Introduction

After more than one year of ravages inflicted by the coronavirus disease 2019 (COVID-19) pandemic – caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) – pharmaceutical intervention involving vaccination has begun in many countries. Despite the availability of vaccines, access to vaccines in some countries remains an obstacle to eradicate the COVID-19 pandemic. Thus, non-pharmaceutical interventions at the individual level such as wearing face masks, personal hygiene (e.g. frequent washing of hands) and other physical barriers (e.g. physical distancing) are still paramount. Many public health agencies such as the US Centers for Disease Control and Prevention and the World Health Organization (WHO) recommend wide compliance with face mask wearing in public settings as part of a comprehensive infection prevention and control (IPC) strategy to reduce transmission of SARS-CoV-2 (1–3). Community-wide face mask wearing is not a new non-pharmaceutical intervention. Dr Lien Teh Wu, a Malayan epidemiologist, pioneered the development of surgical face mask and encouraged medical staff and the public to wear masks during the Manchurian plague of 1910–1911 (4).
Methods

This study has a cross-sectional design. The survey questionnaire was adopted from a previous study by Dai et al. (20) and was offered in the three major languages of Malaysia (Malay, English and Mandarin). Links to the questionnaire were distributed via popular social media platforms (e.g. WhatsApp and Facebook Messenger) and email. Online survey questionnaires are a safe and feasible way of collecting data during the COVID-19 pandemic (21).

To minimise response biases, standard survey approaches were followed (22) such that there was no social pressure to influence responses, no questions that would provoke defensiveness or threaten esteem and no payoff or cost for particular responses. Participation in this survey was voluntary and respondents could opt out at any time. Moreover, respondents were assured anonymity and confidentiality of their responses. All respondents consented to participate in this online survey by clicking the ‘Next’ button to complete the online questionnaire.

Data collected include respondents’ demographic characteristics (ethnicity, gender, age and number of children under 18 years old living in the same household), personal hygiene factors (frequency of washing hands and availability of PPE) and online behavioural factors (hours spent per day on internet, social media and browsing information related to the COVID-19 pandemic on social media).

Some scholars argue that there is little to lose and potentially much to gain from wearing a face mask (5). Wearing a face mask proffers various benefits as masks are cheap and easy to use, have strong sustainability, and good for health and economy (5, 6, 7, 8, 9, 10). Increasing scientific evidence supports the effectiveness of community-wide face mask wearing for the prevention and source control to reduce transmission of SARS-CoV-2 (3, 6, 7, 9, 10, 11, 12, 13, 14). However, the effectiveness of face masks is contingent upon community-wide adoption, high compliance rate most of the time and correct wearing of face masks (5, 8). Additionally, wearing of face masks in conjunction with other non-pharmaceutical interventions is critical for greater effectiveness in reducing transmission of SARS-CoV-2 (3, 6, 9, 10).

Despite their effectiveness, there is heterogeneity in face mask wearing (14, 15) due to various contextual factors, such as demographics, availability and cost of face mask, and culture. Several studies suggest that gender shapes face mask wearing adherence, with males less likely than females to wear a face mask (14, 15). Ethnicity is another factor that has affected face mask wearing adherence during the COVID-19 pandemic (5, 7, 10, 11, 12). Hearne and Niño (14) found that face mask wearing patterns in the U.S. during the COVID-19 pandemic were differently shaped by gender, ethnicity and interactions between these factors. Older individuals are slightly less likely to wear face masks compared to younger individuals (17). A recent study suggests that social media usage may be useful in predictive models of human behaviour during a pandemic (18).

Future research should examine person-context interactions in different geographic locations and cultural contexts to better predict face mask wearing during the COVID-19 pandemic (19). Understanding contextual factors of face mask wearing is important to increase face mask wearing compliance rate during the ongoing and future pandemics. As such, this study aims to identify relationships between demographic factors, personal hygiene factors, online behavioural factors and face mask wearing by Malaysian adults during the COVID-19 pandemic.

