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Original Research

Knowledge and awareness of COVID-19 among Indonesian migrant workers in the Greater China Region

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Objective: Migrant workers are one of the most vulnerable population groups during the coronavirus disease 2019 (COVID-19) pandemic. This study investigated knowledge and awareness of COVID-19 among Indonesian migrant workers (IMWs) in Macao (SAR), Hong Kong (SAR), and Taiwan.

Study design: This was a cross-sectional study.

Methods: Data were collected through an online survey in February and March 2020 to gain information on (1) participants’ sociodemographic characteristics, (2) experience and awareness regarding COVID-19 information, and (3) knowledge and understanding of COVID-19. A series of Chi-squared, t-test, and logistic regression analyses were conducted.

Results: The survey was completed by 491 participants (92.1% female). Knowledge of COVID-19 was obtained from multiple sources, including a large proportion from online social media. However, participants who obtained information from their employer, local social networks, and migrant organisations answered a greater number of questions correctly. One-third of participants reported receiving hoax, fake news, and incorrect information and obtained information from unverified sources. Participants were most interested in information about how to cure COVID-19, and 57.8% knew that no specific drug or vaccine was currently available. Almost all participants correctly identified fever and wearing a facemask as the main COVID-19 symptom and prevention strategy, respectively. Participants with senior high school or higher education and who worked as domestic or care workers had a greater knowledge of COVID-19 than their counterparts.

Conclusions: Public health communication strategies using multiple channels, including employers and community organisations, would help to minimise COVID-19 knowledge gaps. In addition, it is recommended that digital literacy content is added to public health campaigns.

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Consistent with these guidelines, public health authorities in the Greater China Region engaged in campaigns to improve epidemic prevention and control strategies through multiple channels. For example, in Macao (SAR), China, the government provided daily press briefings, and this information was also shared on social media platforms in English. Furthermore, the governments in these regions provided useful information related to COVID-19, such as prevention strategies in several formats (e.g. videos and posters). However, the uptake of these messages by the general public is not known.

As noted in previous epidemics, migrant workers are not specifically targeted in health promotion campaigns and may not receive timely information that can protect their health. It is unclear whether knowledge related to COVID-19 was received by migrant workers, thus increasing their vulnerability to infection during the COVID-19 pandemic. In the absence of COVID-19 information provided by official government public health sources in their native language, migrant workers are likely to have relied on informal sources of information, including peer networks and online social media. Because of the lack of social media regulation, the quality of health information messages is known to vary considerably from official channels and may spread misinformation.

International migration to Greater China has increased in recent years, and one of the largest communities of migrant workers in the region is from Indonesia, numbering >500,000. This population is primarily engaged in domestic work, security, and other non-technical labour. Previous studies have demonstrated that migrant domestic workers, in particular, experience substantial health challenges and barriers to access to health care. This study investigated the knowledge and awareness of COVID-19 among Indonesian migrant workers (IMWs) in Macao (SAR), Hong Kong (SAR), and Taiwan and assessed the various channels they used to receive COVID-19 information during the pandemic. In addition to the concentrated number of IMWs in Macao (SAR), Hong Kong (SAR) and Taiwan, these regions were also chosen because mainstream social media (i.e. Facebook) and search engines (i.e. Google) can be accessed in these locations. Findings from this study are important in strengthening the preventive strategy through public awareness of COVID-19 among migrant workers. Because of the nature of this exploratory study, no hypothesis was tested in the analysis.

Methods

Procedures

A cross-sectional study using an online survey was conducted between 28 February and 31 March 2020. As the study was conducted online with survey links, it was not feasible to target a certain sample size before data collection. In addition, the number of migrant workers during the early phase of the pandemic was fluctuating as a result of layoffs and immigration policies in these three areas. However, to increase the sample diversity, the study was conducted in collaboration with several Indonesian migrant community groups (e.g. the Indonesian Migrant Workers Union and religious-based groups). The survey link was widely distributed through Indonesian migrant’s online social networks for a convenience sample. The survey link was posted on their Facebook groups/pages and sent to their group members through WhatsApp/WeChat/Telegram groups. To reach broader potential participants, the survey link was also promoted offline by advertising it on leaflets and posters that were distributed in restaurants and shops frequently visited by Indonesian migrants. The survey link directed participants to complete the online survey in Qualtrics.

