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Factors influencing health behaviours during the coronavirus disease 2019 outbreak in China: an extended information-motivation-behaviour skills model

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Original Research

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ABSTRACT

Objectives: This study explored the factors influencing health behaviours during the coronavirus disease 2019 (COVID-19) outbreak in China. The impact of perceived stress and positive perception of interventions on health behaviours in China were assessed using the extended information-motivation-behaviour skills (IMB) model.

Study design: Cross-sectional survey.

Methods: The Questionstar online survey tool was used to construct a structured questionnaire based on the IMB model. Between 14 and 22 February 2020, during the peak of COVID-19 epidemic in China, 2449 participants were recruited by snowball sampling on WeChat and Tencent QQ social media platforms in China. Data were collected through an online questionnaire, and structural equation modelling was performed to evaluate the extended IMB model.

Results: Health behaviours were assessed using a scoring system (total score range: 8–40); the average health behaviour score in this study was 34.62 ± 4.44. The term ‘health risk stress’ refers to the impact that perceived stress has on health, and this was experienced by 39.9% of participants. Only 35.9% of participants answered all seven questions on COVID-19 information correctly. The final model showed that information, motivation, behavioural skills, health risk stress and positive perception of interventions had significant direct effects on health behaviours. Health behaviours were positively associated with the positive perception of interventions but negatively associated with health risk stress. Behavioural skills had the greatest impact on health behaviours.

Conclusions: In the face of public health emergencies, the extended IMB model has been used as a theoretical framework to construct more effective interventions. The government should pay attention to publicity and guidance, strengthen positive interactions with the public and disclose relevant information in a timely manner to gain trust and to maintain the positive public perception of the interventions. In terms of health education, the government should focus on behavioural skills, promptly rectify ineffective prevention information and raise awareness about the disease to relieve stress and anxiety in the population.

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Introduction

On 30 January 2020, the World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus-2 as the sixth public health emergency of international concern. As of 14 June 2020, there were 7,690,708 confirmed cases and 427,630 deaths worldwide. WHO
risk assessment is very high. In addition to public health, COVID-19 poses a serious threat to global economic and social development. To curb the development of the epidemic to the greatest extent, the Chinese government and other relevant departments concentrated their medical resources on the treatment of infected persons and adopted a series of comprehensive prevention and control measures based on the principles of controlling transmission sources, cutting off transmission routes and protecting vulnerable populations. At the same time, relevant departments and organisations released timely and accurate information about COVID-19, actively carried out health education and provided residents with authoritative, detailed and specific operational prevention and control guidelines. In addition, it was very important for residents to follow the instructions, adopt appropriate health behaviours and maintain good health habits, such as correctly wearing a mask and avoiding outings or gatherings. These measures help to control the epidemic and reduce the risk of infection.

The aforementioned prevention strategy is consistent with the theory of the information-motivation-behaviour skills (IMB) model, which classifies the factors affecting the occurrence and changes of preventive behaviour into three components of information, motivation and behaviour skills. IMB is a well-proven model, which classifies their medical resources on the treatment of infected persons and adopted a series of comprehensive prevention and control measures based on the principles of controlling transmission sources, cutting off transmission routes and protecting vulnerable populations. At the same time, relevant departments and organisations released timely and accurate information about COVID-19, actively carried out health education and provided residents with authoritative, detailed and specific operational prevention and control guidelines. In addition, it was very important for residents to follow the instructions, adopt appropriate health behaviours and maintain good health habits, such as correctly wearing a mask and avoiding outings or gatherings. These measures help to control the epidemic and reduce the risk of infection.

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COVID-19, coronavirus disease 2019.

Interventions. Cronbach's alpha of the policies. Participants answered using a five-point Likert scale, ranging from 1 (completely disagree) to 5 (completely agree). The higher the score, the higher the positive perception of interventions. Cronbach's alpha = 0.829.

**Positive perception of interventions**

Positive perception of interventions refers to residents' perceptual evaluation of the government's epidemic prevention and control measures, with a total of five items (Table 1, PPI1-PPI5). The main contents were on understanding, support and evaluation of the policies. Participants answered using a five-point Likert scale, ranging from 1 (completely disagree) to 5 (completely agree). The higher the score, the higher the positive perception of interventions. Cronbach's alpha = 0.890.

**Health behaviours**

Health behaviours included prevention of infection of COVID-19, a healthy diet and appropriate exercise, with a total of nine items (Table 1, HB1–HB9). Participants answered using a five-point Likert scale, ranging from 1 (never) to 5 (always). The higher the score, the higher the frequency of positive health behaviours. Cronbach's alpha = 0.835.