Results

Table 1 depicts descriptive statistic of the respondents. Table 2 depicts hours spent per day on internet, social media and browsing information related to the COVID-19 pandemic on social media.
Table 1. Descriptive statistic

| Variable          | Category                        | Frequency | Percent |
|-------------------|---------------------------------|-----------|---------|
| Ethnicity         | Malay                           | 348       | 49.2    |
|                   | Chinese                         | 234       | 33.1    |
|                   | Indian                          | 41        | 5.8     |
|                   | Natives of Sabah and Sarawak    | 85        | 12.0    |
|                   | Total                           | 708       | 100.0   |
| Gender            | Male                            | 345       | 48.7    |
|                   | Female                          | 363       | 51.3    |
|                   | Total                           | 708       | 100.0   |
| Age bracket (years old) | 18–29                          | 101       | 14.3    |
|                   | 30–39                           | 213       | 30.1    |
|                   | 40–49                           | 200       | 28.2    |
|                   | 50–59                           | 159       | 22.5    |
|                   | ≥ 60                            | 35        | 4.9     |
|                   | Total                           | 708       | 100.0   |
| Number of children| None                            | 335       | 47.3    |
|                   | One                             | 119       | 16.8    |
|                   | Two                             | 112       | 15.8    |
|                   | Three                           | 83        | 11.7    |
|                   | Four                            | 41        | 5.8     |
|                   | Five                            | 14        | 2.0     |
|                   | Six or more                     | 4         | 0.6     |
|                   | Total                           | 708       | 100.0   |

Table 2. Hours spent per day on internet, social media and browsing information related to the COVID-19 pandemic on social media

|                         | Mean | Standard deviation |
|-------------------------|------|--------------------|
| Internet                | 7.6  | 3.9                |
| Social media            | 5.1  | 3.7                |
| Browsing information related to the COVID-19 pandemic | 2.5  | 2.5                |

The multinomial logistic regression model is significant \( (P < 0.01) \). Likelihood ratio tests suggest that, overall, availability of PPE \( (P < 0.01) \), hours spent on social media \( (P < 0.01) \) and browsing information related to the COVID-19 pandemic \( (P < 0.05) \) were significantly related to frequency of face mask wearing (Table 3).

Compared with the high compliance rate group, the low compliance rate group had substantially lower access to PPE, followed by less exposure to social media, but members of this group were positively influenced by information related to the COVID-19 pandemic (Table 4). Meanwhile, compared with the high compliance rate group, the medium compliance rate group also lacked PPE, but the lack of access was less severe than that for the low compliance rate group (Table 4).
### Table 3. Likelihood ratio tests

| Effect                                | Model fitting criteria | Likelihood ratio tests |
|---------------------------------------|------------------------|------------------------|
|                                       | -2 log likelihood of   | Chi-squared           |
|                                       | reduced model          | df         | Sig.      |
| Intercept                             | 316.137                | 5.012             | 2         | 0.082    |
| Ethnicity                             | 312.370                | 1.245             | 2         | 0.537    |
| Gender                                | 311.498                | 0.373             | 2         | 0.830    |
| Ethnicity X gender                    | 312.200                | 1.075             | 2         | 0.584    |
| Age                                   | 311.538                | 0.413             | 2         | 0.813    |
| Number of children                    | 312.909                | 1.784             | 2         | 0.410    |
| PPE                                   | 340.195                | 29.070            | 2         | 0.000    |
| Washing hands                         | 316.782                | 5.657             | 2         | 0.059    |
| Internet                              | 311.232                | 0.108             | 2         | 0.948    |
| Social media                          | 324.126                | 13.001            | 2         | 0.002    |
| Browsing information related to the COVID-19 pandemic | 317.446 | 6.321 | 2 | 0.042 |

Note: The dependent variable is the frequency of face mask wearing; X denotes interaction between two variables