Instruments

The survey consisted of several sections. The first section included questions to obtain sociodemographic information. The second section included multiple-choice questions to assess (1) primary sources of information related to COVID-19, (2) experiences in obtaining information on COVID-19, and (3) essential information they wanted relating to COVID-19. The final section assessed participants’ knowledge and awareness of COVID-19 in five domains, including (1) symptoms of COVID-19, (2) COVID-19 transmission routes, (3) availability of specific drugs or vaccines for COVID-19, (4) quarantine period, and (5) prevention strategies.

The questions in this survey were adapted from studies on COVID-19 knowledge among local residents and international migrants in China that applied the Theory of Planned Behaviour, similar to an Ebola prevention education programme in Nigeria. The preventive strategies applied in the three regions of this study were relatively similar because of their proximity to the pandemic epicentre and similar COVID-19 first-case confirmation dates (January 21st, 22nd, and 23rd in Taiwan, Macao, and Hong Kong, respectively). Information and instructions given to the public related to COVID-19 were also relatively similar in these regions (e.g. it was compulsory to wear facemasks in public areas and 14 days of quarantine for incoming passengers). In addition, these three regions had similar experiences of the severe acute respiratory syndrome outbreak in 2003.

The questionnaire was adapted into the Indonesian language. This adaption was in collaboration with executive members of the Indonesian Migrant Workers Union in Macao (SAR), who also communicated extensively with their colleagues in Hong Kong and Taiwan through focus-group discussions between January and February 2020. For example, the 10 sources of COVID-19 information were gathered from migrant workers’ experiences during the beginning of the outbreak. Before data collection, a draft of the online survey was piloted to check language comprehension and estimate the completion time needed. The questionnaire was deemed comprehensible, as no major problems were raised during the pilot study. The questionnaire could be completed in approximately 20–30 min depending on participants’ responses, particularly to questions with open-ended answers.

Analyses

Descriptive statistics were used in presenting the participants’ sources of information, experiences in obtaining information related to COVID-19, and their knowledge and awareness of COVID-19. The data are presented for each region to provide detailed information. However, because of the risk of sampling bias and uneven sampling from the three regions, inferential statistics were not conducted to compare results across regions. Continuous sociodemographic- and knowledge-related variables were dichotomised to enable Chi-squared tests. For example, age was divided into two groups at the mean sample age (≤36 years vs >36 years). Symptom knowledge was dichotomised (correct vs incorrect) by categorising participants who chose three key symptoms (fever, cough, and sore throat) into the correct group. These three key symptoms had been included in public health information about COVID-19 across the Greater China Region since January 2020 and were more commonly advertised than other symptoms that were included in the list. Transmission route knowledge was dichotomised by categorising participants who chose ‘droplets’ and ‘contact’ into the correct group. Treatment knowledge was dichotomised by categorising participants who chose ‘no drug, no vaccine’ into the correct group. Quarantine period knowledge was dichotomised by categorising participants who chose ‘14 days’ into the correct group. Finally, knowledge of prevention strategies was unknown.
Results

Participants in this study were migrant workers in Macao (SAR), Hong Kong (SAR), and Taiwan. The inclusion criteria were that participants were Indonesian who lived in the host country as migrant workers when they completed the online survey and were aged ≥18 years. At the end of the survey period, 568 people from the three regions had accessed the survey, with a completion rate of 86.4% (n = 491). Participants were predominantly from Macao (58.5%), female (92.1%), worked as a domestic worker or caregiver (71.3%), with an average age of 36 years. Participants’ sociodemographic characteristics are presented in Table 1.

The average number of information sources accessed by participants was three (standard deviation = 2.10). In total, 74.3% and 44.8% of participants obtained information related to COVID-19 mainly from social media (Facebook) and electronic/online mass media, respectively (Table 2). Some less frequently accessed sources were local social/migrant organisations (17.5%), printed mass media (14.7%), and non-IMW friends (13.2%). More than one-third of participants received hoax/fake news/incorrect information (14.7%), and non-IMW friends (13.2%). More than one-third of participants (35.0%) were familiar with the Indonesia language. In general, participants were interested in information about how to cure COVID-19 (72.1%) and less interested in psychological support or counselling (22.6%). Some topics under the ‘other’ option that were not listed in the survey but were mentioned by participants included insurance coverage for treatment related to COVID-19, information on face mask distribution, changes in immigration regulation, and flight schedules, and policies to protect migrant workers.