**The extended IMB model**

In Fig. 1, the original IMB model is represented by solid lines, and the nine paths added in the study are represented by the dotted lines. Paths 1–4 were used to evaluate the positive impact of positive perception of interventions on health behaviours, and paths 5–8 were used to estimate the negative impact of perceived stress on health behaviours.
Statistical analyses

Statistical analyses were completed using SAS9.4. The measurement data of normal distribution were reported by mean ± standard deviation, and the count data were reported by frequency (N) and percent (%). The Pearson correlation coefficient and point double correlation coefficient were used to estimate the correlation between variables. Confirmatory factor analysis (CFA) was used to test the relationship between latent variables and observable variables of the measurement model. In each measurement model, when the factor loading of an item was not statistically significant (P > 0.05) or the standardised factor loading estimate was less than 0.4, the item was deleted. Structural equation modelling (SEM) was used to evaluate the extended IMB model. The model was considered to have a good fit when the ratio of chi-square to degrees of freedom was < 5.01, root mean square error of approximation (RMSEA) < 0.08, goodness-of-fit index (GFI) ≥ 0.90, Tucker–Lewis index (TLI) ≥ 0.90 and comparative fit index (CFI) ≥ 0.90.22 SEM and CFA were conducted using Amos 24.0. Bilateral P < 0.05 considered the difference to be statistically significant.

Results

Sociodemographic characteristics

In total, 2533 participants completed the questionnaires; 2449 of these were valid. Table 2 shows the sociodemographic characteristics of the study participants. The majority of the participants were under the age of 40 years (70.5%), female (66.4%), employed (74.9%), with a personal monthly income < 5000 RMB (70.4%) and lived in urban areas (72.8%). Most of the respondents (75.2%) came from Chongqing Municipality and Sichuan Provinces. In total, 39.9% of participants experienced health risk stress (i.e. perceived stress had an impact of their health). The percent of errors in the information for I1 to I7 were 21.9%, 19.1%, 19.3%, 18.3%, 25.7%, 8.1% and 12.3%, respectively. Only 35.9% of participants answered all seven questions on COVID-19 information correctly.

Measurement model

Table 3 presents the significant tests and the estimated CFA with the parameters from the extended IMB constructs. After removing item M6, the motivation latent variable retained five original items (M1-M5) that had a good fit (IFI = 0.973, CFI = 0.972 and RMSEA = 0.054). After deleting item B8, the behavioural skill latent variable retained seven original items (BS1-BS7) that had a good fit (IFI = 0.961, CFI = 0.960 and RMSEA = 0.060). After removing item HB9, the health behaviours latent variable retained eight original items (HB1-HB8) that had a good fit (IFI = 0.983, CFI = 0.983 and RMSEA = 0.049). The five original items were reserved for the latent variable of positive perception of intervention (PP11-PP15), which resulted in a good fit (IFI = 0.968, CFI = 0.968 and RMSEA = 0.043).

The reliabilities of the scales in information, motivation, behavioural skills, perceived stress, positive perception of interventions and health behaviours were 0.607, 0.639, 0.768, 0.829, 0.890 and 0.844, respectively. In addition, all standardised factor loading estimates were > 0.4 and significant (P < 0.05) in each measurement model.

Correlation analysis

The correlation coefficients among all constructs are presented in Table 4. The correlation coefficient between all constructs were statistically significant, except for between information and motivation (r = −0.006, P = 0.716), between positive perception of interventions and information (r = 0.032, P = 0.109) and between health risk stress and motivation (r = −0.031, P = 0.123). Therefore, these three paths were deleted in the extended IMB model, namely, ‘Health Risk Stress → Motivation’, ‘Positive perception of intervention measures → Information’ and ‘Information → Motivation’, respectively.

Path analysis

The final extended IMB model (Fig. 2) had a good fit; that is, χ2/df ratio = 1511.733/305 = 4.892, GFI = 0.949, CFI = 0.939, TLI = 0.930, RMSEA = 0.041. Five factors had significant direct effects on health behaviours; namely, information (β = 0.067, t = 3.408, P < 0.001), motivation (β = 0.192, t = 7.357, P < 0.001), behavioural skills (β = 0.464, t = 10.487, P < 0.001), health risk stress (β = −0.159, t = −8.110, P < 0.001) and positive perception of interventions (β = 0.072, t = −2.212, P = 0.027). Health risk stress exerted indirect impacts on health behaviours through behavioural skills and information. Positive perception of interventions also
exerted indirect impacts on health behaviours through behavioural skills, health risk stress and motivation.

In conclusion, the total effect coefficients of information, motivation, behavioural skills, health risk stress and positive perception of intervention on health behaviours were 0.156, 0.263, 0.464, 0.208 and 0.452, respectively. All variables accounted for 44.0% of health behaviours.

