



Using the health action process approach to predict facemask use and hand washing in the early stages of the COVID-19 pandemic in China

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Abstract

Personal hygiene including wearing facemask and washing hands are instrumental to reduce transmission of COVID-19. The present study applied the health action process approach (HAPA) to examine the process from intention to protective behaviors in the early stages of the COVID-19 pandemic. A longitudinal online survey study was conducted among 229 individuals (61.6% females; $M_{age} = 25.37$ years, $SD_{age} = 8.34$ years) living in Hubei province, China. Action self-efficacy, outcome expectancy, risk perception, intention, planning and action control regarding facemask wearing and hand washing were assessed at baseline (Time 1), and behaviors were assessed a week later (Time 2). Data were collected from 30 January to 16 February 2020. Two structural equation models were specified to test the theory-driven determinants of the facemask wearing and hand washing respectively. The results showed that action self-efficacy predicted intentions to wear facemasks and wash hands. Intention and action control predicted both behaviors at Time 2. Associations between planning and behaviors were mixed. Mediation analyses revealed that action control significantly mediated the relationship between intention and both behaviors (facemask wearing: 90% CI [0.01, 0.12]; hand washing: 95% CI [0.01, 0.21]). Planning did not mediate the relationship between intention and the two behaviors. The findings illustrate that action self-efficacy is positively associated with intention to facemask wearing and hand washing, and action control contributes to bridging intention to behaviors. Both motivational and volitional factors warrant consideration in interventions to improve adherence to facemask wearing and hand washing in COVID-19.

Keywords Hand washing · Facemask wearing · Action control · Health action process approach · COVID-19

The COVID-19 pandemic has taken an unprecedented toll on economics, well-being, and daily life worldwide. The SARS-CoV-2 virus was first reported in Wuhan, China at the end of 2019. The coronavirus outbreak was declared as a global public health emergency on 30 January 2020. According to the National Health Commission (NHC) of the People's Republic of China, by the end of January 2020, the number of infected cases in China reached 11,791 and the number of deaths were 259. The COVID-19 was later declared a pandemic on 11 March 2020 by the World Health Organization (WHO). The cases have been reported worldwide, infected more than 53 million individuals, and caused more than 1 million deaths by 15 November 2020 (WHO coronavirus disease (COVID-19)

dashboard, , 2020). Due to a lack of pharmacological interventions or vaccines, preventing infection is the best approach to contain the ongoing outbreak. During the first outbreak in Wuhan, China, the Chinese government imposed various measures to tackle transmission and prevent infection. Aside from lockdown policies implemented in Wuhan in late January and February, the Chinese Center for Disease Control and Prevention advises the public to continuously take precautionary measures including wearing facemasks and washing hands to reduce exposure to the virus. Facemask use and hand washing are efficacious in controlling respiratory infection. These two public health measures were found to be protective factors against spreading SARS in Hong Kong in 2004 (Lau et al., 2004). Regarding the current COVID-19 pandemic, facemask wearing is an effective way to reduce transmission risk (Chu et al., 2020). Given the cost-effectiveness of these two measures, they are the viable and pragmatic ways for the public to prevent infection. However, adherence to these measures varied (Clark et al., 2020). It is imperative to continuously engage individuals in preventive

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health behaviors to reduce infection rate and prevent further waves of COVID-19. Identifying underpinning determinants and mechanisms of these two behaviors are critical to inform effective behavioral interventions to promote adoption of and adherence to these preventive behaviors. The knowledge will also provide valuable insight in the mechanism of change in preventive health behaviors in a global pandemic such as COVID-19.

The health action process approach (HAPA) provides an effective social-cognitive framework to figure out determinants of health behaviors (Schwarzer, 2008). The HAPA distinguishes pre-intentional motivation phases under which people form their intentions, and post-intentional volition phases under which people are about to perform and maintain their behaviors. In the motivation phase, three belief-based variables predict intention: risk perception (perception of one's possibility of getting infected or having specific conditions), outcome expectancy (attitudes toward the benefit of conducting the health-protective behavior) and action self-efficacy (belief that one has the capacity to carry out the health behavior). Risk perception, which alone is not sufficient to form intention but supports further contemplation, is viewed as a distant antecedent to intention, while outcome expectancy and action self-efficacy are more proximal to forming intention. A recent meta-analysis on the HAPA revealed that action self-efficacy and outcome expectancy were strongest predictors of health behaviors (Zhang et al., 2019b).

