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Research article

Risk perception, compliance with COVID-19 measures, and the role of social media after China's lockdown lift

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ABSTRACT

Introduction: Few studies have investigated people's reactions after a sudden lift. The transitional experiences of Chinese people at the end of 2022 serve as a valuable reference for pandemic management. Therefore, this study investigates Chinese people's perception of risks after the lifting, the influence of risk perception on their compliance with COVID-19 measures, and the moderating effect of social media on this influence.

Methods: Initially, using a random sampling approach, we carried out an online questionnaire survey through Questionnaire Star, an online questionnaire platform. 417 (304 females, 13–64 years old) participants responded to questions on their perception of risks, compliance with COVID-19 measures, and trust in social media. Then, in the follow-up experiment, we observed another 60 (30 females, 18–22 years old) participants' actual behaviors to see how they comply with COVID-19 measures (for the peak of the confirmed cases, we chose to make do with this small size). We also asked them to complete a paper questionnaire on risk perception and trust in social media.

Results: The initial survey indicated that, after the lifting, Chinese citizens perceived high risks (they reported a possibility of 61.04 out of 100 to be infected and threatened by COVID-19. The number was 54 in a previous study), showed a low degree of adherence to COVID-19 measures (on a scale of 1–5, they reported a score of 2.04 in private, and 1.89 in public), and social media positively moderated the relationship between risk perception and adherence ($\Delta R^2 = 0.10$, $p < .01$ for private behavior; $\Delta R^2 = 0.13$, $p < .01$ for public behavior). The follow-up experiment further confirmed these findings.

Conclusion: This study suggests that, when lifting lockdowns on a national scale, the government should inform the public about the risks accurately, encourage healthy behaviors, and make full use of social media to promote adherence to COVID-19 measures. By using a hybrid approach that combines a questionnaire survey with actual behavior observation, this study expands earlier research into the understudied context of lockdown lifts. Finding effective strategies to support individuals through the transition period can facilitate global pandemic management.

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1. Introduction

1.1. Research background

As one of the most contagious diseases in human history [1], COVID-19 has had catastrophic effects on the entire world [2]. In response, governments worldwide imposed various lockdowns to prevent the rapid spread of the virus [3]. Many studies have identified severe impacts of lockdowns on society, such as tourism reduction [4], entrepreneurial shutdown [5], education interruption [6,7], and the like. As a result, many governments decided to lift lockdowns to boost the morale and economy of their respective nations. Nevertheless, few studies have been concerned with this transition period. In this pandemic era, finding effective strategies to support individuals throughout the crisis can facilitate global pandemic control.

For the serious situations at home and abroad, China never lifted the severe restrictions across the nation. However, the Chinese government announced the lifting of the lockdown for the entire nation on December 6th, 2022, following a careful assessment of the virus' infectiousness and the medical supplies in hospitals and pharmacies. The next day, the "New Ten Rules" was released to further optimize the prevention and control measures for COVID-19 after the lift. From 0:00 on December 13th, 2022, the app that tracked people's movements officially went offline, and PCR tests were no longer required to go anywhere. Facing this extraordinary shift from protection to freedom, how might Chinese people react? How would they perceive the risks? How would their risk perception affect the adherence to COVID-19 measures? What helps them deal with the transition successfully? How much would social media help, as suggested by previous studies [1,8–10] that a positive attitude to social media promoted health measures? The present study aims to find answers to these questions.

1.2. The present study

Previous studies found that risk perception conditions human behavior [11,12]. For behaviors in private, when participants perceive an uncontrollable risk, they are more likely to choose an unhealthy lifestyle [13,14]. Regarding behaviors in public, risk perception is a significant predictor of the adoption of suggested prevention measures [15]. It seems that people behave differently in private and in public. Under risk, although people tend to choose unhealthy behaviors in private, they seem to be cautious with healthy measures in public [13–15]. As a result, there is still a necessity to investigate how risk perception affects behavior in general. Moreover, a positive attitude to social media positively moderates the relationship between risk perception and public protective behaviors [1,9,10,16], but whether this finding applies to private behaviors has received no discussion, so this needs to be investigated as well. Finally, nearly all the existing studies are set in the context of lockdowns. Can these findings still hold after the lifting of the lockdowns? The control of the pandemic is equally important after the lift. This poses the need to expand the research context into lockdown lift. Therefore, to provide a reference for pandemic management after it is lifted, this study intends to investigate how Chinese people's risk perception influences their health behaviors in private and in public, and whether trust in social media positively moderates the relationship between risk perception and both private and public behaviors after the lift.

The present study summarized an integrative model. We took risk perception as the independent variable, social media as the moderating variable, and both behaviors in private and in public as dependent variables. We intended to tackle the above questions in light of China's extraordinary shift of control measures. The specific research questions are as follows.

RQ1. How do Chinese people's risk perception influence their compliance with COVID-19 measures in private and in public?

RQ 2. How do Chinese people's trust in social media influence the relationship between risk perception and compliance with COVID-19 measures in private and in public?

This study firstly used an online questionnaire to collect information about these variables. Realizing that the existing studies predominantly rely on self-report scales, which may not reveal the actual behaviors in natural settings, the present study further implemented an experiment to measure participants' actual behaviors. The study attempts to clarify the complex relationships among the variables, and enriches the relevant studies with data from the context of lockdown lifts.

2. Related studies

This section provides a review of related studies focusing on COVID-19 measures, risk perception, and trust in social media content. The literature in these areas offers valuable insights into the rationale for the present study.