Discussion

This study successfully constructed an extended IMB model, wherein information, motivation, behavioural skills, health risk stress and positive perception of interventions on health behaviours were 0.156, 0.263, 0.464, –0.208 and 0.452, respectively. All variables accounted for 44.0% of health behaviours.

Table 2
Sociodemographic characteristics (n = 2449).

| Variables                        | N  | Percent (%) |
|----------------------------------|----|-------------|
| **Gender**                       |    |             |
| Male                             | 823| 33.6        |
| Female                           | 1626| 66.4       |
| **Age (years)**                  |    |             |
| 18–25                            | 837| 34.2        |
| 26–30                            | 463| 18.9        |
| 31–40                            | 427| 17.4        |
| 41–50                            | 486| 19.8        |
| 51–60                            | 192| 7.8         |
| ≥61                              | 44 | 1.8         |
| **Education level**              |    |             |
| Elementary or below              | 48 | 2.0         |
| Junior high school diploma       | 326| 13.3        |
| Senior high school diploma       | 310| 12.7        |
| Advanced diploma                 | 728| 29.7        |
| Baccalaureate degree             | 881| 36.0        |
| Master’s degree or above         | 156| 6.4         |
| **Marital status**               |    |             |
| Non-married                      | 1000| 40.8       |
| Married                          | 1353| 55.3       |
| Divorced                         | 77 | 3.1         |
| Widowed                          | 19 | 0.8         |
| **Personal monthly income (RMB)**|    |             |
| ≤3000                            | 845| 34.5        |
| 3001–5000                        | 880| 35.9        |
| 5001–7000                        | 365| 14.9        |
| 7001–10000                       | 215| 8.8         |
| ≥10,001                          | 144| 5.9         |
| **Region**                       |    |             |
| Urban                            | 1783| 72.8       |
| Township                         | 394 | 16.1        |
| Rural                            | 272 | 11.1        |
| **Province of residence**        |    |             |
| Chongqing Municipality           | 1408| 57.5       |
| Sichuang Provinces               | 434| 17.7        |
| Gansu Provinces                  | 151| 6.2         |
| Jiangxi Provinces                | 114| 4.7         |
| Others                           | 342| 14.0        |
| **Occupation**                   |    |             |
| Employed                         | 1834| 74.9       |
| Students                         | 261| 10.7        |
| Unemployed or ‘job-waiting’ indiviuals | 268| 10.9        |
| Retirees                         | 86 | 3.5         

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Discussion

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One-fifth of the respondents thought that taking antibiotics, consuming Shuanghuanglian oral solution or vinegar, or using gauze masks or activated carbon masks could prevent COVID-19. Such erroneous knowledge could lead to ineffective preventive measures by the population and increase the risk of infection. Therefore, it is necessary to target and proactively conduct health education for groups of different cultural levels and regions to improve residents’ prevention knowledge.

Behavioural skills are indispensable for improving health behaviours and long-term prevention behaviours depends on behavioural skills. The results of this study validate the importance of behavioural skills, which are the mediating factor of information, motivation, perceived stress and positive perception of interventions. Behavioural skills are also the most important direct factors affecting health behaviours, in line with findings from other studies. Therefore, the government advise the public on correct health behaviours, such as wearing masks, washing hands and the use of disinfectants, so that residents can obtain these skills to reduce the risk of infection. It is also necessary to guarantee the supply of protective materials.

In the face of public health emergencies, the level of anxiety will be related to the severity of the disease. The results found that 39.9% of residents suffered from health risk stress. Health risk stress is negatively related to health behaviours, information and behavioural skills, which showed that excessive stress is not conducive to positive health behaviours, and that nervousness and being out of control can lead to negative coping styles. Individuals who maintain a high level of awareness of the danger and maintain a moderate level of stress are the most likely to adopt appropriate...
health behaviours. Therefore, it is necessary for relevant departments to guide residents to treat the epidemic objectively, calmly and rationally, and to take effective intervention measures to reduce stress and anxiety in the population. The total effects of positive perception of interventions on health behaviours are similar to the effects seen with behavioural skills. The positive perception of interventions is negatively related to health risk stress. It is not only a direct influencing factor of health behaviours but also indirectly affects health behaviours through motivation and behavioural skills. It was revealed that suitable prevention and control measures adopted by the government and relevant organisations could reduce the fear and anxiety of residents and improve health behaviours. Therefore, the government should provide accurate, open and transparent information on the situation of the epidemic, strengthen interactions with the public and win the trust of residents. When residents have a high level of trust in the government, stress significantly decreased.

