is not solely direct but substantially mediated by attitudinal factors, particularly the perceived effectiveness of preventive measures. This finding aligns with well-established health behavior change models that stress knowledge alone is insufficient for behavior change unless accompanied by affective and cognitive appraisal processes (*e.g.*, perceived relevance, utility, and personal control) [57]. Belief in the efficacy of specific health behaviors emerged as the key intermediary between knowledge and action, emphasizing the importance of public health interventions that go beyond simple information dissemination. Interpretation of this knowledge is shaped by individual beliefs, perceived feasibility, and trust in the source, and this determines whether

Tab. VI. Multiple regression analysis of perceived effectiveness of preventive measures on knowledge score, controlling for sociodemographic characteristics.

Variable	Avoiding skin-to-skin contact ^a			Avoiding contact with infected animals ^b			Avoiding contact with fomites ^c			Handwashing or hand sanitation ^d			Vaccination against hMPX ^e		
	B	β	p-value	B	β	p-value	B	β	p-value	B	β	p-value	B	β	p-value
(Intercept)	3.506	-	< 0.001	4.098	-	< 0.001	4.466	-	< 0.001	4.212	-	< 0.001	4.133	-	< 0.001
Sex ^f	0.111	0.056	0.221	0.149	0.076	0.092	0.085	0.042	0.340	0.139	0.092	0.038	0.102	0.057	0.203
Age	0.021	0.023	0.666	-0.057	-0.061	0.237	-0.097	-0.102	0.047	-0.005	-0.007	0.891	-0.121	-0.142	0.006
Educational attainment	0.036	0.017	0.726	0.028	0.014	0.780	-0.134	-0.064	0.182	-0.076	-0.048	0.317	-0.060	-0.032	0.509
Monthly household income	0.005	0.009	0.850	-0.017	-0.027	0.545	-0.033	-0.053	0.238	-0.003	-0.007	0.879	0.002	0.004	0.924
Currently employed ^g	0.016	0.008	0.864	0.093	0.050	0.304	0.102	0.054	0.266	0.020	0.014	0.771	-0.006	-0.003	0.945
Residence ^h	0.116	0.055	0.221	0.050	0.024	0.587	-0.117	-0.056	0.205	-0.081	-0.051	0.247	0.012	0.007	0.883
Household size	-0.001	-0.001	0.991	0.038	0.024	0.587	-0.038	-0.023	0.597	-0.017	-0.014	0.745	-0.021	-0.015	0.742
Religious affiliation ⁱ	-0.083	-0.010	0.818	-0.494	-0.063	0.157	-0.287	-0.036	0.414	-0.054	-0.009	0.838	0.141	0.020	0.657
Orientation ^j	0.144	0.052	0.253	-0.022	-0.008	0.858	0.024	0.009	0.843	0.136	0.064	0.145	0.109	0.044	0.329
Comorbidities ^k	-0.003	-0.002	0.970	0.050	0.027	0.544	-0.035	-0.019	0.668	0.077	0.054	0.216	0.014	0.008	0.848
Knowledge score	0.044	0.175	< 0.001	0.055	0.224	< 0.001	0.064	0.253	< 0.001	0.047	0.251	< 0.001	0.041	0.183	< 0.001

^a $F_{(11, 490)} = 1.97$, $p = 0.030$; adjusted $R^2 = 0.021$. ^b $F_{(11, 490)} = 3.24$, $p = < 0.001$; adjusted $R^2 = 0.047$. ^c $F_{(11, 490)} = 4.41$, $p = < 0.001$; adjusted $R^2 = 0.070$. ^d $F_{(11, 490)} = 4.23$, $p = < 0.001$; adjusted $R^2 = 0.066$. ^e $F_{(11, 490)} = 3.23$, $p = < 0.001$; adjusted $R^2 = 0.047$. ^f Male: 0, Female: 1. ^g No: 0, Yes: 1. ^h Rural: 0, Urban: 1. ⁱ Not affiliated: 0, Affiliated: 1. ^j Heterosexual: 0, LGBTQIA+: 1. ^k No: 0, Yes: 1

Tab. VII. Multiple regression analysis of practice of preventive behaviors on knowledge and attitudes, controlling for sociodemographic characteristics.

