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Predictors of changing patterns of adherence to containment measures during the early stage of COVID-19 pandemic: an international longitudinal study

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Abstract

Background Identifying common factors that affect public adherence to COVID-19 containment measures can directly inform the development of official public health communication strategies. The present international longitudinal study aimed to examine whether prosociality, together with other theoretically derived motivating factors (self-efficacy, perceived susceptibility and severity of COVID-19, perceived social support) predict the change in adherence to COVID-19 containment strategies.

Method In wave 1 of data collection, adults from eight geographical regions completed online surveys beginning in April 2020, and wave 2 began in June and ended in September 2020. Hypothesized predictors included prosociality, self-efficacy in following COVID-19 containment measures, perceived susceptibility to COVID-19, perceived severity of COVID-19 and perceived social support. Baseline covariates included age, sex, history of COVID-19 infection and geographical regions. Participants who reported adhering to specific containment measures, including physical distancing, avoidance of non-essential travel and hand hygiene, were classified as adherence. The dependent variable was the category of adherence, which was constructed based on changes in adherence across the survey period and included four categories: non-adherence, less adherence, greater adherence and sustained adherence (which was designated as the reference category).

Results In total, 2189 adult participants (82% female, 57.2% aged 31–59 years) from East Asia (217 [9.7%]), West Asia (246 [11.2%]), North and South America (131 [6.0%]), Northern Europe (600 [27.4%]), Western Europe (322 [14.7%]), Southern Europe (433 [19.8%]), Eastern Europe (148 [6.8%]) and other regions (96 [4.4%]) were analyzed. Adjusted

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multinomial logistic regression analyses showed that prosociality, self-efficacy, perceived susceptibility and severity of COVID-19 were significant factors affecting adherence. Participants with greater self-efficacy at wave 1 were less likely to become non-adherence at wave 2 by 26% (adjusted odds ratio [aOR], 0.74; 95% CI, 0.71 to 0.77; $P < .001$), while those with greater prosociality at wave 1 were less likely to become less adherence at wave 2 by 23% (aOR, 0.77; 95% CI, 0.75 to 0.79; $P = .04$).

Conclusions This study provides evidence that in addition to emphasizing the potential severity of COVID-19 and the potential susceptibility to contact with the virus, fostering self-efficacy in following containment strategies and prosociality appears to be a viable public health education or communication strategy to combat COVID-19.

Keywords Prosociality, Coronavirus, Adherence, Disease containment measures, Longitudinal study

Introduction

Since the outbreak of coronavirus disease (COVID-19) in 2019, government leaders worldwide have used various measures to contain its spread, such as physical distancing, avoiding large gatherings, wearing masks and frequent hand washing [1]. Research has been conducted to assess the impact of these containment measures [2]. For instance, cancelling small gatherings has been found to decrease the effective reproduction number of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (R_t) by up to 83% [3]; while self-isolation, household quarantine and manual contact tracing can reduce COVID-19 transmission up to 64% [4].

Public adherence to disease containment measures remains crucial for controlling the spread of COVID-19. However, such adherence varies depending on the types of measures required to be complied with, the intensities of governmental enforcement measures and is influenced by the interplay of demographic, political, and sociocultural factors [5–7]. In a longitudinal study conducted between March and December 2020 involving 238,797 participants from 14 countries, adherence to lower-cost and habituating behaviors (e.g., mask-wearing in crowded areas) was found to increase progressively over time [8], while adherence to high-cost, sensitizing behaviors (e.g., physical distancing, avoiding crowds) gradually decreased due to pandemic fatigue (i.e., overall tiredness or demotivation to follow recommended protective behaviors) and reduced risk perception of COVID-19 [8].

Psychological factors that influence adherence to COVID-19 related protective behaviors have been recently examined in several theoretical frameworks [6]. The Health Belief Model [9], the Social Cognitive Theory[10], the Reasoned Action Approach [11] and the Health Action Process Approach are theories centered around self-motivation that have been increasingly adopted in COVID-19-related research [12, 13]. These theories suggest that increased self-efficacy, stronger perceived susceptibility to COVID-19 infection and better treatment outcome expectancies are associated with increased adherence to disease containment measures [6], while lack of social support is identified as a behavioral barrier to adherence [13]. The Capability, Opportunity and Motivation Behavior (COM-B) model is another theoretical model that has been used in recent literature related to COVID-19 [14–16], suggesting that changing an individual's behavior to combat COVID-19 can be affected by (1) capabilities, which are the relevant knowledge and skills to engage in that particular behavior; (2) opportunities, referring to resources, cultural norms and/or social support and cues to facilitate the execution of the behavior; and (3) motivation to drive behavioral change [15]. In our previous international surveys, we adopted the Leventhal's Common-Sense Model of Self-Regulation and found that risk perceptions of COVID-19 could shape adherence to containment measures, mediated by less avoidance-based coping and better self-efficacy in disease prevention and management [17, 18].

The literature has undergone extensive expansion in recent years regarding the investigation of factors that determine adherence to COVID-19 containment measures. A review of 29 studies conducted in western countries suggests that people who are female, older, have higher socioeconomic status, trust in government or health authorities, trust in science or medicine and access information from traditional media sources are more likely to adhere to COVID-19 related containment measures [19]. This may be partly due to the increased concern about their own health risks held among these groups [5, 7, 20, 21]. Fear and perceived personal threat of COVID-19 can also improve adherence [22], but both could also lead to anxiety and avoidance behaviors that may lead to lower adherence [23, 24]. Cultural norms and practices (e.g., cultures that prioritize collectivism over individualism may be more likely to adhere to measures that benefit the group as a whole) [25], communication-related factors (e.g., clarity, effectiveness, reach of communication campaigns, channels and methods used to disseminate relevant COVID-19 information) may also shape attitudes and behaviors in response to various containment measures [26].