Table 3 summarises the five domains of knowledge and awareness related to COVID-19 that were assessed in the survey. In general, almost all participants (96.1%) recognised fever as the key symptom of COVID-19, whereas diarrhoea and stomach ache were the least endorsed symptoms (4.89% and 1.63%, respectively). Most participants (94.1%) identified the correct transmission routes of COVID-19 through droplets and contact with infected people; however, a few participants thought that it is transmitted through spoiled food (5.70%). Participants’ knowledge of drugs and vaccines for COVID-19 varied; 57.8% correctly answered that no specific drug or vaccine was currently available. In total, 12.4% of participants chose the incorrect options for the quarantine period. Most participants knew that wearing a mask (96.1%) and washing hands frequently (90.6%) were recommended prevention strategies; however, only two-thirds of participants correctly identified physical distancing as an important strategy, including ‘do not go to crowded places’ (88.0%) and ‘stay indoors and avoid going out’ (62.9%).

The level of symptom knowledge between different sociodemographic groups did not differ significantly. In terms of transmission route knowledge, ‘droplets’ and ‘contact with infected persons’ were correctly identified by 94.1% of participants, particularly among participants with senior high school or higher education level (χ² = 12.09, P = 0.001). Regarding no current drug and vaccine for COVID-19, only approximately half of the participants (57.8%) were aware of this, and they were more likely to be participants with senior high school or higher education (χ² = 4.16, P = 0.041), had stayed >6 years in their host country (χ² = 16.50, P < 0.001), and work as domestic or care workers (χ² = 4.45, P = 0.035). In total, 87.6% of participants correctly identified the quarantine period to be 14 days, and these individuals were more likely to be aged >36 years (χ² = 7.40, P = 0.007) and have a senior high school or higher education (χ² = 4.52, P = 0.034). Finally, all six prevention strategies were only recognised by one-quarter of participants (25.3%) who were more likely to be women (χ² = 9.80, P = 0.002) and work as domestic or care workers (χ² = 4.65, P = 0.034).

Table 1
Sociodemographic characteristics of study participants.

| Characteristic | Region               | Total (n = 491), n (%) |
|---------------|----------------------|------------------------|
|               | Macao (n = 287), n (%) | Hong Kong (n = 146), n (%) | Taiwan (n = 58), n (%) |
| Sex           |                      |                        |                        |
| Female        | 256 (89.2)           | 143 (97.9)             | 53 (91.4)              | 452 (92.1) |
| Male          | 31 (10.8)            | 3 (2.05)               | 5 (8.62)               | 39 (7.90)  |
| Age group     |                      |                        |                        |
| ≤36 years     | 142 (49.5)           | 75 (51.4)              | 23 (39.7)              | 240 (48.6) |
| >36 years     | 145 (50.5)           | 71 (48.6)              | 35 (60.3)              | 276 (51.4) |
| Educational level |                    |                        |                        |
| Elementary or junior high school | 112 (39.0)       | 69 (47.3)              | 23 (39.7)              | 204 (41.5) |
| Senior high school or higher education | 175 (61.0)       | 77 (52.7)              | 35 (60.3)              | 283 (58.5) |
| Length of stay in host country |                    |                        |                        |
| <5 years      | 182 (63.4)           | 50 (34.2)              | 43 (74.1)              | 275 (56.0) |
| ≥6 years      | 105 (36.6)           | 96 (65.8)              | 15 (25.9)              | 216 (44.0) |
| Type of job   |                      |                        |                        |
| Domestic or care workers | 176 (61.3)       | 136 (93.2)             | 38 (65.5)              | 350 (71.3) |
| Non-domestic or care workers | 111 (38.7)      | 10 (6.85)              | 20 (34.5)              | 141 (28.7) |
| Accommodation |                      |                        |                        |
| With employer (live-in) | 88 (30.7)        | 138 (94.5)             | 37 (63.8)              | 263 (53.6) |
| Not with employer (live-out) | 199 (69.3)      | 8 (5.48)               | 21 (36.2)              | 228 (46.4) |