This study has some limitations, including: (1) the randomisation of the sample was poor; however, a large sample size was used to ensure a certain number of individuals in all categories, to minimise bias; (2) extrapolation of the results is limited to some extent; data mainly represented the regions of Chongqing and Sichuan or regions with similar pandemic severity. Chongqing Municipality borders Hubei Province (the epicentre of the epidemic) and is adjacent to Sichuan Province. Between 20 January and 22 February, the total number of confirmed cases in Chongqing Municipality and Sichuan Province was 573 (six deaths) and 526 (three deaths), respectively. In view of the international nature of COVID-19 and its implications, future studies should include a broader sample.

This study has used the extended IMB model as a theoretical framework to construct more effective interventions during the COVID-19 epidemic in China. The government should pay attention to publicity and guidance, strengthen positive interaction with the public and disclose relevant information in a timely manner to gain

| Constructs items (total scores range) | β    | P   | Mean | SD  | IFI/CFI | RMSEA | Crobach’s α |
|--------------------------------------|------|-----|------|-----|---------|-------|-------------|
| Perceived stress (0–56) Score       |      |     |      |     |         |       |             |
| Information (0–7)                    | 0.470| <0.001| 22.25| 7.20| 0.829   |       |             |
| Knowledge score                      | 0.413| <0.001| 23.15| 2.67| 0.973/0.972| 0.054 | 0.639       |
| Motivation (5–25)                    | 0.510| <0.001| 4.34 | 1.27|         |       |             |
| M1                                   | 0.669| <0.001| 2.35 | 0.26| 0.961/0.960| 0.060 | 0.768       |
| M2                                   | 0.476| <0.001| 2.35 | 0.26|         |       |             |
| Positive perception of interventions (5–25) | 0.137| <0.001| 22.25| 2.97| 0.968/0.968| 0.043 | 0.890       |
| PPI1                                 | 0.784| <0.001| 22.25| 2.97|         |       |             |
| PPI2                                 | 0.800| <0.001| 22.25| 2.97|         |       |             |
| PPI3                                 | 0.785| <0.001| 22.25| 2.97|         |       |             |
| PPI4                                 | 0.750| <0.001| 22.25| 2.97|         |       |             |
| Health behaviours (8–40)             | 0.758| <0.001| 22.25| 2.97|         |       |             |
| HB1                                  | 0.606| <0.001| 23.15| 2.67| 0.983/0.983| 0.049 | 0.844       |
| HB2                                  | 0.760| <0.001| 23.15| 2.67|         |       |             |
| HB3                                  | 0.711| <0.001| 23.15| 2.67|         |       |             |
| HB4                                  | 0.718| <0.001| 23.15| 2.67|         |       |             |
| HB5                                  | 0.707| <0.001| 23.15| 2.67|         |       |             |
| HB6                                  | 0.561| <0.001| 23.15| 2.67|         |       |             |
| HB7                                  | 0.584| <0.001| 23.15| 2.67|         |       |             |
| HB8                                  | 0.430| <0.001| 23.15| 2.67|         |       |             |

**Table 3** Constructs for information, motivation, behavioural skills, health behaviours, perceived stress and positive perception of interventions (n = 2449).

**Table 4** Correlation coefficients among model constructs (n = 2449).

| Constructs                  | 1    | 2    | 3    | 4    | 5    |
|-----------------------------|------|------|------|------|------|
| Information                 | 1    | 0.006|      |      |      |
| Motivation                  | -0.006| 1    | 0.187*| 0.184*| 1    |
| Behavioural skills          | 0.161*| 0.245*| 0.494*| 1    |      |
| Health behaviours           | -0.084*, *| -0.031*| -0.203*, *| -0.283*, *| 1    |
| Health risk stress          | 0.032| 0.137*| 0.535*| 0.416*| -0.190*, *|

*SD = standard deviation; IFI = incremental fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation.*

This study has some limitations, including: (1) the randomisation of the sample was poor; however, a large sample size was used to ensure a certain number of individuals in all categories, to minimise bias; (2) extrapolation of the results is limited to some extent; data mainly represented the regions of Chongqing and Sichuan or regions with similar pandemic severity. Chongqing Municipality borders Hubei Province (the epicentre of the epidemic) and is adjacent to Sichuan Province. Between 20 January and 22 February, the total number of confirmed cases in Chongqing Municipality and Sichuan Province was 573 (six deaths) and 526 (three deaths), respectively. In view of the international nature of COVID-19 and its implications, future studies should include a broader sample.
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Author statements

Ethical approval

The study was approved by the Ethics Committee of the First Affiliated Hospital of Chongqing Medical University Ethics (No.2020250).

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Competing interests

None declared.

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