2.1. COVID-19 measures

To slow down the spread of COVID-19, governments across the world implemented various behavior-change measures aimed at encouraging people to modify their behavior, both in private and in public [17]. In private, individuals were advised to adopt healthier lifestyles, including consuming more fresh vegetables and fruits, ensuring sufficient sleep, engaging in regular exercise [11], and the like. These pieces of advice repeatedly appeared in the tips to prevent COVID-19 by official departments such as the National Health Service (NHS) in the UK and the National Health Commission (NHC) in China. In public, individuals were advised to wear face masks, maintain social distancing, and avoid gatherings. These measures were crucial for reducing the transmission of the virus [18]. These behavior-change measures ranged from simple recommendations to enforceable orders [19]. For example, people had to wear face

masks whenever they went out, but they did not have to do exercise regularly.

Given that successful disease control needs a high level of compliance with preventive measures, researchers have attempted to identify the factors that may influence people's adherence tendencies. Among these factors, risk perception [20–22] and social media [9,19,23,24] have drawn much attention. However, as mentioned in Section 1.2, the existing research has not reached a consensus on the relationship among these factors; at the same time, they were all carried out during lockdowns. That creates the need for the present study.

2.2. Risk perception

Risk perception refers to people's subjective assessment of the possibility of facing negative outcomes or contracting diseases [25] such as COVID-19. Past pandemic experiences indicated that the success of slowing down the spread of a highly infectious disease partially relied on the public's accurate perceptions of risks [20–22]. For example, Dryhurst et al. [15] found that risk perception of COVID-19 significantly correlated with the adoption of preventive behaviors in ten countries across Europe, America and Asia. Hassan et al. [9] also reported that in Malaysia, people's risk perception increased their trust in government, and enhanced compliance with policies to combat the threat of COVID-19. This aids in controlling the spread of the virus and ultimately leads to its defeat. Zong et al. [26] also detected positive correlation between risk perception and controlling measures during COVID-19 pandemic in China.

Moreover, prior research has identified factors such as experience with the virus, information from family and friends, and pro-sociality as significant influencers of risk perception [15].Whether these factors still work and how the affected risk perception influence people's compliance behaviors during post-lockdown periods is under-investigated. What's more, limited research exists on risk perception in the specific Chinese context of lockdown lift. Given that risk perception is a subjective psychological construct that is affected by social, cultural, cognitive, and emotional variations [15], it is necessary to understand Chinese people's risk cognition under this novel situation. This can provide timely intervention to guide their private and public behaviors, and contribute to the effective management of COVID-19 after the lift.

2.3. Trust in social media content

Social media, as most people's primary information source, plays a critical role in public health crisis control [25,27]. For example, during the MERS outbreak, social media platforms provided crucial updates on prevention measures and system information [24]. Its major function was information transmission. As for the COVID-19 pandemic, social media played more complex roles. It influenced people's self-efficacy and trust in the government, which in turn affected people's general and protective behaviors [9]. Specifically, when Malaysians perceived public health risks, they were likely to increase trust in government, and adopt behavioral changes to prevent infection. All these studies suggest that social media provides critical information that guides the public's preventive behavior and is a primary contributor to their perception of health risks [9,28].

Nevertheless, easy-to-access platforms can also cause fear, anxiety, depression and other negative effects among people, which predicate negative responses to health crises [29]. People might report high level of risk perception, and low compliance with health behaviors. This reminds us of providing high-quality social media content, promoting engagement in compliance behaviors [9].

Regarding the identified relationship between risk perception and adherence to public health behavior [9,15], we propose that trust in social media might moderate this relationship. This proposal is based on the theory of reasoned action [30], which holds that people's subjective attitude conditions their intention to perform actual behavior. When risk perception enhances adherence to health behaviors, trust in social media (a positive subjective attitude) may strengthen this adherence, as this health behavior is recommended by social media.

Based on the above information, we formulated the following research hypotheses.

H1. Risk perception negatively predicts Chinese people's adherence to COVID-19 measures in private. This hypothesis is based on the finding that individuals with higher risk perception may be more likely to choose an unhealthy lifestyle in private [13].

H2. Risk perception positively predicts Chinese people's adherence to COVID-19 measures in public. This hypothesis is based on the

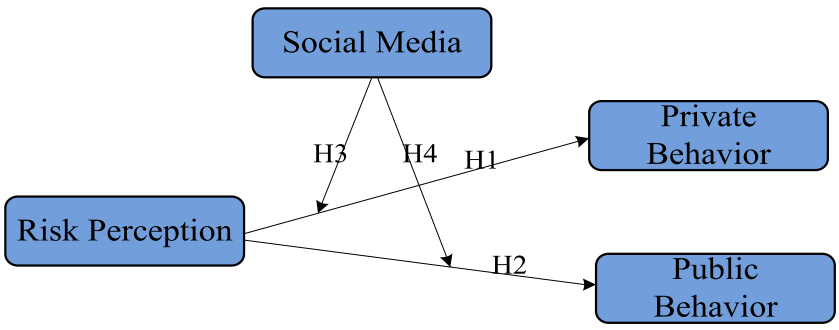


Fig. 1. The hypothesized model.

finding that risk perception significantly predicts the adoption of preventive measures in public [15].

H3. Trust in social media content positively moderates the relationship between risk perception and Chinese people's adherence to COVID-19 measures in public.This hypothesis intends to confirm the previous finding that social media positively moderates the relationship between risk perception and public protective behaviors in Malay [9].

H4. Trust in social media content positively moderates the relationship between risk perception and Chinese people's adherence to COVID-19 measures in private. Previous studies showed that people facing risk behaved differently in public and in private [13,15]. This hypothesis aims to check whether the moderating role of social media in public still holds for private behaviors.

Fig. 1 displays the hypothesized model.