Note: Percentages are calculated by comparing the category frequency with total sample in the region.
### Table 2
Sources of information and experiences in getting information related to COVID-19.

| Variables                                      | Region          | Total, n (%) |
|------------------------------------------------|-----------------|--------------|
| **Primary sources of information related to COVID-19** |                 |              |
| Social media (Facebook)                        | Macao, 210 (73.2) | 365 (74.3)  |
| Electronic/online mass media                   | 128 (44.6)       | 220 (44.8)   |
| Employer                                       | 91 (31.7)        | 166 (33.8)   |
| Online group (e.g., WeChat/WhatsApp group)     | 80 (27.9)        | 163 (32.2)   |
| YouTube                                        | 71 (24.7)        | 122 (24.8)   |
| Indonesian Consulate/Representive              | 46 (16.0)        | 112 (22.8)   |
| Local Labour Department, Health Department, or other local official departments | 52 (18.1) | 102 (20.8) |
| Local social/migrant organisation              | 43 (15.0)        | 86 (17.5)    |
| Printed mass media                             | 31 (10.8)        | 72 (14.7)    |
| Non-Indonesian migrant worker friends          | 31 (10.8)        | 65 (13.2)    |
| Other                                          | 15 (5.2)         | 24 (4.9)     |
| **Experiences in getting information on COVID-19** |                  |              |
| Received hoax/fake news/incorrect information  | 111 (38.7)       | 190 (38.7)   |
| Received information from unknown/unverified sources | 106 (36.9) | 187 (38.1) |
| Difficult to find information in the Bahasa Indonesia language | 100 (34.8) | 172 (35.0) |
| Difficult to find information from official sources | 76 (26.5) | 163 (33.2) |
| Difficult to find information that could be easily understood | 45 (15.7) | 82 (16.7) |
| **Most wanted information related to COVID-19** |                  |              |
| How to cure the disease                        | 198 (69.0)       | 354 (72.1)   |
| Status and trend of epidemic                   | 166 (57.8)       | 316 (64.4)   |
| How to prevent the disease                    | 154 (53.7)       | 262 (53.4)   |
| The symptoms of the disease                   | 134 (46.7)       | 244 (49.7)   |
| How the disease is transmitted                | 122 (42.5)       | 215 (43.8)   |
| Where the virus came from                     | 109 (38.0)       | 196 (39.9)   |
| Other                                          | 91 (31.7)        | 164 (33.4)   |
| Psychological support or counselling          | 51 (17.8)        | 111 (22.6)   |

* Participants may choose more than one option. Percentages are calculated by comparing the category frequency with total sample in the region.

### Table 3
The five domains of knowledge and awareness related to COVID-19 of the study participants.

| Variables                                      | Region          | Total, n (%) |
|------------------------------------------------|-----------------|--------------|
| **Symptoms of COVID-19**                       |                 |              |
| Fever                                          | 276 (96.2)      | 476 (96.1)   |
| Cough                                          | 148 (51.6)      | 258 (52.5)   |
| Sore throat                                    | 118 (41.1)      | 221 (45.0)   |
| Runny nose                                     | 74 (25.8)       | 162 (31.0)   |
| Headache                                       | 65 (22.6)       | 129 (26.3)   |
| Weakness                                       | 55 (19.2)       | 112 (22.8)   |
| Diarrhoea                                      | 11 (3.8)        | 24 (4.9)     |
| Stomach ache                                   | 5 (1.7)         | 8 (1.6)      |
| **Transmission routes of COVID-19**             |                 |              |
| Droplets (e.g., from a sneeze) and contact with infected persons | 268 (93.4) | 462 (94.1) |
| Spoiled food                                   | 18 (6.27)       | 28 (5.70)    |
| Mosquito bites                                 | 1 (0.35)        | 1 (0.20)     |
| From the Soil                                  | 0 (0)           | 0 (0)        |
| **Specific drug or vaccine for COVID-19**       |                 |              |
| No drug, no vaccine                            | 153 (53.3)      | 284 (57.8)   |
| There is a drug but no vaccine                 | 68 (23.7)       | 95 (19.3)    |
| There is both a drug and a vaccine             | 36 (12.5)       | 59 (12.0)    |
| No drug but there is a vaccine                 | 30 (10.5)       | 53 (10.8)    |
| **Quarantine period**                          |                 |              |
| 14 days                                       | 254 (88.5)      | 430 (87.6)   |
| 1 month                                       | 23 (8.0)        | 47 (9.60)    |
| 7 days                                        | 8 (2.79)        | 11 (2.20)    |
| 5 days                                        | 2 (0.7)         | 3 (0.60)     |
| **Prevention strategies**                      |                 |              |
| Wear mask                                     | 274 (95.5)      | 472 (96.1)   |
| Wash hands frequently                         | 255 (88.9)      | 440 (89.6)   |
| Do not go to crowded places                   | 194 (67.6)      | 334 (68.0)   |
| Stay indoors and avoid going out              | 169 (58.9)      | 309 (62.9)   |
| Keep room well ventilated                     | 112 (39.0)      | 209 (42.6)   |
| Do not contact wild animals                   | 85 (29.6)       | 161 (32.8)   |