Variable	Protective sexual practices ^a			Avoiding crowded places/ large gatherings ^b			Proper hand hygiene ^c			Disinfecting fomites/high-touch surfaces ^d		
	B	β	p-value	B	β	p-value	B	β	p-value	B	β	p-value
(Intercept)	0.436	-	0.346	1.262	-	0.052	2.190	-	< 0.001	2.628	-	< 0.001
Sex ^e	0.045	0.023	0.547	0.159	0.069	0.126	0.182	0.127	0.003	0.168	0.089	0.048
Age	0.014	0.015	0.724	-0.053	-0.048	0.352	-0.003	-0.004	0.935	0.063	0.070	0.175
Educational attainment	0.028	0.014	0.736	0.186	0.077	0.112	0.038	0.025	0.584	0.021	0.011	0.824
Monthly household income	-0.002	-0.003	0.945	-0.002	-0.003	0.945	0.013	0.029	0.502	-0.020	-0.034	0.460
Currently employed ^f	-0.016	-0.009	0.832	0.027	0.013	0.797	0.057	0.042	0.368	0.063	0.036	0.466
Residence ^g	0.055	0.027	0.472	0.084	0.034	0.437	-0.083	-0.054	0.194	-0.026	-0.013	0.768
Household size	0.047	0.030	0.425	-0.090	-0.048	0.275	-0.007	-0.006	0.881	-0.040	-0.026	0.554
Religious affiliation ^h	0.180	0.023	0.537	0.730	0.079	0.075	0.481	0.083	0.047	0.251	0.033	0.451
Orientation ⁱ	0.213	0.078	0.039	-0.094	-0.029	0.515	0.169	0.084	0.048	0.096	0.036	0.415
Comorbidities ^j	0.071	0.038	0.302	-0.174	-0.080	0.070	0.002	0.001	0.972	-0.066	-0.037	0.398
Knowledge score	0.003	0.012	0.765	0.017	0.059	0.209	0.022	0.119	0.007	0.025	0.107	0.021
Perceived susceptibility	-0.057	-0.067	0.105	0.051	0.050	0.302	0.002	0.004	0.935	-0.053	-0.064	0.190
Perceived severity	-0.005	-0.006	0.876	0.013	0.013	0.789	-0.018	-0.030	0.523	0.010	0.013	0.796
Perceived effectiveness of preventive measures	0.158	0.567	< 0.001	0.063	0.190	< 0.001	0.062	0.302	< 0.001	0.051	0.190	< 0.001

^a $F_{(14, 487)} = 2.41$, $p = < 0.001$; adjusted $R^2 = 0.327$. ^b $F_{(14, 487)} = 2.06$, $p = 0.002$; adjusted $R^2 = 0.053$. ^c $F_{(14, 487)} = 4.47$, $p = < 0.001$; adjusted $R^2 = 0.155$. ^d $F_{(14, 487)} = 2.50$, $p = < 0.001$; adjusted $R^2 = 0.064$. ^e Male: 0, Female: 1. ^f No: 0, Yes: 1. ^g Rural: 0, Urban: 1. ^h Not affiliated: 0, Affiliated: 1. ⁱ Heterosexual: 0, LGBTQIA+: 1. ^j No: 0, Yes: 1

people translate awareness into action [42, 58]. Health communication strategies can be designed to cultivate positive attitudes and enhance perceived efficacy by demonstrating both the importance of individual actions

and their broader societal impact. Central to this process is fostering a sense of agency while addressing the emotional or contextual barriers that may impede action. If unaddressed, misinformation and stigma can distort

Tab. VIII. Indirect effects of knowledge on practices mediated by attitudes.

Practices (dependent variable)	Attitudes (mediator)	Estimate	Bias-corrected 95% CI	p-value ^a	% mediation
Protective sexual practices	Perceived susceptibility	0.002	0.000, 0.004	0.216	
	Perceived severity	0.000	-0.001, 0.001	0.997	
	Perceived effectiveness of preventive measures	0.040	0.028, 0.054	< 0.001	94.5% ^b
Avoiding crowded places/large gatherings	Perceived susceptibility	-0.001	-0.005, 0.001	0.399	
	Perceived severity	0.000	-0.001, 0.001	0.998	
	Perceived effectiveness of preventive measures	0.016	0.008, 0.026	< 0.001	40.2% ^b
Proper hand hygiene	Perceived susceptibility	0.000	-0.002, 0.002	0.938	
	Perceived severity	0.000	-0.001, 0.001	0.916	
	Perceived effectiveness of preventive measures	0.016	0.010, 0.023	< 0.001	40.9% ^c
Disinfecting fomites/high-touch surfaces	Perceived susceptibility	0.001	-0.001, 0.004	0.367	
	Perceived severity	0.000	-0.001, 0.001	0.980	
	Perceived effectiveness of preventive measures	0.013	0.007, 0.021	< 0.001	33.2% ^c

^a If not statistically significant, no mediation via attitudes. ^b Indirect-only (full) mediation (*i.e.*, knowledge → practice effect not statistically significant; see Tab. IX). ^c Complementary (partial) mediation (*i.e.*, knowledge → practice effect also statistically significant; see Tab. IX).