In the volition phase, planning and action control are hypothesized to fill the gap between intention and behavior. Two kinds of planning are involved. They are action planning and coping planning. Action planning pertains to a mental simulation of when, where and how to enact a behavior, while coping planning helps a person to predict potential barriers to enact a behavior and adopt corresponding strategies. When goal-directed behaviors are initiated, action control—another self-regulatory strategy—helps to maintain behaviors through monitoring, evaluating against behavioral standard, and devoting efforts. This is particularly important for the behaviors requiring daily practice, such as hand washing (Reyes Fernández et al., 2016).

Few studies applied the HAPA to predict facemask wearing, possibly because facemask use is generally linked to medical usage and has limited role in daily life. Support for the HAPA to predict facemask wearing can be partly found in some studies utilizing other social-cognitive theories in previous pandemics such as severe acute respiratory syndrome (SARS) and influenza A/H1N1. For instance, in the health belief model, perceived susceptibility (like “risk perception”) and perceived benefits (similar to “outcome expectancies”) predicted facemask-wearing (Freeman et al., 2014; Tang & Wong, 2004). Under the theory of planned behavior (TPB), attitude (similar to “outcome expectancies”) and perceived behavioral control (overlapped with “self-efficacy”)

contributed to SARS-preventive behaviors (Cheng & Ng, 2006). A qualitative study based on TPB also confirmed the role of perceived susceptibility and seriousness of influenza A/H1N1 pandemic and perceived benefits and barriers in facilitating facemask wearing (Zhang et al., 2019a). However, these theories do not consider the “intention-behavior gap” and ignore the role of self-regulation, including planning and action control which are captured in the HAPA. The study by Zhou et al. (2016) examined facemask use to prevent air pollution under the HAPA. It was shown that self-efficacy and risk perception predicted behavioral intention, and planning and action control mediated intention and facemask use. Considering the predictiveness of the HAPA in health behaviors, it may broaden perspectives in identifying the determinants of facemask wearing in the COVID-19.

Regarding hand hygiene, researchers have applied the HAPA and other social-cognitive models, such as TPB, to explicate its determinants. Self-efficacy and outcome expectancies were found to predict intention to wash hands (Gaube et al., 2018; Reyes Fernández et al., 2016); intention, planning, action control and self-efficacy contributed to improving hand hygiene practices (Derksen et al., 2020; Zhou et al., 2015). Although the HAPA can explain and predict hand washing in both young adults in daily life and healthcare professionals in hospital settings, it remains unclear if the psychological determinants of health-protective hand hygiene practices under acute public pandemics like COVID-19 are the same as those in daily circumstances. Empirical research is needed to confirm the links. This is of particular relevance in places where people practiced daily hand hygiene poorly (Freeman et al., 2014), which made intervention to improve the compliance of hand washing during acute pandemics an urgency.

The HAPA model differed from the previous social cognition theories, such as the TPB, in terms of its implicit stage model assumption (Schwarzer, 2008). The TPB was a kind of continuum models which placed individuals along a range of likelihood of action, and predicted behaviors with a same set of variables across behavior adoption and maintenance in one prediction equation (Ajzen, 1991; Renner et al., 2012). In continuum models, intentions were the most important to health behaviors (Schwarzer, 2008). By contrast, the HAPA divided the process of behavioral change into two distinctive phases and assumed people evolved along time in dynamic processes, which was a typical feature of stage models (Renner et al., 2012; Velicer & Prochaska, 2008). In the HAPA model, phase-specific determinants predicted intention in motivational phase and behavior in volitional phase respectively. In terms of intervention, the implicit stage model could turn into an explicit one and support tailored interventions for non-intenders, intenders, and actors. This solved the problems inherent in “one-size-fits-all” interventions based on the continuum models. The adoption of a post-intentional phase also filled the gap between intentions and behaviors (Schwarzer,

2008). Therefore, the current study grounded in the HAPA and explored the determinants of health protection behaviors during a pandemic.

The current study aimed to identify determinants and mechanisms of wearing facemasks and washing hands among Chinese in the early stages of the COVID-19 pandemic using the HAPA. In our model, action self-efficacy, outcome expectancies and risk perception were proposed to predict intention to wear facemasks and wash hands at Time 1 respectively. Intention in turn was specified to predict planning and action control. Planning and action control, serving as mediators between intention and behavior, would predict hand washing and mask wearing at Time 2.