* Participants may choose more than one option. Percentage is calculated by comparing the category frequency with total sample in the region.

* All these six options were correct. However, fever, cough, and sore throat were three key symptoms that participants were categorised into a correct group if answered these three options.

* These six options were correct. Only participants who chose all strategies together were categorized as correct.
The number of information sources accessed by participants was not significantly different between correct and incorrect groups across the five knowledge domains (see Table 4).

The detailed logistic regression results on the odds of correct answers from five dimensions of COVID-19 knowledge and awareness with 11 primary sources of COVID-19 information are presented in Table 5. The odds ratio (OR) for correct symptoms knowledge indicated that when sociodemographic variables were controlled, participants who (1) obtained information from their employer were 2.11 times more likely to have correct knowledge than participants who did not (95% confidence interval [CI] 1.41–3.17; P < 0.001), (2) obtained information from local social/migrant organisations were 1.67 times more likely to have correct knowledge than participants who did not (95% CI 1.03–2.72; P = 0.038), (3) obtained information from other sources outside the list were 2.42 times more likely to have correct knowledge than participants who did not (95% CI 1.05–5.60; P = 0.047), and (4) obtained information from WeChat/WhatsApp groups were 0.56 times less likely to have correct knowledge than participants who did not (95% CI 0.36–0.86; P = 0.009).

The OR for correct transmission route knowledge indicated that when sociodemographic variables were controlled, participants who (1) obtained information from WeChat/WhatsApp groups were 0.45 times less likely to have correct knowledge than participants who did not (95% CI 0.21–0.99; P = 0.047). The OR for correct drug and vaccine knowledge indicated that when sociodemographic variables were controlled, participants who (1) obtained information from electronic/online mass media were 1.49 times more likely to have correct knowledge than participants who did not (95% CI 1.01–2.21; P = 0.043) and (2) obtained information from local social/migrant organisations were 1.79 times more likely to have correct knowledge than participants who did not (95% CI 1.07–2.98; P = 0.025).

The OR for correct quarantine period knowledge indicated that when sociodemographic variables were controlled, participants who (1) obtained information from their employer were 2.38 times more likely to have correct knowledge than participants who did not (95% CI 1.22–4.67; P = 0.011), (2) obtained information from the Indonesian Consulate/Representative were 2.99 times more likely to have correct knowledge than participants who did not (95% CI 1.24–7.23; P = 0.015), (3) obtained information from an online WeChat/WhatsApp groups were 0.48 times less likely to have correct knowledge than participants who did not (95% CI 0.28–0.85; P = 0.011), and (4) obtained information from YouTube were 0.36 times less likely to have correct knowledge than participants who did not (95% CI 0.20–0.63; P < 0.001).

The OR for correct prevention strategies knowledge indicated that when sociodemographic variables were controlled, participants who (1) obtained information from the local Labour Department, Health Department, or other local official departments were 1.65 times more likely to have correct knowledge than participants who did not (95% CI 1.01–2.69; P = 0.044); and (2) obtained information from local social/migrant organisations were 1.84 times more likely to have correct knowledge than participants who did not (95% CI 1.10–3.07; P = 0.020).