3. Experiment 1

3.1. Participants

To obtain a nationally representative sample, we used the sample service provided by Questionnaire Star, an online questionnaire platform. When the questionnaire was compiled, the platform randomly distributed the link to potential participants through Wechat or e-mail throughout China. All people voluntarily participated in the survey and gave their informed consent (permissions were taken for minors from their parents or guardians). Finally, we received responses from 420 Chinese native speakers from 16 provinces and regions in China. This sample size meets the guidelines for exploratory research during the COVID-19 pandemic [31]. The survey's cover letter explained the purpose of the study and assured the confidentiality of their information.

The survey was launched on December 16th, 2022, and closed on December 22nd, 2022. During this period, a large number of people reported on their WeChat Moments (or other social media) that they had tested positive. News reports confirmed that China was entering the first peak of the pandemic after the lift of the lockdown. This emphasized the need to look into how people perceive the risk and their corresponding behaviors to find efficient ways to deal with the pandemic's peak.

We excluded three participants from our analysis due to a shorter response time (their response time was out of the range of mean time plus or minus three standard divisions). Therefore, the final sample comprised 417 participants. More details can be found in Table 1.

3.2. Measures

The online questionnaire consisted of a section about demographic information, and translated versions of questions on people's risk perception, people's behaviors in private, people's behaviors in public, and social media content perception.

3.2.1. Demographic information

This section included age, gender, educational level, location, and COVID-19 infection history. The results are shown in Table 1.

3.2.2. Perceptions of risks

Six questions on risk perception were adopted from Brown, Coventry and Pepper [11]. They measured extrinsic mortality risk, infection risk, perceived threat of COVID-19 to life, as well as the control over possible infection. They are believed to depict people's risk perception in a comprehensive manner. Participants were required to indicate the possibility of the described situations on a scale of 0–100 (0 represents "no chance at all", and 100 represents "absolutely certain").

Table 1
Demographic information of participants.

Age	Range	Mean	SD
	13–64	36.8	12.36
		Frequency	Percentage (%)
Gender	Male	113	27.1
	Female	304	72.9
Education level	Middle Schools	32	7.67
	Colleges	25	6
	Undergraduates	270	64.75
	Postgraduates	90	21.58
Location	North China	72	17.27
	North-east China	63	15.11
	East China	56	13.43
	South-central China	79	18.94
	South-west China	66	15.83
	North-west China	81	19.42
COVID-19 infection	Yes	72	17.27
	No	345	82.73

1. If you were to follow all recommended measures for reducing your risk of COVID-19 infection, what do you think the likelihood would be of becoming infected?
2. Given the current outbreak of COVID-19, if you were to do absolutely everything you could to take care of your health, what do you think the likelihood would be of you living to the age of 78? (It was 81 in the original version, because the average life span in the UK in that year was 81. We changed it to 78 as the average lifespan in China as of 2022 is 78 years old. Thus, we modified it to match China's lifespan while keeping the intended meaning of the question.)
3. Before the outbreak of COVID-19, if you were to do absolutely everything you could to take care of your health, what do you think the likelihood would be of you living to the age of 78?
4. Do you consider COVID-19 to pose a threat to your life?
5. If you became infected with COVID-19, how concerned would you be about spreading the infection to others?
6. If you became infected with COVID-19, how much control do you think you would have over preventing the spread of infection to others?

To avoid misunderstandings and information discrepancies, three language education researchers back-translated the questions into Chinese following the rules established by Maneesriwongul and Dixon [32]. The pilot testing of the back-translated version showed high reliability (Cronbach's $\alpha = 0.86$).

3.2.3. Behaviors in private

We also adapted four questions on people's behaviors in private from Brown, Coventry and Pepper [11]. On a scale of 1–5, participants were asked to rate how closely they adhered to the given advice against COVID-19 (1 represents "never follow at all", and 5 represents "always follow"). These pieces of advice were the same as the tips to prevent and treat COVID-19 infection issued by the NHC in China and the NHS in the UK.

1. Eat at least five portions of a variety of fruits and vegetables every day.
2. Avoid regularly drinking more than 14 units of alcohol per week.
3. Do at least 150 min of moderately intense exercise a week or 75 min of vigorously intense exercise a week.
4. Do not smoke.

Back translation was also employed to avoid misunderstandings.The pilot testing of the back-translated version showed high reliability as well (Cronbach's $\alpha = 0.82$).

3.2.4. Behaviors in public

Similarly, six questions on people's behaviors in public were adapted from Brown, Coventry and Pepper [11] and Dawi, Namazi and Maresova [33]. On a scale of 1–5, participants were asked to rate how closely they adhered to the given advice against COVID-19 (1 represents "never follow at all", and 5 represents "always follow").

1. Only go outside of your home for food, medical reasons or work (but only if you cannot work from home).
2. If you do go outside of your home, stay 1 m or more away from other people at all times.
3. Do not go outside of your home to meet others, even friends or family.
4. Wash your hands with soap and water often, making sure to do this for at least 20 s.
5. Cover your mouth and nose with a tissue or your sleeve (not your hands) when you cough or sneeze.
6. Do not touch your eyes, nose or mouth if your hands are not clean.

Back translation was employed to avoid misunderstandings as well. The pilot testing of the back-translated version also showed high reliability (Cronbach's $\alpha = 0.85$).