Method

Participants and Procedure

Data were collected from 30 January to 16 February 2020, when was the epidemic outbreak of COVID-19 in China. Residents in Hubei province, China were recruited via social media platforms to participate in a two-wave online survey with a time interval of one week. Participants were included if they were then resided in Hubei province. All participants provided informed consent before answering the survey on www.sojump.com. The survey took about ten minutes to complete. According to the Public Guidelines on Prevention and Control of COVID-19 promulgated by the National Health Commission of China, guidance of appropriate mask wearing and hand washing steps were presented before the respective parts of the survey. A sample of 253 participants then completed the survey concerning HAPA-related psychological variables regarding facemask wearing and hand washing (intention, action self-efficacy, coping self-efficacy, risk perception, outcome expectancy, planning, and action control) and demographic information at baseline (Time 1). They reported their facemask wearing and hand washing behaviors a week later (Time 2).

A total of 24 participants opted out at Time 2, resulting in 229 (90.51%) participants in the final analyses. Out of 229 participants, 88 (38.4%) were male and 141 (61.6%) were female; 52 (22.7%) stayed at Wuhan at the point this survey was conducted, while 177 (77.3%) lived in other cities in Hubei. The age of the final sample ranged from 13 to 53 years ($M = 25.37$; $SD = 8.34$). Participants who completed questionnaires at both time points were given 10 RMB (approximately \$1.5 USD) as an appreciation.

Materials

Measurements of facemask use and hand washing behaviors in this study were adapted from the Chinese scale of facemask

wearing and hand washing in prevention of air pollution and influenza (Zhou et al., 2015; Zhou et al., 2016) to the situation of COVID-19. These measures demonstrated good internal consistencies (Zhou et al., 2016). The original scales were adapted from Schwarzer (2008) and Snichotta et al. (2005) and were translated from English to Chinese and back-translated by bilingual psychology researchers. Scores in each scale were summed, with higher scores indicating greater levels in that construct.

Action Self-Efficacy Action self-efficacy of facemask wearing was assessed with four items ($\alpha = .88$) on a 5-point scale (1 = *not confident at all* to 5 = *very confident*). The participants answered the questions by supposing that they hardly wore facemask outside during the pandemic. A sample item was “In order to protect myself, I have confidence in starting to wear a medical surgical facemask or respirator even if they are expensive”. Cronbach’s alpha and McDonald’s omega were .88.

Three items measured action self-efficacy of hand washing on a scale from 1 (*not confident at all*) to 4 (*very confident*). The items began with “Suppose that you currently fail to meet the hand washing standards recommended by the NHC. Please answer the following questions.” One sample item was “During the epidemic of COVID-19, I have confidence in starting to wash my hands according to the guidelines of NHC even if it takes time”. Internal consistency was good (α and omega = .95).

Risk Perception Risk perception of facemask wearing was measured by two items on a scale from 1 (*extremely impossible*) to 5 (*extremely possible*). Participants rated their perceived risk of getting infected for oneself or their family members. A sample item was “During the epidemic of COVID-19, I will get infected if I don’t wear a medical or surgical facemask or respirator when I go out”. Spearman’s rho was .85.

Risk perception of hand washing were assessed by two items on a scale of 5 (1 = *extremely impossible* to 4 = *extremely possible*). A sample item was “During the epidemic of COVID-19, the risk of getting infected by coronavirus will be...if I don’t follow the guidelines of hand washing by NHC”. Spearman’s rho was .91.

Outcome Expectancy Outcome expectancy of facemask wearing was evaluated by three items on a 5-point scale (1 = *completely disagree* to 5 = *completely agree*). One sample item was “The risk of others getting infected by coronavirus will be decreased if I wear a medical or surgical facemask or respirator when I go out”. Cronbach’s alpha was .55 and McDonald’s omega was .56.

Outcome expectancy of hand washing was assessed by three items on a 4-point scale (1 = *completely disagree* to 4 = *completely agree*). One sample item was “I will be healthy

most of the time during the epidemic of COVID-19 if I wash my hands as the NHC suggested". Cronbach's alpha was .82 and omega was .83.

Intention Facemask wearing intention was assessed by a single item: "In the next week, I intend to put on a medical surgical mask or respirator if I must go out". Participants responded on a 5-point scale (1 = *completely disagree*, 5 = *completely agree*).

Hand washing intention was measured by the item: "In the next week, I intend to wash my hands with water and soap/hand sanitizer according to the suggestion of NHC", on a 5-point scale (1 = *completely disagree*, 5 = *completely agree*).