### Discussion

The present study investigated IMWs’ knowledge and awareness of COVID-19 in the Greater China Region, including Macao (SAR), Hong Kong (SAR), and Taiwan. To our knowledge, there are no other similar reports for this population; however, our findings could be compared with other COVID-19 knowledge studies among international migrants in other countries, such as international migrants in China and Latinx in the United States. Participants obtained information related to COVID-19 from various sources, mostly from social media (Facebook), as this online social networking platform is also used to connect with family and friends. Furthermore, Indonesia was ranked as the third-largest Facebook user in the world. This finding was different from previous studies among international migrants in mainland China, where WeChat was the most common channel to obtain information related to COVID-19, and television was the most common information source for local urban and rural residents in China. However, a survey among Indonesian people in Indonesia found that participants obtained COVID-19 information mainly from television news (79.1%), followed by social media (57.7%), which could indicate that IMWs may have difficulty in understanding the television programmes in their host country.

Approximately one-third of participants (38.7%) experienced obtaining hoax/fake news/incorrect information and received information from unverified sources. A previous study on social media literacy among university students also found that the distribution of fake news on social media in Indonesia was severe, particularly from user-generated content. These findings are consistent with the high level of misleading information (the so-called ‘infodemic’), which may reduce beneficial health behaviours and increase psychological distress during the pandemic. Social interventions could be used to fight this infodemic using crowdsourcing judgements where the audiences are requested to rate the accuracy of the news or information before sharing it with others.

### Table 4

Average number (mean) of information sources accessed by participants.

| Five domains of knowledge and awareness related to COVID-19 | n   | Mean | SD  | t     | P-value |
|-----------------------------------------------------------|-----|------|-----|-------|---------|
| Symptoms of COVID-19                                      |     |      |     |       |         |
| Incorrect                                                 | 338 | 2.94 | 1.99| −1.70 | 0.090   |
| Correct                                                   | 153 | 3.29 | 2.31|       |         |
| Transmission routes of COVID-19                           |     |      |     |       |         |
| Incorrect                                                 | 29  | 3.17 | 2.62| 0.33  | 0.744   |
| Correct                                                   | 462 | 3.04 | 2.07|       |         |
| Specific drug or vaccine for COVID-19                     |     |      |     |       |         |
| Incorrect                                                 | 207 | 2.87 | 1.98| −1.57 | 0.116   |
| Correct                                                   | 284 | 3.18 | 2.18|       |         |
| Quarantine period                                         |     |      |     |       |         |
| Incorrect                                                 | 61  | 2.95 | 2.03| −0.39 | 0.697   |
| Correct                                                   | 430 | 3.06 | 2.11|       |         |
| Prevention strategies                                     |     |      |     |       |         |
| Incorrect                                                 | 367 | 2.95 | 2.03| −1.78 | 0.075   |
| Correct                                                   | 124 | 3.34 | 2.28|       |         |

SD, standard deviation.
The governments of Macao (SAR), Hong Kong (SAR), and Taiwan are all using official and verified social media accounts to communicate with the public during the pandemic. For example, the Macao (SAR) government has two official verified Facebook accounts: one is its government information channel and the other is a newly created account specifically for pandemic communications. They have news feeds and occasionally provide infographics in English to inform knowledge on preventing COVID-19. However, as most of the information provided through these accounts are still in Chinese and its English version is always delayed, it is recommended that the migrant workers’ country Consulate/Representative should provide timely translations of situational updates from the host country because not all migrant workers are fluent in the local language or in English. The WHO also partnered with Facebook to reduce the number of hoax/false news/incorrect information being shared on the social media platform, as this misinformation increases the risk of being infected or other serious consequences.17,30

Participants were primarily interested in how to cure COVID-19, which is in line with results from international migrants in China,22 but differs from individuals in Vietnam who were more interested in updating news about the pandemic.15 Public health communication campaigns about the disease should include information about drugs and vaccines because only half of the participants were aware that no specific drug or vaccine was available for COVID-19 during the early period of this pandemic, which was comparable with Latinx migrant workers in the United States.22 Similar to international migrants in China,15 IMWs in this study had little interest in psychological support or counselling because it might not be a priority for them at the early stage of the pandemic. However, information on mental health services should be provided as early as possible to prevent the negative psychological impacts of the pandemic, including anxiety and depression, that could increase after several months.31 In addition, support groups to assist the migrant workers in dealing with stress could also be established, without being labelled as a mental health service to avoid the stigma.