In view of the communal nature of the COVID-19 pandemic, there has been a call to explore the role of prosociality in the context of curbing the spread of COVID-19. Prosociality refers to an attitude or a set of voluntary actions that an individual may adopt to help, care for, or comfort others [27]. As suggested by the Social Identity Theory [28], the sense of belonging, identity and prosociality would often increase within a group in supporting one another if group members perceive themselves as facing crises [29]. Prosociality requires people to think and act collectively with kindness, cooperation and sensitivity to others' welfare (e.g., protect others from COVID-19). It has recently been considered as an important target of public health interventions to promote adherence to disease containment measures [30–33], adopting mobile applications for contact tracing [34] and vaccine uptake [35, 36]. However, the association between prosociality and adherence or uptake of COVID-19-related measures has only been demonstrated in single-center, cross-sectional and correlational studies [32–34, 36, 37], in which changing patterns of adherence behaviors have been neglected. Indeed, variations in moral obligations, cultural values, social norms and public leaderships across regions may affect the degree to which individuals prioritize the well-being of others over their own self-interests [38, 39]. Furthermore, differences in the severity and prevalence of COVID-19 across regions may impact individuals' perceived needs for adherence to related containment measures. Therefore, in this longitudinal study involving an international sample of participants, we aimed to examine whether prosociality, along with other known self-focused motivating factors such as self-efficacy, perceived susceptibility and severity of COVID-19, and perceived social support, can predict changes in adherence to COVID-19 containment measures during the first year of the pandemic. This study will also take into account other demographic factors and the status of COVID-19.

Methods

Design and study participants

The study was part of the international COVID-IMPACT survey, which aimed to examine the psychological and behavioral responses of the public to COVID-19 and its related containment measures [18, 30, 40, 41]. Between April and June 2020, the first wave of the survey (wave 1) was administered to a sample of adults aged 18 years or older who were able to read at least one of the following languages: English, Chinese, Spanish, French, German, Turkish, Portuguese, Italian, Dutch, Polish, Romanian, Greek, Hungarian, Persian, Finnish, Slovenian, Latvian, and Montenegrin. These individuals were recruited from 51 countries across the globe through various means, such as press outlets (e.g., newspapers, newsletters, radio stations), social media platforms, professional groups' mailing lists, and networks, as well as mass mailings from participating universities. No exclusion criteria for participation were set. Those who volunteered to participate in the study were invited to provide their informed consent electronically and complete a 20-min survey on a secure online platform. Upon completion, the participants were directed to another secured platform to indicate whether they would like to be contacted for follow-up data collection and to provide their email addresses. If agreed, they were recontacted between August and September 2020 for the second wave of the survey (wave 2). Since the time spent to administer each survey was approximately less than 20 min, no compensation was provided. The study received ethics approval from the Cyprus National Bioethics Committee (ref.: EEBK E* 2020.01.60) and by the local ethics boards whose research team members were involved in collecting data. Our reporting followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines [42].

Measures

Adherence to COVID-19 containment measures

In both wave 1 and wave 2 of the survey, participants were asked to rate their level of adherence to (1) physical distancing, (2) self-isolation, avoidance of non-essential travel, and (3) hand hygiene during the pandemic, with response options ranging from '1' for non-adherence to '10' for fully adherence. Participants who responded '7 = mostly adherent' or higher for all three items were considered as adherence. The following explanatory variables were assessed at wave 1:

Self-efficacy

Five items (response: '1' = strongly disagree to '7' = strongly agree) based on Bandura's self-efficacy theory were adopted to measure whether the participants perceived themselves as competent in following the COVID-19 containment measures. An example item is "I have the skills to get through this difficult situation", with a higher total score indicating better self-efficacy [17].

Perceived susceptibility and severity

Six items (response: '1' = strongly disagree to '6' = strongly agree) based on the Health Belief Model were used to assess the participants' overall illness perceptions toward COVID-19, with higher total scores indicating stronger perceptions. One example item assessing perceived susceptibility is "I am concerned about the risk of getting the COVID-19", while an example item assessing perceived severity was "My life will change if I get infected by COVID-19" [43].

Prosociality

Six items (response: '1' = never to '5' = always) adapted from the Prosocialness Scale for Adults were used to assess six different prosocial behaviors during the COVID-19 pandemic, such as sharing, helping, taking care of others and showing empathy. Example items are 'I try to help others' and 'I am empathic with those in need'. A higher total score indicates greater prosocial motivation [44].

Perceived social support

Three items of the Oslo Social Support Scale were used to assess the availability of social support by asking the number of people that were closed to the participant (response: '1' = none to '4' = more than 5 people), the extent of interest and concern that people show in what the participants did (response: '1' = none to '5' = a lot) and the possibility of getting practical help from neighbors (response: '1' = very difficult to '5' = very easy). A higher total score indicates better social support [45].

The psychometric properties of the aforementioned measures have been stated in our previous publications [18, 30, 40, 41], with acceptable internal consistencies across study regions (Cronbach's alphas = 0.76 to 0.85) and satisfactory construct validity ($rs = 0.68$ to 0.82) to their corresponding validation measures [18, 30, 40, 41]. Details of the measures appear in Supplementary Table 1.

Sociodemographic variables

The following sociodemographic variables were assessed at wave 1, including sex (male/ female), age in years (18–30/ 31–59/ ≥ 60), educational level (higher school or below/ college or university/ postgraduate or above/ others), marital status (single/ in a relationship or engaged/ married/ others), having children (yes/no), employment status (working as full-time/ part-time/ unemployed/ parental leave/ retired), working as a healthcare professional (yes/no), as well as the personal, partner and the significant others' history of COVID-19 infection (yes/ unsure/ no). Geographical region was also included, following the recommended classifications given by the Population Division of the Department of Economic and Social Affairs of the United Nation (East Asia/ West Asia/ North and South America/ Northern Europe/ Western Europe/ Southern Europe/ Eastern Europe or others) [46]. Details of the countries involved in these regions appear in Supplementary Table 2.

Statistical analysis

To assess changes of adherence to COVID-19 containment measures in the two waves of surveys, the participants were classified into four types of adherence groups, including (1) the 'non-adherence group', which referred to those who scored less than seven on all three question items assessing adherence to COVID-19 containment measures in both waves of surveys; (2) the 'less adherence group', which referred to those who showed a reduced number of question items with scores equal to or larger than seven in wave 2 when compared to wave 1; (3) the 'sustained adherence group', referring to those reported scores greater than seven on all three question item in both waves of surveys; and (4) the 'greater adherence group', referring to those who had an increase number of question items with scores equal to or greater than seven in wave 2 when compared to wave 1. Subsequently, descriptive data on sociodemographic characteristics of the participants and outcome measures were computed and summarized. Univariate analyses, such as one-way analysis of variance (ANOVA) and chi-square test, were conducted to examine whether the means or distributions of proportions of explanatory variables differed significantly across the four adherence groups. Multinomial logistic regression was conducted to examine whether those plausible factors, including prosociality, self-efficacy, perceived susceptibility and severity of COVID-19 and perceived social support, were associated with the change in adherence to COVID-19 containment measures. This analysis was adjusted for covariates (region, sex, age and history of COVID-19 infection) that showed significant differences in the distributions of proportions of their corresponding attributes across the four adherence groups. Results of regression analyses were reported as odds ratio (OR) with 95% confidence interval (CI). All statistical tests conducted in IBM SPSS 26.0 (IBM Corp, Armonk: NY, USA) were considered significant at P-value < 0.05, two-sided.