3.2.5. Trust in social media

In reference to Jia and Meng [16], three questions were adopted to investigate people's trust in social media content. Factor analysis in their study indicated that social media comprised three major dimensions: official social media, mass social media, and family and friends circle. They received a high level of trust from people in the face of COVID-19 (3.46, 3.26 and 2.54 out of 5, respectively). Therefore, the three questions are concerned with the three dimensions. On a scale of 1–5, participants were asked to rate how much they agreed with the statement (1 represents "strongly disagree", and 5 represents "strongly agree"). This is in line with the measure in Hassan et al. [9]'s study. For example, they asked participants to scale such a question: *During the current pandemic, the government carries out its duties effectively*.

1. The information that I have obtained from official social media regarding COVID-19 has been trustworthy.
2. The information that I have obtained from mass media regarding COVID-19 has been trustworthy.
3. The information that I have obtained from friends and family regarding COVID-19 has been trustworthy.

3.3. Data Collection

In total, there were 24 questions in the questionnaire. They were combined into one instrument on the Questionnaire Star platform. The pilot test (127 participants, 63 females, ages ranging from 19 to 57 years, M = 32.5, SD = 10.21) indicated high reliability for each variable (Cronbach's α was 0.87, 0.84, 0.90, 0.80, respectively). The sample service of the platform randomly distributed the link across China. The cover letter of the questionnaire required informed consent and voluntary participation. All people participated in the survey voluntarily and gave their informed consent (for minors, the consent was given by their parents or guardians). Participants received a small amount of money via a digital "red envelope" at the end of the survey, provided that their response time was within the set range. No outlier was detected because all participants' scores were within the range of mean score plus or minus three standard divisions.

3.4. Results and discussion

All data were analyzed using IBM SPSS Statistics 25. First, the data were divided into five parts: demographic information, risk perception, health behavior in private, health behavior in public, and trust in social media (the latter four were the variables in the hypothesized model in Fig. 1). Next, Cronbach's α, mean (M), and standard deviation (SD) were calculated for the four variables. Then, to check the moderating effect of trust in social media on the relationship between risk perception and both behaviors in private and in public, two hierarchical regression analyses were conducted. The details of the analysis are presented in detail below.

3.4.1. Demographic information

Table 1 contains the demographic information of all participants. Of them, 304 (72.9 %) were female and aged between 13 and 64 (M = 36.8, SD = 12.36). Their educational level ranged from middle school students (32, 7.67 %), college students (25, 6 %), undergraduates (270, 64.75 %) to postgraduates (90, 21.58 %). They originated in six administrative areas of China: north China (72, 17.27 %), north-east China (63, 15.11 %), east China (56, 13.43 %), south-central China (79, 18.94 %), south-west China (66, 15.83 %), and north-west China (81, 19.42 %). 72 of them, or 17.27 %, said they had already been infected with COVID-19.

3.4.2. Descriptive statistics of the four variables

The descriptive statistics of the four variables were calculated. Table 2 summarizes the results.

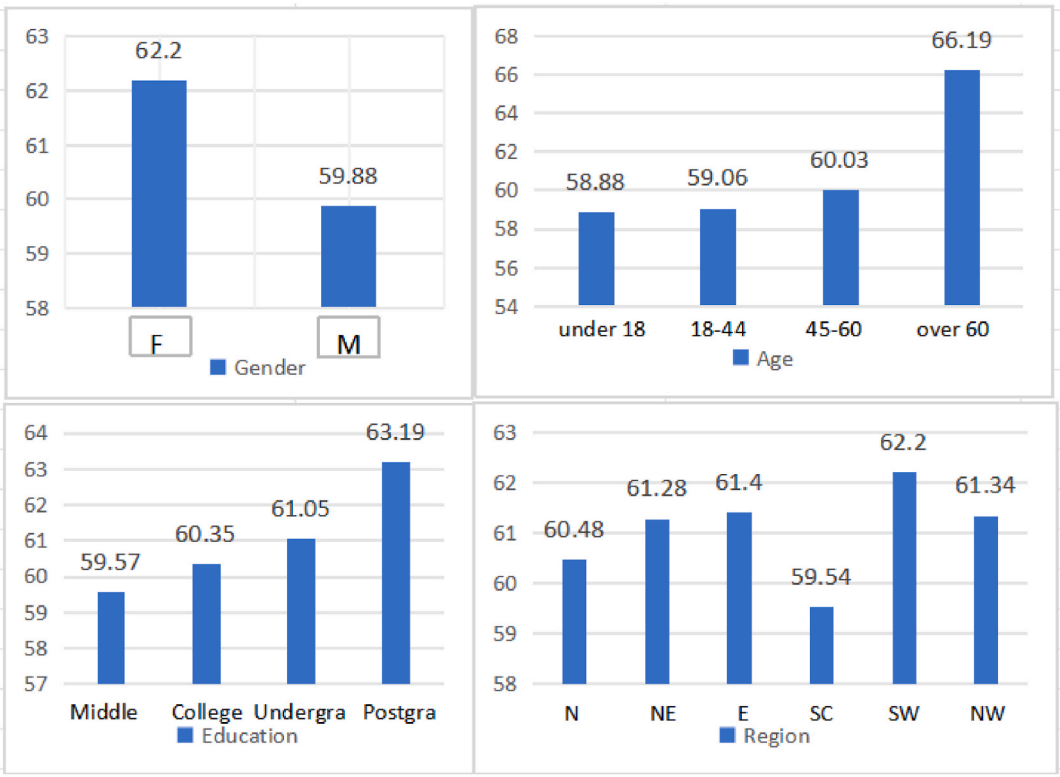
Table 2 showed that participants had a high perception of risks (they responded that the possibility of being infected and threatened by COVID-19 was 61.04 out of 100, SD = 14.81. It was 54 in a similar survey.) after the lockdown lift. Specifically, females (61.39 out of 100) were more likely to perceive the risks than males (59.88 out of 100). This percentage rose with age: it was 58.88 for participants under the age of 18, 60.96 for those between the ages of 18 and 44, 61.63 for those between 45 and 60, and 71.5 for those over 60. The same happened with educational levels, from 55.57 for middle school students, 60.05 for college students, 61.19 for undergraduate students, and 62.57 for postgraduate students. For regional differences, participants from the south-central part of China displayed a slightly lower percentage (59.54) than people from other areas (from 60.48 to 62.20). Comparatively speaking, people infected with COVID-19 had a slightly higher percentage (61.90) than those without infection experience (60.78). These details are depicted in Fig. 2.