Planning Planning of facemask wearing was measured by three items on a scale from 1 (*completely disagree*) to 5 (*completely agree*). The aspects of planning included time and place to wear a mask, the proper way of wearing a mask, and sufficient reserve of masks. One sample item was "In the next week, I have made an explicit plan on when and where to put on a facemask". Cronbach's alpha was .73 and omega was .76.

Planning of hand washing was assessed by three items rated on a scale from 1 (*completely disagree*) to 4 (*completely agree*). An example item was "In the next week, I have made a detailed plan to deal with the lack of water or hand cleaners". Internal consistency was good ($\alpha = .87$ and $\omega = .88$).

Action Control The 3-item action control of facemask wearing evaluated self-monitoring ("I always remind myself to wear a facemask when I have to go out,") awareness ("I have consistent awareness of wearing a facemask when I have to go out,") and self-regulatory effort ("I tried not to forget to wear a facemask when I have to go out"). Responses were rated on a scale from 1 (*completely disagree*) to 5 (*completely agree*). Cronbach's alpha and McDonald's omega were .74.

Action control of hand washing measured two items which addressed self-monitoring and awareness, on a scale from 1 (*completely disagree*) to 4 (*completely agree*). A sample item is "In the past week, I put an effort to remind myself of washing hands regularly". Spearman's rho was .74.

Behaviors Facemask wearing was assessed by the item "In the past week, I wore medical surgical masks or respirators if I need to go out". Responses were rated on a 5-point scale (1 = *completely disagree* to 5 = *completely agree*) ($M = 4.65$, $SD = .78$).

Hand washing was measured by four items on a scale from 1 (*completely disagree*) to 5 (*completely agree*). The items assessed hand washing behavior suggested by the NHC. Scores of these items was summated as an indicator of hand washing behavior. A sample item was "In the past week, I

washed my hands every time after I cough or sneeze". The Cronbach's alpha is .76 with $M = 17.56$ and $SD = 2.89$.

Data Analysis

After listwise deletion of the drop-out participants, there were no missing values in the final sample of 229 individuals. First, independent-sample t tests, χ^2 tests, and multivariate analyses of variance (MANOVA) were conducted for attrition analysis of categorical variables and continuous variables by SPSS 24.0. Second, descriptive statistics and bivariate correlations were calculated between motivational and volitional variables (Time 1) and facemask wearing and hand washing behavior (Time 2) by SPSS 24.0. Third, confirmatory factor analysis was conducted to evaluate the goodness of fit of the measurement model using Mplus8.0. Structural equation modeling (SEM) was performed using Mplus 8.0 to evaluate the overall models and sequential mediating effect of planning (Time 1) and action control (Time 1) between intention (Time 1) and subsequent facemask wearing (Time 2) and hand washing behavior (Time 2) respectively. Standardized coefficients, goodness-of-fit indices and bootstrapped 95% CIs for indirect effects based on 5000 resamples were calculated. The goodness of fit of the model was assessed by multiple indices: Chi-Square/degree of freedom ratio (χ^2/df), comparative fit index (CFI), Tucker-Lewis fit index (TLI), root mean squared error of approximation (RMSEA) and standardized root mean square residual (SRMR). The model was considered a good fit if $\chi^2/df < 3$, CFI and TLI ≥ 0.95 , RMSEA ≤ 0.06 , and SRMR ≤ 0.08 (Hu & Bentler, 1999).

Results

Attrition Analyses

Participants who dropped out at Time 2 did not differ from those who completed the study at two time points in terms of age, gender, education, and total knowledge of facemask and hand-washing (all $ps > .1$). Participants who dropped out were made up of more minorities ($\chi^2(1) = 93.43$, $p < .001$) and more residents in Wuhan instead of other cities in Hubei ($\chi^2(1) = 6.21$, $p = .01$) than those who retained. Multivariate analyses of variance showed that participants who dropped out were not significantly different from those who retained on the motivational and volitional factors in terms of facemask wearing (Wilks' Lambda = 0.986, $F(6) = 0.581$, $p = .745$, partial $\eta^2 = 0.014$), and on the factors expect risk perception in terms of handwashing (Wilks' Lambda = 0.963, $F(5) = 1.887$, $p = .097$, partial $\eta^2 = 0.037$). Participants who dropped out had significantly higher level of risk perception of

handwashing than individuals who completed the survey ($F(1) = .515, p = .02, \text{partial } \eta^2 = 0.022$).