Results

Sample characteristics

Among the 9565 participants who completed wave 1 of the survey, 8948 participants (93.5%) agreed to be recontacted. Of these, 2189 (24.4%) were successfully re-contacted to provide the follow-up data. The participants (82% female, 57.2% aged 31–59 years) were from East Asia (217 [9.7%]), West Asia (246 [11.2%]), North and South America (131 [6.0%]), Northern Europe (600 [27.4%]), Western Europe (322 [14.7%]), Southern Europe (433 [19.8%]), Eastern Europe (148 [6.8%]) and other regions (96 [4.4%]). The participants mainly had a postgraduate degree (1058 [48.3%]), were married (821 [37.5%]), had children (902 [58.8%]), worked full-time (1235 [56.4%] and less than one-fifth (374 [17.4]) were health care professionals. Almost half of the participants (1206 [55.1%]) sustained adherence in both waves of surveys. We conducted wave 1 of the survey in April 2020 and therefore less than one-tenth of respondents (28

[1.3%]), their partners (24 [1.1%]) and significant others (136 [6.2%]) were infected with COVID-19. Compared to the other three adherence groups, the sustained adherence group (1206 [55.1%]) reported the highest scores in the self-efficacy of following the COVID-19 containment measures ($M = 26.21$), perceived susceptibility ($M = 9.14$) and perceived severity of COVID-19 ($M = 13.21$), as well as prosociality ($M = 22.87$), respectively (see Table 1).

Predictors of changing patterns of adherence to COVID-19 containment measures

The multinomial logistic regression model was statistically significant ($\chi 2$ (51) = 379.41, $P < .001$), with a total variance of 28.1% explained (Nagelkerke R^2) and correctly classifying 69.5% of cases. Two sociodemographic covariates, which were sex and history of COVID-19 infection, were predictive of adherence. Taking the 'sustained adherence group' as a reference group, male (adjusted odds ratio [aOR], 2.34; 95% CI 1.64 to 3.35; $P < .001$), those who were infected with COVID-19 or had COVID-19 symptoms at wave 1 were more likely to become non-adherence at wave 2 (aOR, 2.37, 95% CI 1.55 to 3.63; $P < .001$). Self-efficacy (aOR = 0.74, 95% CI 0.71 to 0.77; $P < .001$), perceived susceptibility (aOR = 0.93, 95% CI 0.88 to 0.99; $P = 0.02$), perceived severity (aOR = 0.90, 95% CI 0.85 to 0.94; $P < .001$), and prosociality (aOR = 0.85, 95% CI 0.81 to 0.89; $P = .008$) measured at wave 1 were significant factors in lowering the risk of becoming non-adherence at wave 2. Similarly, self-efficacy (aOR = 0.93, 95% CI 0.91 to 0.96; $P < .001$), perceived susceptibility (aOR = 0.96, 95% CI 0.93 to 1.00; $P = .04$), perceived severity (aOR = 0.96, 95% CI 0.93 to 0.99; $P = .02$), and prosociality (aOR = 0.77, 95% CI 0.75 to 0.79; $P = .04$) measured at wave 1 were significant factors in lowering the risk of becoming less adherence at wave 2. Notably, attaining better self-efficacy at wave 1 reduced the likelihood of being non-adherence at wave 2 by 26% (aOR = 0.74), while being more prosocial at wave 1 reduced the likelihood of becoming less adherence at wave 2 by 23% (aOR = 0.77, see Table 2).

Discussion

The current study investigated the changes of adherence in COVID-19 containment measures in a large convenience sample of adults from eight geographical regions between April and September 2020 in which the early stage of COVID-19 pandemic occurred. Half of the respondents fully adhered to the suggested strategies, such as physical distancing, self-isolation, and hand hygiene, at six months follow-up after the baseline. Across all the groups in accordance with the patterns of adherence behaviors, the odds of not adhering to all strategies increased at least twice if the participants were male and infected with COVID-19. Indeed, the differences in sex and COVID-19 status affecting adherence to COVID-19 containment measures have been discussed in the literature [47–50], in which lower levels of perceived threats of illness and adherence among males are considered as important factors explaining the increased rates of COVID-19 related morbidity and mortality compared to women [47–50]. Our findings are also consistent with the existing body of knowledge supporting that various sociodemographic factors, such as older age [50], caregivers of elderly or children and working as part-time or retired, could affect adherence [5, 51].

Self-efficacy, perceived susceptibility and severity of COVID-19 were found to be the significant factors in lowering the risks of becoming non-adherence and less adherence to COVID-19 containment measures at follow-up. Interestingly, we found that self-efficacy attained a larger reduction in the risk of being non-adherent than that of perceived susceptibility and severity, suggesting that an individual's belief that one can carry out and adhere to COVID-19 containment measures is more important than one's beliefs about the severity of COVID-19 or the risk of getting infected [52]. Indeed, the Health Action Process Approach also indicates that self-efficacy is the proximal determinant for developing an intention to change behavior, while risk perception is considered a distal determinant [12].

Our adjusted analysis showed that prosociality contributed significant reductions in the risks of becoming non-adherence and less adherence to COVID-19 containment measures at follow-up (i.e., 15% and 23%, respectively). COVID-19 containment measures (e.g., vaccinations and social distancing) have been recently discussed as global public good where people can 'free-ride' on others: receiving social benefits from others (e.g., reduced risk of infection as others follow the rules) without paying for the costs (e.g., continue dining out) [53]. Hence, promoting adherence to COVID-19 containment measures has been recently framed as a prosocial act. The extant literature has identified a number of contributors that shape the prosocial motivations in the face of collective action problems (e.g., public health crises like COVID-19), including personality traits, individual values, core political values, empathy and sympathy toward individuals vulnerable to the problem [22, 54]. Our findings further extend the understanding of prosociality, in which its protective role on non-adherence still remains and even exerts a stronger, longitudinal effect when simultaneously compared to that of self-efficacy in spite of the heterogeneity of the participants' characteristics across study regions.