For the adherence to COVID-19 measures, Table 2 shows that on a scale of 1–5 to follow health advice for private life (the higher the score is, the more likely people adhere to the measures), participants only reported a score of 2.04. This is in line with the findings that high-risk perception leads to lower engagement with health-promoting behaviors [11,14]. Regarding the public behaviors, we obtained a much lower score (1.89) than that for the private behaviors (2.04). This is contrary to our expectations and some of the previous findings. For example, the first global investigation of risk perception of COVID-19 indicated that COVID-19 risk could significantly predict the adoption of preventive behaviors such as wearing masks, washing hands and maintaining social distancing [15]. This extraordinary lockdown lift may be the reason why the results of our survey differ from those of the global survey. Under this situation, Chinese people might think it was impossible for them not to be infected. If people perceive uncontrolled risk, they might give up sticking to preventive behaviors [15]. This will be further explained in the Discussion section.

As for the trust in social media content, the score is not encouraging, either. On a trust scale of 1–5 (the higher the score is, the more people trust social media), participants reported a score of 2.22 (it ranged from 2.54 to 3.46 in a previous study in China [16]). This is contrary to the previous finding that Malaysian people relied on social media to gather information on COVID-19, which increased people's self-efficacy and trust in the government [9], and also that social media played a vital role in managing COVID-19 damages and crises [1,9,16]. This serves as a reminder to officials and the government that social media should be regulated to deliver high-quality, reliable information during this extraordinary shift in control measures [34,35].

Table 2
Descriptive statistics of the four variables.

	M	SD	α
Risk perception	61.04	14.81	0.92
Private behavior	2.04	0.64	0.87
Public behavior	1.89	0.69	0.83
Social media	2.22	0.63	0.85



(N = North China, NE = North-east China, E = East China,

SC = South-central China, SW = South-west China, NW = North-west China)

Fig. 2. Risk perception.

3.4.3. Relationships among the four variables

Hierarchical regression analysis was carried out to check the relationships among the four variables. The results are presented in Table 3. We will report them in the order of the four hypotheses.

As for the predictive power of risk perception for private behavior (H1), Table 3 shows that risk perception is not predictive of Chinese people's private behavior ($F(2, 414) = 0.03$, $p > .05$, $R^2 = 0.00$). The first hypothesis was not supported by our study.

This is also the case for the predictive power of risk perception for public behavior (H2). Table 3 shows that risk perception is not predictive of Chinese people's public health behavior ($F(2, 414) = 0.93$, $p > .05$, $R^2 = 0.00$). The second hypothesis was thus also refuted.

However, the moderating role of social media between risk perception and both private and public behavior (H3 and H4) has been supported by our results. When we took the trust in social media content into consideration, the predictive power of risk perception for private behavior significantly increased ($F(3, 413) = 15.72$, $p < .01$, $R^2 = 0.10$). This suggests that trust in social media positively moderates the relationship between risk perception and Chinese people's private behavior ($\Delta R^2 = 0.10$, $p < .01$). This confirms the third hypothesis, because it implies that the more people believe social media information, the less they are influenced by the high-risk perception, which encourages them to return to a healthy lifestyle [11].

Once again, when we took the trust in social media content into consideration, the predictive power of risk perception for public behavior also improved greatly ($F(3, 413) = 21.43$, $p < .01$, $R^2 = 0.13$). This suggests that trust in social media content positively moderates the relationship between risk perception and Chinese people's public behavior ($\Delta R^2 = 0.13$, $p < .01$). The fourth hypothesis

Table 3
Hierarchical regression analysis of the four variables (CI = 95 %).

	R	R^2	Adjusted R^2	F	β	Sig.
RP-PRB	0.01	0.00	−.00	0.03	.02	0.86
RP*SM-PRB	0.32	0.10	0.10	15.72	.32	0.00
RP-PUB	0.06	0.00	0.00	0.93	−.05	0.34
RP*SM-PUB	0.37	0.13	0.13	21.43	.36	0.00

(RP = risk perception; PRB = private behavior; SM = trust in social media; PUB = public behavior).

was thus supported. This implies that the more people believe social media information, the less they are influenced by the high-risk perception, which makes them more likely to follow the public protective measures.

3.4.4. Discussion

Facing the extraordinary shift of control measures in China, this study intended to investigate how Chinese people perceive the risks after the lockdown lift, how this perception influences their health behaviors, and whether trust in social media content moderates these two relationships. The results indicate that risk perception was not predictive of the adoption of COVID-19 measures either in private or in public, and trust in social media positively moderated the effect of risk perception on both behaviors in private and in public. The explanations and implications are presented as follows.