### Table 4. Parameter estimates

| Face mask wearing compliance rate* | Beta   | Std. error | Wald   | df | Sig. |
|------------------------------------|--------|------------|--------|----|------|
| Low compliance rate                |        |            |        |    |      |
| Intercept                          | 3.553  | 1.603      | 4.909  | 1  | 0.027|
| Ethnicity                          | 0.773  | 0.712      | 1.180  | 1  | 0.277|
| Gender                             | 0.622  | 1.031      | 0.364  | 1  | 0.546|
| Ethnicity X gender                 | −0.333 | 0.452      | 0.542  | 1  | 0.462|
| Age                                | −0.015 | 0.25  | 0.372  | 1  | 0.542|
| Number of children                 | 0.046  | 0.167      | 0.077  | 1  | 0.781|
| PPE                                | −1.145 | 0.251      | 20.873 | 1  | 0.000|
| Washing hands                      | −0.339 | 0.198      | 2.935  | 1  | 0.087|
| Internet                           | 0.021  | 0.073      | 0.079  | 1  | 0.778|
| Social media                       | −0.406 | 0.144      | 7.964  | 1  | 0.005|
| Browsing information related to the COVID-19 pandemic | 0.332 | 0.141 | 5.567 | 1 | 0.018|

| Medium compliance rate             |        |            |        |    |      |
|------------------------------------|--------|------------|--------|----|------|
| Intercept                          | 0.840  | 1.592      | 0.278  | 1  | 0.598|
| Ethnicity                          | 0.314  | 0.843      | 0.139  | 1  | 0.709|
| Gender                             | 0.139  | 1.019      | 0.019  | 1  | 0.892|
| Ethnicity X gender                 | −0.457 | 0.622      | 0.539  | 1  | 0.463|
| Age                                | 0.004  | 0.024      | 0.024  | 1  | 0.877|
| Number of children                 | 0.196  | 0.144      | 1.840  | 1  | 0.175|
| PPE                                | −0.699 | 0.221      | 10.000 | 1  | 0.002|
| Washing hands                      | −0.292 | 0.167      | 3.063  | 1  | 0.080|
| Internet                           | 0.014  | 0.070      | 0.038  | 1  | 0.846|
| Social media                       | 0.067  | 0.069      | 0.957  | 1  | 0.328|
| Browsing information related to the COVID-19 pandemic | −0.064 | 0.107 | 0.364 | 1 | 0.546|

Note: *Reference group is high face mask wearing compliance rate; X denotes interaction between two variables*
Discussion

This study empirically identified that lack of PPE, fewer social media hours and fewer hours of browsing information related to the COVID-19 pandemic were associated with low compliance rate for face mask wearing by some adults in Malaysia. As opposed to investigating the general population (i.e. a shotgun approach), this study advanced contextual understanding of face mask wearing by specific groups during the COVID-19 pandemic. The divergent findings compared with prior studies on the influence of gender, ethnicity and age on face mask wearing underscores the importance of context in research concerning face mask wearing, as was also discussed in the Introduction section.

The benefits proffered by wearing face mask are subject to the availability and affordability of face masks over a prolonged period. Specifically, face mask expenses may further add to financial burdens experienced by low-income group during the COVID-19 pandemic. To increase community-wide face mask wearing compliance rate as part of a comprehensive strategy of infection prevention and control to reduce transmission of SARS-CoV-2, results of this study indicate that a two-pronged action plan involving free face mask use of social media platforms to provide reminders about face mask wearing and information related to the COVID-19 pandemic targeted at the low compliance rate group could be beneficial.

Conclusion

This study has several limitations that should be addressed by future research. First, face mask wearing was measured at only a single time point during the pandemic. Second, given the contextual factors of face mask wearing, the findings here are not generalisable. As such, future research should investigate factors associated with face mask wearing in different countries and cultural settings for tailored non-pharmaceutical interventions.

Face masks were used during the Manchurian plague of 1910–1911. The WHO warns that more lethal viruses will emerge in the future (23). As such, face masks will continue to play an important role in future pandemics before new vaccines are widely available.

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Ethics Approval

This study conformed to the guidelines of the Declaration of Helsinki and was approved by the Research Ethics Committee of Xiamen University Malaysia, Malaysia (reference number: REC-2004.01).

Conflict of Interest

None.

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Brief Communications | Face mask wearing compliance rate

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