We found that perceived social support did not affect the patterns of adherence to the COVID-19 containment

Table 1 Characteristics of the participants by level of adherence to COVID-19 containment measures

Characteristics	All (*N* = 2189)	Non-adherence group (*n* = 219)	Less adherence group (*n* = 674)	Sustained adherence group (*n* = 1206)	Greater adherence group (*n* = 90)	χ^2 *or F(df)/*	*P* value
Region[a], No. (%)							
East Asia	213 (9.7)	21 (9.6)	27 (4.0)	148 (12.3)	17 (18.9)	145 (21)	< .001
West Asia	246 (11.2)	32 (14.6)	81 (12.0)	128 (10.6)	5 (5.6)		
North and South America	131 (6.0)	7 (3.2)	20 (3.0)	93 (7.7)	11 (12.2)		
Northern Europe	600 (27.4)	44 (20.1)	179 (26.6)	356 (29.5)	21 (23.3)		
Western Europe	322 (14.7)	47 (21.5)	135 (20.0)	123 (10.2)	17 (18.9)		
Southern Europe	433 (19.8)	36 (16.4)	131 (19.4)	253 (21.0)	13 (14.4)		
Eastern Europe	148 (6.8)	22 (10.0)	69 (10.2)	56 (4.6)	1 (1.1)		
Others	96 (4.4)	10 (4.6)	32 (4.7)	49 (4.1)	5 (5.6)		
Sex, No. (%)							
Male	394 (18.0)	70 (32.0)	108 (16.0)	191 (15.8)	25 (27.8)	40.37 (3)	< .001
Female	1795 (82.0)	149 (68.0)	566 (84.0)	1015 (84.2)	65 (72.2)		
Age in years, No. (%)							
Young adults (18–30 years)	782 (35.7)	99 (45.2)	243 (36.1)	407 (33.7)	33 (36.7)	17.02 (6)	.009
Middle-aged (31–59 years)	1253 (57.2)	111 (50.7)	394 (58.5)	699 (58.0)	49 (54.4)		
Older adults (≥ 60 years)	154 (7.0)	9 (4.1)	37 (5.5)	100 (8.3)	8 (8.9)		
Educational level, No. (%)							
Higher school or below	212 (9.7)	30 (13.7)	68 (10.1)	107 (8.9)	7 (7.8)	10.77 (9)	.29
College or university	884 (40.4)	92 (42.0)	262 (38.9)	495 (41.9)	35 (38.9)		
Postgraduate or above	1058 (48.3)	91 (41.6)	332 (49.3)	588 (48.8)	47 (52.2)		
Others	35 (1.6)	6 (2.7)	12 (1.8)	16 (1.3)	1 (1.1)		
Marital status, No. (%)							
Single	657 (30.0)	83 (37.9)	192 (28.5)	354 (29.4)	28 (31.1)	10.44 (9)	.32
In a relationship/ engaged	556 (25.4)	57 (26.0)	169 (25.1)	307 (25.5)	23 (25.6)		
Married	821 (37.5)	67 (30.6)	259 (38.4)	463 (38.4)	32 (35.6)		
Others (divorced/widowed/separated)	155 (7.1)	12 (5.5)	54 (8.0)	82 (6.8)	7 (7.8)		
Having children, No. (%)							
Yes	902 (41.2)	74 (33.8)	274 (40.7)	516 (42.8)	38 (42.2)	6.34 (3)	.10
No	1287 (58.8)	145 (66.2)	400 (59.3)	690 (57.2)	52 (57.8)		
Employment status, No. (%)							
Full-time	1235 (56.4)	127 (58.0)	374 (55.5)	683 (56.6)	51 (56.6)	16.99 (12)	.15
Part-time	363 (16.6)	29 (13.2)	123 (18.2)	196 (16.3)	15 (16.7)		
Unemployed	442 (20.2)	50 (22.8)	133 (19.7)	237 (19.7)	22 (24.4)		
Parental leave	50 (2.3)	9 (4.1)	16 (2.4)	25 (2.1)	0 (0.0)		
Retired	99 (4.5)	4 (1.8)	28 (4.2)	65 (5.4)	2 (2.2)		
Working as health care professionals[b], No. (%)							
Yes	374 (17.4)	39 (17.9)	125 (18.9)	193 (16.3)	17 (19.1)	2.25 (3)	.52
No	1780 (82.6)	179 (82.1)	537 (81.1)	992 (83.7)	72 (80.9)		
Have you been infected by COVID-19?, No. (%)							
Yes	28 (1.3)	7 (3.2)	9 (1.3)	11 (0.9)	1 (1.1)	32.29 (6)	< .001
I am not sure but I have symptoms	234 (10.7)	40 (18.3)	85 (12.6)	99 (8.2)	10 (11.1)		
No	1927 (88.0)	172 (78.5)	580 (86.1)	1096 (90.9)	79 (87.8)		
Have your partner been infected by COVID-19?, No. (%)						9.53 (6)	.15
Yes	24 (1.1)	4 (1.9)	6 (0.9)	13 (1.1)	1 (1.1)		

Table 1 (continued)

Characteristics	All (*N* = 2189)	Non-adherence group (*n* = 219)	Less adherence group (*n* = 674)	Sustained adherence group (*n* = 1206)	Greater adherence group (*n* = 90)	χ^2 *or F(df)/*	*P* value
I am not sure but I have symptoms	149 (6.9)	21 (9.7)	55 (8.2)	70 (5.9)	3 (3.4)		
No	1990 (92.0)	191 (88.4)	608 (90.9)	1107 (93.0)	84 (95.5)		
Has your significant others being infected by COVID-19, No. (%)						6.46 (6)	.37
Yes	136 (6.2)	12 (5.5)	46 (6.8)	70 (5.8)	8 (8.9)		
I am not sure but I have symptoms	196 (9.0)	24 (11.0)	69 (10.2)	95 (7.9)	8 (8.9)		
No	1857 (84.8)	183 (83.6)	559 (82.9)	1041 (86.3)	74 (82.2)		
Self-efficacy, mean (SD)	25.69 (3.69)	23.67 (4.89)	25.56 (3.64)	26.21 (3.26)	24.58 (4.11)	34.50 (3)	< .001
Perceived susceptibility, mean (SD)	8.75 (3.45)	7.83 (3.57)	8.40 (3.36)	9.14 (3.43)	8.50 (3.39)	13.03 (3)	< .001
Perceived severity, mean (SD)	12.63 (3.71)	10.98 (3.97)	12.07 (3.66)	13.21 (3.56)	13.07 (3.51)	30.97 (3)	< .001
Prosociality, mean (SD)	22.66 (4.08)	21.87 (4.27)	22.66 (3.99)	22.87 (4.07)	22.00 (4.14)	4.63 (3)	.004
Perceived social support, mean (SD)	9.81 (2.12)	9.50 (2.19)	9.99 (2.08)	9.79 (2.11)	9.53 (2.33)	3.83 (3)	.012