Confirmatory Factor Analysis

Five-factor models (action self-efficacy, risk perception, outcome expectancy, planning, and action control) were analyzed for both facemask wearing and hand washing to evaluate the quality of fit of the proposed measurement model. The measurement models all yielded a good fit: $\chi^2(80) = 136.84, p < .001, \chi^2/df = 1.71, CFI = .96, TLI = .95, (RMSEA = .056, 90\% \text{ confidence interval (CI)} = [0.039, 0.071])$ for the model of facemask wearing; and $\chi^2(55) = 107.99, p < .001, \chi^2/df = 1.96, CFI = .98, TLI = .97, RMSEA = .065, 90\% \text{ CI} = [0.047, 0.083]$ for the model of hand washing. The good fit of the models indicated that the items had reflected the five proposed constructs.

Preliminary Analyses

Table 1 presents demographic information of the sample. Correlational analysis was conducted to test associations between HAPA-based variables (Time 1) and health behaviors (Time 2). Facemask wearing at Time 2 was positively associated with risk perception, action self-efficacy, intention, planning and action control assessed at Time 1 (r range = 0.14–0.26, $ps < .05$). Hand washing behavior has significant positive associations with most of the motivational and volitional variables (r range = 0.16–0.33, $ps < .01$), except for planning. Table 2 shows descriptive and correlational statistics of the variables.

Structural Equation Models

A power analysis was conducted to test the structural model with an alpha of .05, degrees of freedom of 109 for facemask wearing and 80 for hand washing, a sample size of 229, null RMSEA of .00 and alternative RMSEA of .06 (Preacher & Coffman, 2006). Results indicated that power greater than .99 was achieved. Structural equation model showed adequate goodness-of-fit indices for both facemask wearing ($\chi^2(109) = 200.88, p < .001, \chi^2/df = 1.84, CFI = .941, TLI = .926, SRMR = .084, RMSEA = .061, 90\% \text{ CI} [0.047, 0.074]$) and hand washing behavior ($\chi^2(80) = 184.88, p < .001, \chi^2/df = 2.70, CFI = .954, TLI = .940, SRMR = .084, RMSEA = .076, 90\% \text{ CI} [0.061, 0.090]$). The model accounted for 17% of variance in intention and 17% of variance in facemask wearing. Regarding hand washing, the model accounted for 41% of variance in intention and 16% of that in behavior. Standardized coefficients are displayed in Fig. 1. Action self-efficacy significantly predicted intentions to wear facemasks and to wash hands, while outcome expectancy and risk perception failed to predict intention. Intention and action

Table 1 Demographic Characteristics ($N = 229$)

| | N (M) | % (SD) |
|------------------------|-------|--------|
| Age | 25.37 | 8.34 |
| Gender | | |
| Male | 88 | 38.40 |
| Female | 141 | 61.60 |
| Ethnicity | | |
| Han | 30 | 22.90 |
| Minority | 25 | 19.08 |
| Current Location | | |
| Wuhan | 52 | 22.70 |
| Hubei | 177 | 77.30 |
| Educational Attainment | | |
| Primary | 1 | .40 |
| Junior | 4 | 1.70 |
| High School | 60 | 26.20 |
| College | 12 | 5.20 |
| Bachelor | 101 | 44.10 |
| Master | 44 | 19.20 |
| Doctor | 7 | 3.10 |
| Employment Status | | |
| No | 155 | 67.70 |
| Part-time | 5 | 2.20 |
| Full-time | 67 | 29.30 |
| Retired | 2 | .90 |
| Marital Status | | |
| Single | 183 | 79.9 |
| Married | 43 | 18.8 |
| Separated | 1 | .40 |
| Divorced | 2 | .90 |

control predicted facemask wearing and hand washing at Time 2, while the effect of planning was mixed for the two behaviors. Planning significantly predicts hand washing but failed to predict the performance of facemask wearing. Mediation analyses revealed that intention had significant direct effect on wearing facemasks (95% CI [0.09, 0.40]) and washing hands (95% CI [0.10, 0.38]). Intention also had significant indirect effect on facemask wearing and hand washing through action control (90% CI [0.01, 0.12], 95% CI [0.01, 0.21], respectively). No mediation effect of planning was found between intention and the two behaviors. Table 3 presents the decomposition of the effects of intention on facemask wearing and hand washing.