Tab. IX. Direct effects of knowledge on practices

Practices	Estimate	Bias-corrected 95% CI	p-value
Protective sexual practices	0.002	-0.016, 0.021	0.802
Avoiding crowded places/large gatherings	0.024	-0.002, 0.050	0.069
Proper hand hygiene	0.024	0.008, 0.039	0.002
Disinfecting fomites/high-touch surfaces	0.027	0.006, 0.048	0.012

attitudes and blunt behavioral responses, undermining otherwise effective campaigns [37, 38].

Our use of a parallel multiple mediator model [41] with composite attitude scores provided a robust representation of psychological mechanisms while avoiding overfitting. Our survey instrument also demonstrated strong internal consistency (Cronbach's $\alpha = 0.84$). These methodological strengths enhance the credibility of the findings and suggest the robustness of the proposed mechanism across diverse population subgroups. Our study also showed the potential for methodological innovation in participant recruitment. Although convenience sampling has limitations, collaborating with GO Cavite demonstrated how digital communities can support public health research. Overall, our findings highlight a model where knowledge and attitudes jointly shape practice, emphasizing the need for interventions that build both information and affective engagement to sustain preventive behavior [59].

Several limitations must be acknowledged. First, the cross-sectional nature of the study prevents inference of causal relationships. While mediation analysis offers insight into potential causal pathways, temporality

cannot be firmly established without longitudinal data. Second, although we aimed for broad coverage by recruiting through social media, our sampling method was non-probabilistic and subject to self-selection bias. The use of an online, convenience sample may limit generalizability, particularly to older adults, rural residents, or those without internet access. Similarly, individuals more concerned about health or more digitally literate may have been more likely to participate, potentially skewing knowledge and attitude estimates. Additionally, self-reported data are subject to social desirability bias, particularly with regard to attitudes and practices. Nonetheless, we believe the large and active follower base of GO Cavite likely captures a demographically diverse subset of the public, and our sociodemographic profiling confirmed variation across key variables. Third, while our tool was available in both English and Filipino, we cannot rule out interpretation variability across different literacy levels. Despite pretesting, certain items, particularly those addressing complex epidemiological concepts, may have posed cognitive demands for some respondents. Future research should explore mixed-method approaches or in-person interviews to clarify nuanced public beliefs and address such limitations.

Conclusion

Our study underscores the complex nature of public health behavior in response to emerging infectious diseases like hMPX. Knowledge levels among the Philippine general population are variable, with significant gaps in areas critical for risk assessment and prevention. Attitudes play a crucial mediating role in translating knowledge into preventive practices, highlighting the importance of designing interventions that target both cognitive

understanding and affective appraisal. Addressing these knowledge and attitudinal gaps through tailored, stigma-free public health messaging will be essential in mitigating the risk of hMPX transmission in the Philippines, particularly in light of vaccine unavailability and the potential for localized outbreaks. Further research should explore longitudinal changes in KAP and investigate the effectiveness of specific educational strategies in altering health behaviors.

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Conflicts of interest statement

The authors declare no conflicts of interest.

Authors' contributions

All authors made substantial contributions to the different aspects of this study. Conceptualization: DI, MT, NS, MP, RT, JV, GD, AM, MADP, PC, BMA, MLO. Methodology: NS, MP, RT. Validation: MVH. Project administration: DI, MT, NS, MP, RT, JV, GD, AM, MADP, PC, BMA, MLO. Investigation: DI, MT, NS, MP, RT, JV, GD, AM, MADP, PC, BMA, MLO. Visualization: AM. Supervision: MVH, DI, MT. Data curation: MVH. Formal analysis: MVH, NS. Writing, original draft: MVH. Writing, review and editing: MVH, DI, MT, NS, MP, RT, JV, GD, AM, MADP, PC, BMA, MLO.

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