[a] In this study, East Asia included Hong Kong; West Asia included Cyprus and Turkey; Northern and Southern America included Colombia and the United States; Northern Europe included The United Kingdom, Finland, Ireland and Latvia; Western Europe included Switzerland, Germany, Austria and France; Southern Europe included Greece, Spain, Italy, Portugal and Montenegro; Eastern Europe included Poland, Romania and Hungary

[b] 1.6% missing data

measures. This finding is contrast with those of recent studies indicating that individuals who perceive more social support from their friends can influence their health behaviors either positively or negatively, due to social norms or peer pressure [55, 56]. Of note, as a result of social distancing measures (e.g., lockdowns, work-from-home arrangements) implemented during the survey period, it was more difficult for individuals to interact socially and/or gather, which explained the relatively low perceived level of social support.

Study strengths and limitations

Our findings were based on an international, geographically diverse sample and the timing of data collection was within one month after the World Health Organization declared COVID-19 as a pandemic. In addition, we classified the participants into subgroups in accordance with their different patterns of adherence. The understanding of the predictors and covariates in each subgroup provides future directions for tailoring public health programs or messages in promoting adherence to COVID-19 containment measures.

It is important to consider the limitations of our study when interpreting the results. Our study was conducted in two phases, and the assumption of linearity of associations between variables limits the scope of a more advanced longitudinal analysis, which considers time effect as an additional covariate. In order to better examine the effect of changes in health-related perception variables on adherence behaviors over time, future research could employ latent growth curve modelling analysis to evaluate the trajectory of change in both independent and dependent variables. This analytical approach allows for the modeling of within-person and between-person variability in the data, thus providing a more comprehensive understanding of the relationship between the variables over time [57, 58]. While the instruments used in our study were found to have satisfactory psychometric properties in terms of validity and reliability, we did not conduct a multiple-group factor analysis alignment to further examine the measurement equivalence or invariance of these instruments across different cultural or linguistic groups [59]. Implementing this method could have strengthened the cross-cultural validity of our study and ensured that our findings could be applied to a broader population.

Our assessment of adherence to COVID-19 containment measures deserves attention. The first wave of our survey was conducted in April 2020, during the early stage of the pandemic when there was a lack of consensus among global political and public health leaders on the necessity of wearing masks in community settings [60, 61]. Misinformation regarding the utility of masks, potential adverse effects, and severe shortages

Table 2 Results of the multinomial logistic regression investigating predictors of changing patterns of adherence of COVID-19 containment measures

	Non-adherence group (*N* = 219)			Less adherence group (*N* = 674)			Greater adherence group (*N* = 90)		
	aOR	95% CI	*P* value	aOR	95% CI	*P* value	aOR	95% CI	*P* value
Region[a]									
East Asia	1.05	0.42–2.63	.91	0.32	0.17–0.60	< .001	1.18	0.39–3.52	.77
West Asia	1.96	0.82–4.73	.13	1.11	0.65–1.92	.70	0.53	0.14–1.08	.34
North and South America	0.58	0.19–1.76	.34	0.39	0.20–0.76	.005	1.39	0.45–4.35	.58
Northern Europe	0.84	0.37–1.93	.69	0.81	0.50–1.33	.41	0.64	0.22–1.81	.40
Western Europe	2.34	1.01–5.42	.05	1.66	0.99–2.78	.06	1.47	0.50–4.30	.48
Southern Europe	1.38	0.59–3.21	.46	0.92	0.56–1.53	.75	0.62	0.21–1.85	.39
Eastern Europe	2.44	0.97–6.16	.06	1.98	1.11–3.54	.02	0.21	0.02–1.92	.17
Others	[Reference]			[Reference]			[Reference]		
Sex									
Male	2.34	1.64–3.35	< .001	1.02	0.77–1.34	.92	1.84	0.98–3.08	.05
Female	[Reference]			[Reference]			[Reference]		
Age in years									
Young adults (18–30 years)	1.44	0.67–3.13	.35	1.30	0.83–2.01	.25	.746	0.31–1.78	.51
Middle-aged (31–59 years)	1.02	0.48–2.17	.96	1.21	0.80–1.84	.36	.745	0.33–1.69	.48
Older adults (≥ 60 years)	[Reference]			[Reference]			[Reference]		
Infected by COVID-19									
Yes/ have symptoms	2.37	1.55–3.63	< .001	1.35	0.99–1.84	.06	1.31	0.66–2.60	.44
No symptoms	[Reference]			[Reference]			[Reference]		
Motivating factors									
Self-efficacy	0.74	0.71–0.77	< .001	0.93	0.91–0.96	< .001	0.88	0.84–1.05	.05
Perceived susceptibility	0.93	0.88–0.99	.02	0.96	0.93–1.00	.04	0.94	0.87–1.01	.10
Perceived severity	0.90	0.85–0.94	< .001	0.96	0.93–0.99	.02	1.00	0.92–1.07	.90
Prosociality	0.85	0.81–0.89	.008	0.77	0.75–0.79	.04	0.97	0.92–1.03	.31
Perceived social support	1.00	0.93–1.09	.95	1.028	0.98–1.08	.32	1.01	0.90–1.14	.82

[a] In this study, East Asia included Hong Kong; West Asia included Cyprus and Turkey; Northern and Southern America included Colombia and the United States; Northern Europe included The United Kingdom, Finland, Ireland and Latvia; Western Europe included Switzerland, Germany, Austria and France; Southern Europe included Greece, Spain, Italy, Portugal and Montenegro; Eastern Europe included Poland, Romania and Hungary

Reference category for the dependent variable is the sustained adherence group (*N* = 1206)

of medical resources, including medical masks, further complicated the situation [60, 61]. As a result, universal adoption of mask wearing was not achieved [62], and we did not collect data on participants' adherence to this measure over time. For future studies investigating adherence patterns to various containment measures during outbreaks of infectious diseases, assessing adherence to proper face mask wearing is highly recommended to gain a more comprehensive understanding of adherence behaviors. As the assessments were based on self-reports, which were regarded as the best capture of how people early responded to the rapid-changing nature of COVID-19. Nevertheless, objective measurement of adherence to health behaviors are often preferable and less susceptible to response biases. The use of tracking technologies such as mobile apps, wearable devices, or location tracking tools may also potentially provide a more accurate understanding of real-time adherence behaviors [63].