Discussion

The aim of the present study was to identify potential determinants of two health-protective behaviors, hand washing and

Table 2 Correlation Matrix of Study Variables (N = 229)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | M | SD |
|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 1. Risk perception (T1) | – | .19** | .38** | .34** | .38** | .12 | .16** | 5.19 | 1.93 |
| 2. Outcome expectancy (T1) | .12 | – | .53** | .41** | .55** | .19** | .26** | 10.64 | 1.54 |
| 3. Action self-efficacy (T1) | .22** | .26** | – | .62** | .72** | .21** | .22** | 10.55 | 1.85 |
| 4. Intention (T1) | .16* | .21** | .35** | – | .14** | .54** | .33** | 4.63 | .62 |
| 5. Planning (T1) | .20** | .40** | .16** | .30** | – | .21** | -.09 | 10.22 | 1.97 |
| 6. Action control (T1) | .20** | .24** | .28** | .30** | .32** | – | .28** | 15.00 | 3.41 |
| 7. Behavior (T2) | .16* | .09 | .21** | .14* | .20** | .26** | – | 16.62 | 3.25 |
| M | 8.20 | 12.82 | 18.11 | 4.77 | 17.81 | 14.40 | 4.39 | | |
| SD | 1.75 | 1.72 | 2.79 | .76 | 2.60 | 1.25 | 1.06 | | |

Note. T1 = Time 1; T2 = Time 2. Intercorrelations for facemask wearing are presented below the diagonal. Intercorrelations for hand washing are presented above the diagonal. Means and standard deviations for hand washing are presented in the vertical columns. Means and standard deviations for mask wearing are presented in the horizontal rows

* $p < .05$. ** $p < .01$

facemask wearing, in the early stages of the COVID-19 pandemic based on the HAPA. Consistent with the HAPA predictions, action self-efficacy had a significant direct effect on intention for both behaviors; intention and action control had significant direct effects on hand washing and facemask wearing, while planning was a significant determinant only for hand washing. Further, intention had a significant indirect effect on both behaviors mediated by action control. The results supported the motivational and volitional processes in enacting health-protective behaviors in COVID-19.

In the motivation phase, action self-efficacy was a stable predictor of intention for both behaviors, which concurred with the previous studies indicating self-efficacy played a prominent role in health-related behavior, such as social distancing and hand hygiene during COVID-19 (Derksen et al., 2020; Hamilton et al., 2020). Outcome expectancies didn't predict intentions as expected. The results were also consistent with other studies conducted during COVID-19, indicating

attitudes towards benefits of behaviors failed to predict intention (Derksen et al., 2020; Hamilton et al., 2020). The nonsignificant effect of outcome expectancy was also observed in a study of facemask use to prevent air pollution (Zhou et al., 2016). What's more, the effect of risk perception on intention also fell short of statistical significance, in line with the previous findings on hand hygiene during the pandemic (Derksen et al., 2020). A recent meta-analysis also found a limited role of risk perception in changing behaviors (Zhang et al., 2019b). After the outbreak of COVID-19, the government and media made great efforts in persuading the importance of facemask wearing and hand washing in reducing virus transmission. Individuals in China, especially in Wuhan, paid much attention to the preventive information, were well aware of the threat and gained generally high outcome expectancies. The results from the motivational processes suggested that awareness of a known threat and perceived positive outcomes from protective behaviors would be less likely to translate into