Regarding symptoms, almost all participants were aware that fever was the main symptom of COVID-19. However, many participants did not know that a cough and sore throat were also key symptoms associated with COVID-19. COVID-19 knowledge accuracy should be increased, including in the future outbreaks, because it was found that low COVID-19 knowledge had positive correlations with vaccine hesitancy and an unwillingness to be vaccinated among adults.32 Despite a lack of awareness of symptoms, knowledge of prevention strategies was high, with most participants knowing that wearing a facemask and handwashing could prevent virus transmission, which was similar to results found for Latinx migrant workers in the United States.22 However, awareness of physical distancing measures was relatively low, suggesting that increased education around prevention strategies is required in the future.

Educational level was a key factor associated with virus knowledge, which is similar to survey findings on COVID-19 knowledge among residents in mainland China during the early phase of the COVID-19 pandemic.33,34 IMWs with elementary or junior high school education were less likely to correctly answer questions about virus transmission route, drug and vaccine availability, and quarantine periods compared with their peers with higher educational backgrounds. These results could be because of participants with higher educational levels having more comprehension skills compared with their counterparts. Therefore, the content of educational campaigns should use a language that

| Sources of information | Symptoms | Transmission routes | Drug and vaccine | Quarantine period | Prevention strategies |
|------------------------|----------|---------------------|-----------------|------------------|---------------------|
| Social media (Facebook) | No 1 | 1 | 1 | 1 | 1 |
| Yes | 0.77 | 0.59 | 1.18 | 0.230 | 0.30 |
| Electronic/online mass media | No 1 | 1 | 1 | 1 | 1 |
| Yes | 1.45 | 1.07 | 2.18 | 0.069 | 1.04 |
| Employer | No 1 | 1 | 1 | 1 | 1 |
| Yes | 2.11 | 1.41 | <0.001 | 2.16 | 0.84 |
| Online group (i.e. WeChat/WhatsApp) | No 1 | 1 | 1 | 1 | 1 |
| Yes | 0.56 | 0.36 | 0.009 | 0.278 | 0.007 |
| YouTube | No 1 | 1 | 1 | 1 | 1 |
| Yes | 0.31 | 0.19 | 0.009 | 0.519 | 0.009 |
| Indonesian Consulate/Representative | No 1 | 1 | 1 | 1 | 1 |
| Yes | 0.77 | 0.59 | 1.18 | 0.230 | 0.30 |
| Employer | No 1 | 1 | 1 | 1 | 1 |
| Yes | 2.11 | 1.41 | <0.001 | 2.16 | 0.84 |
| Non-Indonesian migrant worker friends | No 1 | 1 | 1 | 1 | 1 |
| Yes | 1.24 | 0.71 | 0.038 | 2.72 | 0.022 |
| Other | No 1 | 1 | 1 | 1 | 1 |
| Yes | 2.42 | 1.05 | 0.008 | 0.46 | 0.034 |

The odds ratio (OR) and 95% confidence interval (CI) for the correct five dimensions of COVID-19 knowledge and participants’ sources of information. The bold values are the p-value < 0.05.
can be easily understood and be complemented with an illustration or simple infographic. In this study, 16.7% of participants could not find information on COVID-19 that was easy for them to understand. In addition, approximately one-third of participants who work as domestic or care workers (e.g. cleaners, cooks, and servers) knew less about drug/vaccine and prevention strategies than their counterparts. Therefore, different strategies may be useful in disseminating information on COVID-19 for these population groups (e.g. through collaboration with their employers).

The logistic regression analyses suggested that IMWs who received information related to COVID-19 symptoms, drugs and vaccines, quarantine periods, and prevention strategies from their employer and local social/migrant organisations (e.g. Migrant Workers Union) showed greater understanding than their counterparts. These findings are comparable with the international students who are supported by their university through the student union or the international office. Hence, it is also important to empower local social migrant organisations in educating migrant workers about the disease. On the other hand, IMWs who accessed information related to COVID-19 symptoms and quarantine periods from WeChat/WhatsApp groups and YouTube tended to be more likely to exhibit an incorrect understanding compared with IMWs who did not receive information from these sources. Public health communication campaigns should encourage migrant workers to access only reliable information sources and recheck the information before sharing it.