It is noteworthy that the regression analysis included key sociodemographic and health-related perception variables based on Bandura's self-efficacy theory, the Social Cognitive Theory, and the Health Belief Model, which achieved a correct classification rate of up to 69.5%. However, other contextual or social determinants of adherence to containment measures could be considered in future research, such as place of living, housing quality, political polarization and inclinations, trust in government and scientific evidence, susceptibility to misinformation, as well as health or e-health literacy levels [64, 65]. Additionally, regional differences in adherence to COVID-19 containment measures may be attributed to a variety of factors, cultural disparities, access to healthcare and information, socioeconomic status,

and government policies, as well as initial perceptions and response to COVID-19. However, in view of the small sample size in some regions (e.g., East Asia, Eastern Europe and other regions, each was less than 10% of the total samples), subgroup analysis was not feasible in our study. While we adjust for geographic region in our regression analysis to account for potential regional differences in adherence, the aforementioned factors warrant further investigation in future studies. Finally, over 80% of the participants were female and the survey was conducted via online which may limit the generalizability of our findings to other populations. Further research with more diverse samples is needed to confirm our results and to better understand the impact of personal factors on adherence to COVID-19 and other related infection prevention measures.

Conclusions

Our investigations remind that across regions and cultures, some inner qualities of a human being, such as acting prosocially through helping and supporting for the benefit of others and perceived competence in executing behaviors can affect individuals in taking small steps to contain the COVID-19 spread. Pandemic-specific public health communication and behavioral intervention efforts should possess qualities of prosociality as a powerful altruistic motivator for better adherence to COVID-19 containment measures, alongside with the support of scientific evidence, social norm and consensus which increase an individual's self-efficacy [66, 67]. Deontological messages highlighting the importance of societal and communal benefits (e.g., protect others) rather than the benefit to oneself (e.g., protect yourself) in times of public health crisis may be especially effective for people to engage in health policy-relevant behaviors.

Abbreviations

ANOVA	Analysis of variance
aOR	Adjusted odds ratio
COVID-19	Coronavirus disease 2019
MD	Mean difference

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12992-023-00928-7.

Additional file 1: Supplementary Table 1. Measures used in the COVID-IMPACT study.

Additional file 2: Supplementary Table 2. Number of the participants involved in the study from each country and geographical region.

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Authors' contributions

YYC, APK, MK and AG conceived and contributed for planning and data collection. YYC performed the statistical analyses and drafted the manuscript. APK, MK and AG contributed for preparation and critical review of the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by the Cyprus National Bioethics Committee (ΕΕΒΚ ΕΠ 2020.01.60), the Survey and Behavioral Research Ethics Committee, The Chinese University of Hong Kong (Reference Number: SBRE-19–593) as well as the corresponding ethic committees of the universities or governmental institutions of the participating countries. Each study participant read the consent form along with a plain language summary indicating the nature of the study and its related study procedures and ticked their consent in the online form prior to accessing the study questionnaire.

Consent for publication

Not applicable. The survey was anonymous for all participants.

Competing interests

All authors declare no conflict of interest.