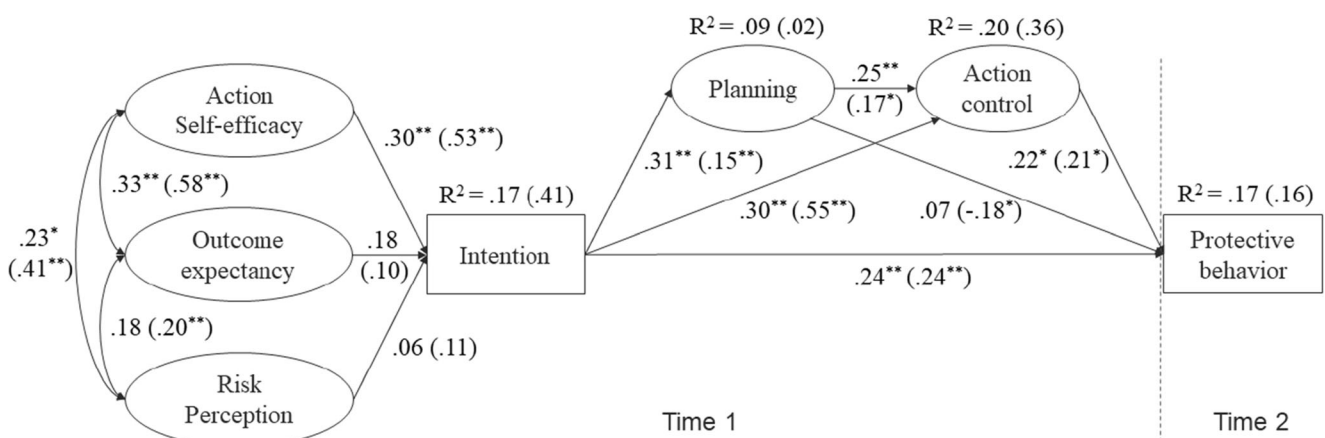


Fig. 1 Facemask wearing and hand washing behavior during COVID-19 in the Health and Action Process Approach (HAPA). Coefficients for hand washing behavior are displayed in brackets. Latent variables are

represented by circles and observed variables by rectangles. Standard solution (N = 229). Estimates are standardized coefficients. * $p < .05$. ** $p < .01$.

Table 3 Decomposition of the Effect of Intention on Facemask Wearing and Hand Washing At Time 2. (N = 229)

| | Facemask wearing | | Hand washing | |
|-----------------------------|------------------------|-------------------------|------------------------|---------------|
| | Standardized estimates | 95% CI | Standardized estimates | 95% CI |
| Total effect | .35 | [0.20, 0.49] | .33 | [0.23, 0.43] |
| Total indirect effect | .10 | [0.02, 0.18] | .09 | [-0.01, 0.19] |
| | | Indirect effect through | | |
| Planning | .02 | [-0.03, 0.07] | -.03 | [-0.06, 0.00] |
| Action control | .06 | [-0.00, 0.13] | .11 | [0.01, 0.21] |
| Planning and action control | .02 | [-0.01, 0.04] | .01 | [-0.00, 0.01] |
| Direct effect | .24 | [0.09, 0.40] | .24 | [0.10, 0.38] |

Note. CI = confidence interval

intentions to carry out protective behaviors unless high self-efficacy was present. Mere risk perception might generate avoidance, denial or other maladaptive coping behaviors and steer individuals away from protection behaviors. In addition, not only a belief that protection behaviors were effective to reduce risks was necessary, a belief in one's capabilities to perform these behaviors was pivotal. It was found that self-efficacy was more important than fear appeals for engaging protective behaviors during the pandemic, such that it itself constituted a pathway to compliance (Jørgensen et al., 2021). The current study demonstrated the different effects of the motivational determinants during the COVID-19 pandemic.

In the volition phase, intention and action control have significant positive effects on behaviors, aligned with previous studies. Intention was a strong predictor of health behaviors based on classic social cognition theories, such as the theory of planned behavior (McEachan et al., 2011). Action control exerted a greater influence on behaviors than planning and self-efficacy, as demonstrated by previous studies (Scholz et al., 2009). Action control also mediated the relationship between intention and facemask wearing and hand washing, serving as the most proximal factor to health behaviors, which was also observed in another study of hand washing (Reyes Fernández et al., 2016).

However, we found planning only predicted hand washing, and didn't mediate the relationship between intentions and both behaviors. The results failed to verify the role of planning in bridging intention-behavior gap (Schwarzer, 2008), which may be accounted for by two reasons. First, the context of a public health emergency may explain the lack of effect of planning as a mediating process. The severe outbreak in Hubei province in January 2020 demanded immediate responses at all levels. The central government of China imposed a lockdown in Wuhan to contain the outbreak. The

Wuhan city government also implemented other stringent public health interventions including mandating individuals to wear masks in public places. Besides, the government strongly called on the public to maintain personal hygiene by wearing masks and washing hands. Thus, these measures were not an individual voluntary act which depended on planning and choice, rather, it was perceived as a compulsory and essential measure that have to be immediately enforced by every individual. Subjective norms and social pressure may be influential enough to promote the transition from intention to behavior enactment (Zhang et al., 2020), bypassing the volitional factor of planning. Take facemask wearing as an example, facemask use was ubiquitous on the street and any noncompliance would be viewed as deviance and negligence of public interest. Individuals might feel obliged to wear facemasks to avoid social pressure. Therefore, subjective norms and social pressure might be accountable in enacting these behaviors (Lin et al., 2020). Meanwhile, these norms might provide overt on-site cues for individuals to continuously be self-aware, self-monitor and self-regulate, which were important components of action control, their health behaviors. Taken together, this could explain why action control was a significant mediator while planning was not. Future research may elucidate the relationship between social norm and action control on health behaviors.