A digital literacy campaign might also be considered to increase migrant workers’ skills in recognising reliable accounts or information related to COVID-19. Participants who accessed information on the quarantine period from the Indonesian Consulate/Representative tended to have a more accurate understanding than their peers who did not access this source. This might be a result of the quarantine period related to the immigration process and stay of permit that migrant workers must consider if they want to conduct international travel, which is similar to results from international migrants in China. The Indonesian Consulate/Representative could also help in educating other domains of COVID-19 knowledge, such as its symptoms and prevention strategies.

The present study has several strengths, including the diverse and large sample of migrants in the three regions across Greater China and the cooperation with local migrant workers groups to design and carry out the study. The study also has some limitations. First, although online surveys may be the most effective method to reach migrant workers because the majority of them have smartphones and Internet connection, and considering the physical distancing strategy during the pandemic, it is worth considering that some IMWs might not have smartphones or be allowed to use them nor be allowed to go out, as found in a previous study among IMWs in Taiwan. In addition, selection bias may be present, as IMWs who answered the survey might have had a particular interest in the pandemic. Those who were most vulnerable and not interested in the pandemic may have been excluded because of limitations in the sampling approach. To increase the sample diversity, posters and leaflets contained the survey information were also distributed in common places visited by IMWs, such as Indonesian restaurants.

Second, the male IMWs were underrepresented, and they might have different knowledge and awareness of COVID-19. The dominance of female IMWs in this study (92.1%) actually represents the proportion of women in the region; 99.8% of IMWs in Hong Kong in 2018 were female and 75.4% in Taiwan in 2019. This also reflects the gendered nature of migration and the caretaking jobs that are predominant in the region. Similar studies in other countries that are dominated by male IMWs (e.g. Malaysia) may complement findings from this study.

Third, as this was a cross-sectional study with a convenience sampling method and it was not possible to adjust for multiple sources of media use and other confounders, the casual association between particular sources of information and correct knowledge and understanding related to COVID-19 may be biased. For example, the survey link distribution was assisted by migrant communities, and the findings showed that participants who obtained information from social/migrant organisations were more likely to have correct knowledge than participants who did not.

Finally, this study was conducted among IMWs only; their socio-demographic backgrounds may be different from other dominant migrant worker groups in the Greater China Region (e.g. migrant workers from The Philippines and Vietnam). Therefore, the findings from this study may not be applicable to other communities of migrant workers. Further studies among migrant workers from different nationalities should be conducted to provide a more complete picture about migrant workers’ knowledge and awareness of COVID-19.

Conclusions

IMWs in the Greater China Region, including Macao (SAR), Hong Kong (SAR), and Taiwan, were knowledgeable and aware of COVID-19, and this information was received from multiple sources (mostly social media). However, their knowledge and awareness of COVID-19 could be improved by using easily understood content disseminated in their native language because more than one-third of participants reported difficulty in finding information in the Bahasa Indonesia language. Particular information related to COVID-19 that should be promoted more widely to IMWs includes other prevention strategies besides wearing a facemask, information about the cure (drug/vaccine), and other symptoms besides fever. The role of the employer and local social/migrant organisations should be maximised in disseminating COVID-19 information because these sources appear to have provided more accurate information. In contrast, IMWs should be encouraged to check the accuracy of the information they receive from online groups (e.g. WeChat/WhatsApp group) and YouTube because IMWs who obtained information from these sources reported more incorrect responses to knowledge questions than their counterparts. To overcome this issue, digital literacy should be promoted, including how to identify fake news and misinformation, to complement health promotion campaigns.

Author statements

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Ethical approval

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Competing interests

The authors have no conflict of interest to declare.
Consent for publication
Not applicable.
Availability of data and materials
The data that support the findings of this study are available from the corresponding author on reasonable request.

Authors’ contributions
A.L. and B.J.H. drafted the study and article outlines. A.L., B.J.H., and C.W. developed the methods. A.L. wrote the draft of article. C.W., C.D., A.I.L.F., C.A.L., and B.J.H. provided critical feedback for the article, including data analysis and interpretation. All authors read and approved the final article.

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