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References

1. Pincombe M, Reese V, Dolan CB. The effectiveness of national-level containment and closure policies across income levels during the COVID-19 pandemic: an analysis of 113 countries. Health Policy Plan. 2021;36(7):1152–62.
2. Wibbens PD, Koo WWY, McGahan AM. Which COVID policies are most effective? A Bayesian analysis of COVID-19 by jurisdiction. PLoS One. 2021;15(12):e0244177.
3. Haug N, Geyrhofer L, Londei A, Dervic E, Desvars-Larrive A, Loreto V, Pinior B, Thurner S, Klimek P. Ranking the effectiveness of worldwide COVID-19 government interventions. Nat Hum Behav. 2020;4(12):1303–12.
4. Kucharski AJ, Klepac P, Conlan AJK, Kissler SM, Tang ML, Fry H, Gog JR, Edmunds WJ. Effectiveness of isolation, testing, contact tracing, and physical distancing on reducing transmission of SARS-CoV-2 in different settings: a mathematical modelling study. Lancet Infect Dis. 2020;20(10):1151–60.
5. Coroiu A, Moran C, Campbell T, Geller AC. Barriers and facilitators of adherence to social distancing recommendations during COVID- 19 among a large international sample of adults. PLoS One. 2020;15(10):e0239795.
6. Dixon D, Den Daas C, Hubbard G, Johnston M. Using behavioural theory to understand adherence to behaviours that reduce transmission of COVID-19; evidence from the CHARIS representative national study. Br J Health Psychol. 2022;27(1):116–35.
7. Margraf J, Brailovskaia J, Schneider S. Behavioral measures to fight COVID-19: an 8-country study of perceived usefulness, adherence and their predictors. PLoS One. 2020;15(12):e0243523.
8. Petherick A, Goldszmidt R, Andrade EB, Furst R, Hale T, Pott A, Wood A. A worldwide assessment of changes in adherence to COVID-19 protective behaviours and hypothesized pandemic fatigue. Nat Hum Behav. 2021;5(9):1145–60.
9. Al-Sabbagh MQ, Al-Ani A, Mafrachi B, Siyam A, Isleem U, Massad FI, Alsabbagh Q, Abufaraj M. Predictors of adherence with home quarantine during COVID-19 crisis: the case of health belief model. Psychol Health Med. 2022;27(1):215–27.
10. Lin C-Y, Imani V, Majd NR, Ghasemi Z, Griffiths MD, Hamilton K, Hagger MS, Pakpour AH. Using an integrated social cognition model to predict COVID-19 preventive behaviours. Br J Health Psychol. 2020;25(4):981–1005.
11. Lueck JA, Spiers A. Which beliefs predict intention to get vaccinated against COVID-19? A mixed-methods reasoned action approach applied to health communication. J Health Commun. 2020;25(10):790–8.
12. Lao CK, Li X, Zhao N, Gou M, Zhou G. Using the health action process approach to predict facemask use and hand washing in the early stages of the COVID-19 pandemic in China. Curr Psychol. 2021;17:1–10.
13. Beeckman M, De Paepe A, Van Alboom M, Maes S, Wauters A, Baert F, Kissi A, Veirman E, Van Ryckeghem DML, Poppe L. Adherence to the physical distancing measures during the COVID-19 pandemic: a HAPA-based perspective. Appl Psychol Health Well Being. 2020;12(4):1224–43.
14. Gibson Miller J, Hartman TK, Levita L, Martinez AP, Mason L, McBride O, McKay R, Murphy J, Shevlin M, Stocks TVA, et al. Capability, opportunity, and motivation to enact hygienic practices in the early stages of the COVID-19 outbreak in the United Kingdom. Br J Health Psychol. 2020;25(4):856–64.
15. West R, Michie S, Rubin GJ, Amlôt R. Applying principles of behaviour change to reduce SARS-CoV-2 transmission. Nat Hum Behav. 2020;4(5):451–9.
16. Liu S, Liu J. Understanding behavioral intentions toward COVID-19 vaccines: theory-based content analysis of tweets. J Med Internet Res. 2021;23(5):e28118.
17. Chong YY, Chien WT, Cheng HY, Chow KM, Kassianos A, Karekla M, Gloster A. The role of illness perceptions, coping and self-efficacy on adherence to precautionary measures for COVID-19. Int J Environ Res Public Health. 2020;17:6540.
18. Chong YY, Chien WT, Cheng HY, Lamnisos D, Ļubenko J, Presti G, Squatrito V, Constantinou M, Nicolaou C, Papacostas S, et al. Patterns of psychological responses among the public during the early phase of COVID-19: a cross-regional analysis. Int J Environ Res Public Health. 2021;18(8):4143.
19. Moran C, Campbell DJ, Campbell TS, Roach P, Bourassa L, Collins Z, Stasiewicz M, McLane P. Predictors of attitudes and adherence to COVID-19 public health guidelines in Western countries: a rapid review of the emerging literature. J Public Health. 2021;43(4):739–53.
20. Szczuka Z, Abraham C, Baban A, Brooks S, Cipolletta S, Danso E, Dombrowski SU, Gan Y, Gaspar T, de Matos MG, et al. The trajectory of COVID-19 pandemic and handwashing adherence: findings from 14 countries. BMC Public Health. 2021;21(1):1791.
21. Georgieva I, Lantta T, Lickiewicz J, Pekara J, Wikman S, Loseviča M, Raveesh BN, Mihai A, Lepping P. Perceived effectiveness, restrictiveness, and compliance with containment measures against the Covid-19 pandemic: an international comparative study in 11 countries. Int J Environ Res Public Health. 2021;18(7):3806.
22. Morstead T, Zheng J, Sin NL, King DB, DeLongis A. Adherence to recommended preventive behaviors during the COVID-19 pandemic: the role of empathy and perceived health threat. Ann Behav Med. 2021;56(4):381–92.
23 Alimoradi Z, Ohayon MM, Griffiths MD, Lin CY, Pakpour AH. Fear of COVID-19 and its association with mental health-related factors: systematic review and meta-analysis. BJPsych Open. 2022;8(2):e73.
24. Ahorsu DK, Lin CY, Imani V, Saffari M, Griffiths MD, Pakpour AH. The fear of COVID-19 Scale: development and initial validation. Int J Mental Health Addict. 2022;20(3):1537–45.
25 Maaravi Y, Levy A, Gur T, Confino D, Segal S. "The Tragedy of the Commons": how individualism and collectivism affected the spread of the COVID-19 pandemic. Front Public Health. 2021;9:627559.
26. Ratcliff CL, Wicke R, Harvill B. Communicating uncertainty to the public during the COVID-19 pandemic: a scoping review of the literature. Ann Int Commun Assoc. 2022;46(2):1–30.
27. Raposa EB, Laws HB, Ansell EB. Prosocial behavior mitigates the negative effects of stress in everyday life. Clin Psychol Sci. 2016;4(4):691–8.
28. Tajfel H, Turner JC. The social identity theory of intergroup behavior. Polit Psychol: Psychology Press; 2004. p. 276–93.
29. Zagefka H. Prosociality during COVID-19: globally focussed solidarity brings greater benefits than nationally focussed solidarity. J Community Appl Soc Psychol. 2022;32(1):73–86.
30. Haller E, Lubenko J, Presti G, Squatrito V, Constantinou M, Nicolaou C, Papacostas S, Aydın G, Chong YY, Chien WT, et al. To help or not to help? prosocial behavior, its association with well-being, and predictors of prosocial behavior during the coronavirus disease pandemic. Front Psychol. 2022;12:775032.
31. Syropoulos S, Markowitz EM. Prosocial responses to COVID-19: examining the role of gratitude, fairness and legacy motives. Pers Individ Dif. 2021;171:110488.
32 Nelson-Coffey SK, O'Brien MM, Braunstein BM, Mickelson KD, Ha T. Health behavior adherence and emotional adjustment during the COVID-19 pandemic in a US nationally representative sample: the roles of prosocial motivation and gratitude. Soc Sci Med. 2021;284:114243.
33. Heffner J, Vives M-L, FeldmanHall O. Emotional responses to prosocial messages increase willingness to self-isolate during the COVID-19 pandemic. Pers Individ Dif. 2020;170:110420.
34. Shoji M, Ito A, Cato S, Iida T, Ishida K, Katsumata H, McElwain KM. Prosociality and the uptake of COVID-19 contact tracing apps: survey analysis of intergenerational differences in Japan. JMIR Mhealth Uhealth. 2021;9(8):e29923.
35 Oleksy T, Wnuk A, Gambin M, Łyś A, Bargiel-Matusiewicz K, Pisula E. Barriers and facilitators of willingness to vaccinate against COVID-19: role of prosociality, authoritarianism and conspiracy mentality. A four-wave longitudinal study. Pers Individ Dif. 2022;190:111524.
36. Enea V, Eisenbeck N, Carreno DF, Douglas KM, Sutton RM, Agostini M, Bélanger JJ, Gützkow B, Kreienkamp J, Abakoumkin G et al. Intentions to be vaccinated against COVID-19: the role of prosociality and conspiracy