First, participants reported a high level of risk perception and a low tendency to adhere to COVID-19 measures. The results agree with the finding for private behaviors [11,13,14], but contradict the finding for public behaviors [9,15]. This contradiction might be explained by the Uncontrollable Mortality Risk Hypothesis [11]. If people perceive more risks beyond their control, they are less motivated to engage in healthy behaviors [13,14]. This is because, despite their efforts to maintain their health, those people do not think they will live long enough to reap the benefits of healthy living (our survey shows that, compared to the expected lifespan of 73.97 years old before COVID-19's break, the number fell to 67.25 during COVID-19). Under the context of lockdown lift on a national scale, people may feel that it is impossible not to contact the COVID-19 virus (on average, 311 out of 417 participants indicated that there was a greater than 71 % chance that they would become infected in our survey. It was 54 % in a similar study [11]). In this circumstance, people might give up trying to adhere to preventative advice. This agrees with the finding that people who were exposed to greater threats were more likely to take risks [36]. Therefore, people should be informed that the lockdown was only lifted after carefully assessing the virus' infectiousness. The virus was much less harmful and infectious than before, and hospitals and pharmacies had sufficient medical supplies. These measures could build confidence and positive attitudes in people, thus promoting healthy lifestyles.

Next, trust in social media positively moderates the correlation between risk perception and both the behaviors in private and in public. This is in line with previous findings that the perception of government information and the perception of social media positively moderate attitudes toward preventive behavior [9,33]. It highlights the critical role of social media in improving people's attitudes toward healthy behavior, which in turn slows down the spread of infectious diseases. Social media is now the main means of communication between the government and the public, as well as between the public and family members and other relatives, due to the virus's rapid spread [37,38]. It plays a positive role in disseminating accurate information [10] and promoting situational awareness [8,39]. This might be explained by the theory of reasoned action [30], which states that an individual's actual behavior is conditioned by the intention to perform that behavior, and this is influenced by one's subjective attitude. In our study, people were more likely to take precautions and adhere more closely to the guidelines for health behavior if they placed more trust in the information they found on social media (the positive subjective attitude). This result reminds communicators of the need to provide high-quality information to increase trust in social media [34,35]. For example, Jia and Meng [16] found that people heavily rely on official media to obtain information about COVID-19. Therefore, these media should update accurate information timely. In this way, people's trust in social media will gradually increase.

There are limitations to our survey. Given the context, an online questionnaire was the safest option, but the self-reported data might be too subjective. So the generalizability of our findings needs further confirmation using other methods on different participants. Thus, we tried to remedy this by carrying out a small-scale experiment. The details are reported in Section 4. Moreover, only two participants over 60 years old were included in our survey due to its online nature. They may not be familiar with the procedure of online surveys, thus choosing not to participate in it. As a result, our finding might not be applicable to this group. In general, they have less access to online information, and may run into more issues in light of this difficult circumstance. Thus, specific policies are advised to be put in place for them. Finally, to ensure the consistency of the information, this study only recruited native Chinese speakers. It might be better to include foreigners who can read Chinese as well.

4. Experiment 2

4.1. Participants

Due to the sharp increase in confirmed cases, people still chose to stay at home after the lifting, so it was difficult to find potential participants for our experiment. Therefore, we decided to recruit university students. All universities in China separated confirmed cases from healthy students. It was thus safe for the healthy ones to participate in our experiment. A total of 60 students (30 females, average age = 19.6 years, SD = 2.3, Chinese native speakers, majoring in English, Finance, Arts, and Education) from a university in north-west China took part in the experiment for a 10-yuan payment. The number of 60 was set in reference to the minimum requirement for participants in psychological experiments [40]. None of them had participated in the questionnaire survey, which prevented them from knowing the purpose of our experiment. They gave their informed consent and participated voluntarily in the study.

4.2. Materials and procedure

Participants were randomly divided into six groups, with 10 students in each group. Each group came in turn with an interval of 1 h. The first group was required to arrive at the experiment room at 9 a.m. on the experiment day. An hour later, the second group came at

10 a.m., and then the third group at 11 a.m., until the last group.

For each group, when all of the group members had arrived, we informed them of the unexpected change of the experiment room (we made up a reason for the change: the initially designated room would have an unscheduled emergency meeting), and they needed to line up and walk after the first author to the new room for 5 min. During this process, the experiment assistants (out of the sight of participants) estimated the distances between every two people and recorded them (this was designed in reference to the second public behavior in Section 3.2.4: If you do go outside of your home, stay 1 m or more away from other people at all times). Following Shi et al. [41], we evenly divided the 1 m into five distances to match the scale 1–5 in the questionnaire: 0–0.2 m for scale 1, 0.3–0.4 m for scale 2, 0.5–0.6 m for scale 3, 0.7–0.8 m for scale 4, and 0.0.9–1 m or more for scale 5. In this way, we could conveniently recorded their public behavior with accurate scales. When they arrived at the new room, we expressed our apology for the trouble caused by changing rooms, and offered to treat them to a fried-chicken hamburger of five different portions of fruit and vegetables (this was designed in reference to the private behavior in Section 3.2.3: Eat at least five portions of a variety of fruit and vegetables every day). In line with Shi et al. [41], one portion corresponds to 1 on the scale, two portions to 2, three portions to 3, four portions to 4 and five portions to 5. Students made the decision of their own will and took the food by themselves from the table in the center of the room. After that, they were asked to finish a paper questionnaire on risk perception [11] and trust in social media [16], both on a scale of 1–5: the same as those in Experiment 1. When the experiment ended, we asked them about the purpose of the experiment. None of them gave the right answer. Thus, the design was successful. When all groups had completed the experiment, they were all debriefed about the process and the true purpose of the experiment. They reported no impact of the room-changing and signed informed consent for us to use the data in our research.

4.3. Results and discussion

4.3.1. Results

In line with the hypothesized model in Fig. 1, the descriptive statistics of the four variables were also calculated. Table 4 summarizes the results.