Another possible reason was that these two behaviors might not require a detailed plan. Compared to other health behaviors like dietary behaviors, facemask wearing and hand washing take one to two steps such that extensive plans of implementation seem unnecessary. The effect of planning in the HAPA may be better applied in behaviors which entail longer processes of change and behaviors which requires more complex steps. Besides, as noted above, individuals were mostly required to wear facemasks in public places.

People were well prepared to wear facemasks accordingly, regardless of when and where. This was supported by the high scores of planning found in the study. Therefore, future research may systematically examine the determinants of different health-protection behaviors at different contexts.

The present study extends knowledge on the applicability of the HAPA model to understand protective behaviors in a global pandemic. The HAPA model has been applied across behaviors, including physical activity (Luszczynska et al., 2010) dietary management, sunscreen use (Schüz et al., 2016), dental flossing (Schwarzer et al., 2007), vaccination uptake (Payaprom et al., 2011) and smoking (Radtke et al., 2012). These studies assessed health behaviors that do not proximally incur risk on one's health. Whereas hand washing and facemask use have been examined as daily hygiene practice and pollution prevention in the general population (Reyes Fernández et al., 2016; Zhou et al., 2016), these two behaviors were considered instrumental to reduce infection risk of COVID-19. Thus, the present study provided unique insights into the mechanisms of facemask use and hand washing in a pandemic. One of the strengths of the HAPA model was that it included planning and action control to bridge motivational and volitional factors of behaviors (Schwarzer, 2008). The findings have several implications for public health interventions designed for enhancing facemask use and hand washing. First, compared with educating the public about the risk of infection, enhancing action self-efficacy could facilitate intention to engage in health behavior. Campaigns have to be empowering so that individuals feel motivated to change. This was supported by a longitudinal intervention for hand washing which found that the module increasing self-efficacy was more effective in improving hand washing frequencies than modules targeting risk perception and outcome expectancies (Lhakang et al., 2015). Second, instructing individuals on action control strategies is a promising way to promote behavior change. Mobile health intervention might be useful means to prompt individuals perform health behaviors. These self-regulation-based interventions effectively improved other health behaviors (Poppe et al., 2019; Rollo & Prapavessis, 2020). Future research can confirm the potential of these interventions in promoting facemask wearing and hand washing.

The study has some limitations. First, the data was collected during when individuals were likely to have already engage in facemask wearing and hand washing. Besides, participants self-reported their behaviors. Response might be affected by recall bias and social desirability. However, the anonymity of the survey suggested that participants might be more likely to report truthful answers. To minimize recall bias, future studies

might utilize ecological momentary assessment to capture individuals' health behaviors in real time and in natural settings. In addition, the measure for outcome expectancy of facemask use had poor internal consistency. Item analysis revealed that the item regarding decreased infection risk if masks are worn had lower mean and lower item-total correlations than those of the other items. It was likely that the multiple transmission modes of the COVID-19 virus affected participants' perceived outcome expectancy of wearing a mask, resulting in a lower internal consistency of outcome expectancy of facemask use. Future studies should further validate the measurements.

Conclusions

In sum, the present study applied the HAPA to evaluate motivational and volitional processes of facemask wearing and hand washing during the COVID-19 pandemic. The results support the model in general, and highlight the importance of action self-efficacy in predicting intention and action control in mediating effects of intention on health protection behaviors. The findings inform future public health interventions aimed at improving adoption and adherence of these behaviors.

Authors' Contributions Guangyu Zhou, Nan Zhao and Mengke Gou contributed to the study conception and design. Material preparation and data collection were performed by Nan Zhao and Mengke Gou. Data analysis were performed by Mengke Gou, Xinyi Li and Chao Kei Lao. The first draft of the manuscript was written by Chao Kei Lao and Xinyi Li, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data Availability The datasets, syntax and outcome files generated during and/or analysed during the current study are available in the Open Science Framework repository, https://osf.io/9enfr/?view_only=972e87f9a6634d07a0ba980aeb6f1508

Declarations

Conflict of Interest The authors have no conflicts of interest to declare that are relevant to the content of this article.

Ethics Approval The research was approved by the Institutional Review Board of Peking University.

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Consent to Publication Participants all consented to submitting findings for publishing purposes.

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