beliefs across 20 countries. Health Commun. 2022:1–10 [Epub online ahead of print].
37. West TN, Le Nguyen K, Zhou J, Prinzing MM, Wells JL, Fredrickson BL. How the affective quality of social connections may contribute to public health: prosocial tendencies account for the links between positivity resonance and behaviors that reduce the spread of COVID-19. Affect Sci. 2021;2(3):241–61.
38. Gherghel C, Nastas D, Hashimoto T, Takai J, Cargile AC. Culture, morality, and the effect of prosocial behavior motivation on positive affect. Ethic Behav. 2020;30(2):126–49.
39. Yang L, Ren Y. Moral obligation, public leadership, and collective action for epidemic prevention and control: evidence from the coronavirus disease 2019 (COVID-19) emergency. Int J Environ Res Public Health. 2020;17(8):2731.
40. Chong YY, Chien WT, Cheng HY, Kassianos AP, Gloster A, Karekla M. Can psychological flexibility and prosociality mitigate illness perceptions toward COVID-19 on mental health? A cross-sectional study among Hong Kong adults. Global Health. 2021;17:43.
41. Gloster AT, Lamnisos D, Lubenko J, Presti G, Squatrito V, Constantinou M, Nicolaou C, Papacostas S, Aydin G, Chong YY, et al. Impact of COVID-19 pandemic on mental health: an international study. PLoS One. 2020;15(12):e0244809.
42. Vandenbroucke JP, von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, Poole C, Schlesselman JJ, Egger M. for the SI. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. PLoS Med. 2007;4(10):e297.
43. Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the health belief model. Health Educ Q. 1988;15(2):175–83.
44. Caprara GV, Steca P, Zelli A, Capanna C. A new scale for measuring adults' prosocialness. Eur J Psychol Assess. 2005;21(2):77–89.
45. Dalgard OS, Dowrick C, Lehtinen V, Vazquez-Barquero JL, Casey P, Wilkinson G, Ayuso-Mateos JL, Page H, Dunn G. Negative life events, social support and gender difference in depression. Soc Psychiatry Psychiatr Epidemiol. 2006;41(6):444–51.
46. United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects 2019, Volume II: Demographic Profiles (ST/ESA/SER.A/427). 2019. https://population.un.org/wpp/Publications/Files/WPP2019_Volume-II-Demographic-Profiles.pdf. Accessed on 4 March 2023.
47. Urbán R, Király O, Demetrovics Z. Who complies with coronavirus disease 2019 precautions and who does not? Curr Opin Psychiatry. 2021;34(4):363–8.
48. Noone C, Warner NZ, Byrne M, Durand H, Lavoie KL, McGuire BE, McSharry J, Meade O, Morrissey E, Molloy GJ. A scoping review of research on the determinants of adherence to social distancing measures during the COVID-19 pandemic. Health Psychol Rev. 2021;15(3):350–70.
49. Carvalho LdF, Machado GM. Differences in adherence to COVID-19 pandemic containment measures: psychopathy traits, empathy, and sex. Trends Psychiatry Psychother. 2020;42:389–92.
50. Lin T, Harris EA, Heemskerk A, Van Bavel JJ, Ebner NC. A multi-national test on self-reported compliance with COVID-19 public health measures: the role of individual age and gender demographics and countries' developmental status. Soc Sci Med. 2021;286:114335.
51. Howe MM, Feldman EC, Lampert SL, Kenney AE, Davies W, Greenley RN. Caregiver perceptions of importance of COVID-19 preventative health guidelines and difficulty following guidelines are associated with child adherence rates. Fam Syst Health. 2021;39(4):632–7.
52. Luszczynska A, Szczuka Z, Abraham C, Baban A, Brooks S, Cipolletta S, Danso E, Dombrowski SU, Gan Y, Gaspar T, et al. The interplay between strictness of policies and individuals' self-regulatory efforts: associations with handwashing during the COVID-19 Pandemic. Ann Behav Med. 2021;56(4):368–80.
53. Cato S, Iida T, Ishida K, Ito A, McElwain KM, Shoji M. Social distancing as a public good under the COVID-19 pandemic. Public Health. 2020;188:51–3.
54. Politi E, Van Assche J, Caprara GV, Phalet K. No man is an island: psychological underpinnings of prosociality in the midst of the COVID-19 outbreak. Pers Individ Dif. 2021;171:110534.
55. Ellis WE, Dumas TM, Hutchinson LR, Talebi S. Staying safe or staying popular? Popularity and reputation concerns predict adherence and adjustment during the COVID-19 pandemic. Youth Soc. 2022:0044118X221074383 [Epub online ahead of print].
56. Andrews JL, Foulkes L, Blakemore S-J. Peer influence in adolescence: public-health implications for COVID-19. Trends Cogn Sci. 2020;24(8):585–7.
57. Wright L, Steptoe A, Fancourt D. Patterns of compliance with COVID-19 preventive behaviours: a latent class analysis of 20 000 UK adults. J Epidemiol Community Health. 2022;76(3):247–53.
58. Sharma M, Mindermann S, Rogers-Smith C, Leech G, Snodin B, Ahuja J, Sandbrink JB, Monrad JT, Altman G, Dhaliwal G. Understanding the effectiveness of government interventions against the resurgence of COVID-19 in Europe. Nat Commun. 2021;12(1):5820.
59. Muthén B, Asparouhov T. Recent methods for the study of measurement invariance with many groups: alignment and random effects. Soc Method Res. 2018;47(4):637–64.
60. Chan KH, Yuen KY. COVID-19 epidemic: disentangling the re-emerging controversy about medical facemasks from an epidemiological perspective. Int J Epidemiol. 2020;49(4):1063–6.
61. Romer D, Jamieson KH. Conspiracy theories as barriers to controlling the spread of COVID-19 in the US. Soc Sci Med. 2020;263:113356.
62. Alwan NA, Burgess RA, Ashworth S, Beale R, Bhadelia N, Bogaert D, et al. Scientific consensus on the COVID-19 pandemic: we need to act now. Lancet. 2020;396(10260):e71–2.
63. Budd J, Miller BS, Manning EM, Lampos V, Zhuang M, Edelstein M, Rees G, Emery VC, Stevens MM, Keegan N, et al. Digital technologies in the public-health response to COVID-19. Nat Med. 2020;26(8):1183–92.
64. Constantinou M, Gloster AT, Karekla M. I won't comply because it is a hoax: conspiracy beliefs, lockdown compliance, and the importance of psychological flexibility. J Contextual Behav Sci. 2021;20:46–51.
65. Chong YY, Cheng HY, Chan HYL, Chien WT, Wong SYS. COVID-19 pandemic, infodemic and the role of eHealth literacy. Int J Nurs Stud. 2020;108:103644.
66. Bonell C, Michie S, Reicher S, West R, Bear L, Yardley L, Curtis V, Amlôt R, Rubin GJ. Harnessing behavioural science in public health campaigns to maintain "social distancing" in response to the COVID-19 pandemic: key principles. J Epidemiol Community Health. 2020;74(8):617–9.
67. Gloster AT, Rinner MTB, Meyer AH. Increasing prosocial behavior and decreasing selfishness in the lab and everyday life. Sci Rep. 2020;10(1):21220.

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