Table 4 shows that students (60 in total, 30 females; M = 19.6 years old) displayed a high perception of risks (they reported a possibility of 65.62 out of 100 getting infected and threatened by COVID-19, SD = 12.33). Comparatively speaking, female students (68.63, SD = 11.35) still had a higher risk perception than males (57.92, SD = 13.42). At the same time, all participants displayed low trust in social media (on a scale of 1–5, they reported a score of 2.17 to trust social media, SD = 3.23) and low adherence to health behaviors (1.78 out of 5 in private, and 1.02 out of 5 in public). These results further confirmed the data in Table 2 from Experiment 1 that participants had a high perception of risks, low adherence to both private and public health behaviors, and low trust in social media.

We also employed hierarchical regression analysis to test the moderating role of social media between risk perception and health behaviors. The results are presented in Table 5.

The results support our findings in Experiment 1. Specifically, risk perception is still not predictive of either Chinese people's private behavior ($F(2, 414) = 0.00$, $p > .05$, $R^2 = 0.00$) or their public behavior ($F(2, 414) = 0.11$, $p > .05$, $R^2 = 0.00$). This further refutes the first two hypotheses. Moreover, when we consider trust in social media, the predictive power of risk perception for both private behavior ($F(3, 413) = 24.82$, $p < .01$, $R^2 = 0.47$) and public behavior ($F(3, 413) = 19.58$, $p < .01$, $R^2 = 0.41$) greatly improves. That suggests the positive moderating effect of trust in social media on health behaviors ($\Delta R^2 = 0.45$, $p < .01$ for private behavior; $\Delta R^2 = 0.39$, $p < .01$ for public behavior). This again confirms the latter two hypotheses. Taken together, Experiment 2 further supports the findings in Experiment 1.

4.3.2. Discussion

To avoid a disconnect between self-reported response and actual behavior in natural settings [36,42], we designed experiments to observe participants' adherence to health behavior in private and in public, and had them finish a paper questionnaire on risk perception and trust in social media. We obtained the same results as in Experiment 1. Still, risk perception was not predictive of the adoption of COVID-19 measures either in private or in public, and trust in social media positively moderated the effect of risk perception on both behaviors in private and in public. The following provides explanations for the findings.

First, few students (12 out of 60) kept a safe 1-m distance on the way to the new room despite two informing notices about the safe social distance on the way (low adherence to health behavior in public. On a scale of 1–5, students got a score of 1.02. It was 1.89 in the initial survey). There are several possible reasons. First, to guarantee the reliability of the experiment results, we did not orally remind them to stay 1 m apart, as our intention was to record their subconscious behaviors. Second, when we enrolled participants, we excluded confirmed cases of COVID-19. Therefore, students should think it is safe to gather together even though it is possible to get

Table 4
Descriptive statistics of the four variables in the experiment.

	M	SD	α
Risk perception	65.62	12.33	0.90
Private behavior	1.78	4.63	0.85
Public behavior	1.02	6.51	0.82
Social media	2.17	3.23	0.87

Table 5
Hierarchical regression analysis of the four variables (CI = 95 %).

	R	R^2	Adjusted R^2	F	β	Sig.
RP-PRB	0.01	0.00	−.02	0.00	−.00	0.97
RP*SM-PRB	0.68	0.47	0.45	24.82	.68	0.00
RP-PUB	0.04	0.00	−0.02	0.11	.04	0.34
RP*SM-PUB	0.64	0.41	0.39	19.58	.64	0.00

(RP = risk perception; PRB = private behavior; SM = trust in social media; PUB = public behavior).

infected by asymptomatic carriers or cases who are in the incubation period. For example, one student said: *There is no need to keep a distance. We are all safe because all confirmed cases have been quarantined.* Third, previous research has constantly shown that young adults display higher risk propensity than old adults [43]. Our participants fell into the young adult range. Their high risk perception led to little interest in adhering to public preventive measures. Although it contradicted the previous findings [15], it can be explained by the Uncontrollable Mortality Risk Hypothesis as well [11,14]. When people believe there is an uncontrollable risk, they give up on trying to maintain their health because they don't think the risk can be eliminated. This may cause the low adherence to health behaviors in this study.

Second, few students (21 out of 60) chose the hamburger with five portions of fruit and vegetables (low adherence to health behavior in private. On a scale of 1–5, students got a score of 1.78. It was 2.04 in the initial survey). First, much evidence suggests the prevalence of risky behaviors under the threat of risk [36]. For example, Bhutani, van Dellen and Cooper [44] found that individuals tend to engage in riskier dining habits, such as having a large proportion of ultra-processed foods and a low intake of healthy fruits, during the COVID-19 pandemic. In the experiment, students showed a higher risk perception (65.62) than the participants in the initial survey (61.04) ($t(59) = 4.80$, $p < .05$). That may cause the lower adherence to the health behavior in private in the experiment ($t(59) = -10.26$, $p < .05$). This seems to suggest the predictive power of risk perception for health behavior as hypothesized in H1, even though it was not supported by the regression analysis. Second, Chronic stress [45–47], boredom [48,49] and fear caused by COVID-19 [50] are known to increase cravings for unhealthy food and snacks. Facing the unexpected lifting of the lockdown, vulnerable university students [3] were under greater pressure and boredom. Thus, it makes sense that hamburgers would be chosen more often than vegetables and fruits. For instance, one student said: *hamburgers made me relieved*!

Third, trust in social media also positively moderates the relationship between risk perception and health behavior. The more people trust social media, the less they are influenced by risk perception, and the more likely they are to adhere to health behaviors both in private and in public. This further confirms the findings in Experiment 1, and also aligns with previous studies [9,33,51]. According to the theory of reasoned action [30], an individual's behavior is conditioned by one's subjective attitude. If people evaluate the suggested behavior in a positive way (a positive attitude), they are more likely to perform the behavior. Therefore, fostering a positive attitude towards social media brings healthy behaviors among people. Jia and Meng [16] confirmed that during health crisis, the public relied heavily on government and official social media, which enhanced the trust in social media and facilitated crisis control. Interestingly, 43 of the 60 participants were concerned about spreading the infection if they tested positive. This might be the result of Chinese people's shared collectivism. Consequently, social media can emphasize concern for others and group spirit to encourage healthy lifestyles [52]. Moreover, we need to emphasize the importance of using social media to effectively communicate public health guidelines and encourage adherence to preventive measures [53]. For example, we can display health guidelines and preventive measures in varied modalities, such as catchy slogans, short videos, live songs, or even some sitcoms to draw people's attention.

The experiment is limited in several ways. First, the samples were only students from one university. It is unclear whether the findings can be generalized to other populations in other areas of different ages and educational levels. Second, we only observed two actual behaviors (a 1-m distance from the public measure, and eating habits from private), since initiating other behaviors under the experiment was impossible. Third, the number of participants was relatively small. During the pandemic's peak, we chose to make do with them. We hope to improve these aspects in future studies.

5. Conclusion

China swiftly implemented lockdown measures in response to the COVID-19 pandemic. On December 6th, 2022, the Chinese government announced that the lockdowns would be lifted nationwide the next day after carefully considering the situation. Since few studies have investigated this challenging shift of control measures, this study attempts to address the gap. Based on the identified relationship among risk perception, health behavior, and trust in social media, we explored: (1)How do Chinese people's risk perception influence their compliance with COVID-19 measures in private and in public? and (2) How do Chinese people's trust in social media influence the relationship between risk perception and compliance with COVID-19 measures in private and in public?

We initially implemented an online questionnaire survey on 417 (304 females, 13–64 years old) participants' risk perception, compliance with health behavior in private and in public, and trust in social media. The results indicated that, after the lifting, Chinese citizens perceived high risks (they reported a possibility of 61.04 out of 100 to be infected and threatened by COVID-19), showed a low degree of adherence to COVID-19 measures (on a degree scale of 1–5, they reported a score of 2.04 in private, and 1.89 in public), and social media positively moderated the relationship between risk perception and adherence ($\Delta R^2 = 0.10$, $p < .01$ for private behavior; $\Delta R^2 = 0.13$, $p < .01$ for public behavior). Then, we observed another 60 (30 females, 18–22 years old) participants' actual behaviors to

see their health behavior in private and in public, and asked them to complete a paper questionnaire on risk perception and trust in social media. The results confirmed the high perception of risk (65.62 out of 100), low trust in social media (2.17 out of 5), low adherence to health measures (1.78 in private, and 1.02 in public), and the moderating role of social media between risk perception and adherence ($\Delta R^2 = 0.45$, $p < .01$ for private behavior; $\Delta R^2 = 0.39$, $p < .01$ for public behavior).

These results highlight the need to orient public communication efforts for effective pandemic control. Public health strategies should avoid instilling fear and risk cognition in people, encourage adherence to control measures, and enable social media to positively impact people's decision-making and self-efficacy. For example, when alerting the audience to the risk of the health issue, it is equally important to offer effective coping information and to boost people's efficacy to respond to the risk.

Nevertheless, all the findings should be received with caution, for the survey only recruited Chinese native speakers, the experiment merely observed students from one university, and the whole study was implemented during the first peak of the pandemic after the lockdown lift. More participants from different backgrounds are expected to participate in future studies, and more experiment designs were expected to observe other actual behaviors.

Future directions

This study opens the door to several promising avenues for future research, offering opportunities to deepen our understanding of risk perception, compliance with health measures, and the role of social media in pandemic contexts. Cross-cultural comparative studies represent a critical step forward, encompassing participants from diverse cultural backgrounds and regions. Such investigations can elucidate how cultural factors shape risk perception, health behavior, and the influence of social media on a global scale.

Longitudinal studies present another intriguing prospect, allowing for the continuous monitoring of individuals' attitudes and behaviors over an extended period. These studies offer a dynamic perspective on how risk perception and compliance evolve during the post-lockdown phase, shedding light on potential changes in the impact of social media over time.

Furthermore, researchers should delve into the content of health-related information disseminated via social media platforms. Beyond evaluating individual trust in these platforms, an in-depth analysis of the information shared can illuminate the role of social media in countering misinformation during public health crises. These investigations can inform strategies for promoting accurate health information dissemination.

Incorporating interventions into research design is an essential strategy. By targeting risk communication and health behavior, researchers can assess the effectiveness of these interventions and provide evidence for the development of evidence-based public health policies. These future research directions, when approached with academic rigor, can contribute to a more comprehensive understanding of the complex interplay between risk perception, health behavior, and the influence of social media in the context of pandemics, facilitating more effective and culturally sensitive strategies for pandemic management.

Ethics statement

The study was approved by the Bilingual Cognition and Development Lab (BCDL_202205_003), Guangdong University of Foreign Studies, Guangzhou, China. All participants took part in the study voluntarily.

Informed consent

Informed consent was obtained from all participants (for minors, the consent was obtained from their parents or guardians).

Data availability statement

The data that support the findings of this study have not been deposited into a publicly available repository, but are available from the corresponding author upon reasonable request.

CRediT authorship contribution statement

Juanjuan Wang: Writing – original draft, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Meng Xiao:** Resources, Investigation, Data curation. **Wenjing Wang:** Resources, Investigation, Data curation. **Yi Sun:** Writing – review & editing, Validation, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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