Effects of COVID-19 event intensity on college students' health lifestyles: time perspective mediating model and its gender difference

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Abstract

The pandemic of COVID-19 had not only led to healthy-damage behaviors, but also raised people's attention to health and generated health-promoting behaviors. However, little is known about the mechanism underlying how the perception of COVID-19 intensity affects health behaviors. The present study investigated the mediating effect of DBTP between event intensity and health behaviors and the moderating role of gender in this relation. Nine hundred and twenty-four Chinese college students (348 males and 576 females) completed a battery of self-report questionnaires, including COVID-19 Event Intensity Scale, Chinese version of Zimbardo Time Perspective Inventory (ZTPI) and Healthy Lifestyle Scale. Moderated mediation analysis was performed using conditional process analysis. The results showed that COVID-19 intensity had a positive predictive effect on college students' health behaviors. DBTP played a partial mediating role in the relationship between COVID-19 intensity and health behaviors for male and not female. In female group, COVID-19 intensity and DBTP was significantly linked with health behaviour; however, COVID-19 intensity and DBTP were not significantly linked. The findings indicated that COVID-19 intensity perceived by college students could increase their health behaviors, and intervention focus on BTP may contribute to health behaviors only in male. Practical implications were discussed in this academic research.

Keywords Event intensity · Time perspective · Healthy lifestyle · Gender difference · Moderated medication

Introduction

The outbreak of coronavirus disease 2019 (COVID-19) caused unprecedented stress and disruptions in people's daily lives and public health. In contrast to most Western countries, China adopted a zero-COVID policy to contain the transmission of COVID-19 to keep COVID-19 cases as close to zero as possible (Burki, 2022). Indeed, after strict regulations were administrated across China, including quarantine, mask-wearing, large-scale nucleic acid assay, etc., the situation of COVID-19 in China significantly improved (Tang et al., 2020; Tu et al., 2020). However, the prolonged anti-pandemic measures have been causing significant disruption to people's daily routine such as lack of social interactions, feeling restricted, shifted to work from home, being laid off, and resulted in financial difficulties, which may deteriorate mental health (Lau et al., 2022).

During the COVID-19, young adults and college students may face more mental challenges, including academic pressure, employment pressure, and family pressure (Alemany-Arrebola et al., 2020; Ren et al., 2021; Zhai & Du, 2020). For example, Cao et al. (2020) performed a cross-sectional study in China and found that 0.9% of college students were experiencing severe anxiety, 2.7% were experiencing moderate anxiety, and 21.3% were experiencing mild anxiety. In China, nearly 40% of nursing students were found to have some degree of academic burnout during COVID-19 (Wang et al., 2021), and in the US, 91% of college students reported being worried about the future health of themselves or their families (Son et al., 2020). College students play a crucial role in the development of a country. Therefore, it is necessary and urgent to pay attention to the mental health of college students during the epidemic.

COVID-19 event intensity and health behaviors

While the COVID-19 pandemic has brought profound negative impact on people's lives, it has also carried out

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a thorough health education for the public. Health has become the prevailing concern that takes precedence over all others issues. There are some findings indicating that COVID-19 risk perception and perceived severity of the disease, are longitudinally positively related with the engagement in preventive behaviors across different phases of the pandemic (Fu et al., 2021; Qin et al., 2021). According to the survey of China Education Daily, 78% of people are willing to take exercise and maintain a healthy lifestyle after the COVID-19 pandemic (Ke & Chen, 2022). Lockdown resulted in higher time spent in walking and moderate physical activity compared to pre COVID-19. Increased physical activity from week 2 to week 4 of lockdown was associated with improved physical health in France and Switzerland (Cheval et al., 2021).

These studies confirmed that although different populations are exposed the same traumatic event (the COVID-19), they take positive or negative behaviors depends on their perception and evaluation of the event. Therefore, understanding and identifying the mechanism is vital to enhance health behaviors of COVID-19. And Health Belief Model (HBM) may help to understand the determinant factors of COVID-19 health behaviors. HBM is one of the most effective theory for identifying factors affecting on the perception of the behavior (Malik et al., 2021). The model suggested that changes in preventive health behavior were originally based on six factors: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy and cues to action (Tesema et al., 2021). The perceived risk of people developing COVID-19 was considered to be the primary motive to change within the HBM, which assumes that the higher the perceived threat, the more likely an individual will modify his or her behaviors to avoid that threat.

Furthermore, Lutchyn and Yzer study indicated the importance of time frame in behavioral definitions in belief-elicitation research. They found that time perspective (TP) affects the type of salient behavioral beliefs. And TP was most likely to be influenced by contextual forces, such as state changes, challenging life events (e.g., trauma), or altered states of consciousness (Lutchyn & Yzer, 2011). Uncertainty about the future was a distinguishing feature of the COVID-19 pandemic (Rettie & Daniels, 2021). Studies had shown that many people's TP shifted as they focused on the immediate, present danger and future plans became uncertain. And distortions in TP were valuable predictors for anxiety and depression levels during the first period of the pandemic (Holman et al., 2022; Micillo et al., 2022). Therefore, we assumed that TP might influence the relationship between event intensity and health behaviors, investigating mediating mechanisms of TP is very necessary.

Time perspective as a mediator

Time perspective (TP) represents an individual's cognitive way of relating to the psychological concepts of past, present and future, which affects decision making and subsequent actions (Boniwell, 2005). Zimbardo and Boyd (1999) empirically distinguished five TPs based on repeated factor analyses: Past-Negative (PN), Past-Positive (PP), Present-Fatalistic (PF), Present-Hedonistic (PH), and Future (F). TP is a powerful influence on many aspects of behaviors, attitudes and values, including studies on binge eating and binge drinking (Laghi et al., 2012), substance use (Barnett et al., 2013), and alcohol consumption (Beenstock et al., 2011), where higher scores on PP and F time perspectives are associated with wellbeing and positive functioning (Wills et al., 2001), with the reverse true for PN, PH and PF time perspectives (Bitsko et al., 2010; McKay et al., 2014; Sword et al., 2014).

By now, the basic association between TPs and health-related behaviors has been reasonably well established, recent studies have focused on the importance of the balanced time perspective (BTP), reflecting an ideal blend of TP components (high scores on PP, moderate PH and F, and relatively low scores on PF and PN) (Zimbardo & Boyd, 1999). A number of studies have found BTP show more stronger relationships with well-being relative to any individual TP (Boniwell et al., 2010; Griffina & Wildbur, 2020). Individuals with BTP have exhibited greater levels of gratitude (Zhang et al., 2013), positive mood (Stolarski et al., 2014), and psychological well-being (Sailer et al., 2014) compared with those who were less balanced. These results indicated that BTP is meaningfully related to a broad spectrum of mental health indicators.

Moreover, research has shown that TP is malleable in response to life changing situations that include stress, adversity, and traumas that in turn can significantly affect the notion of time that individuals have in their lives (Carstensen et al., 1999; Holman & Silver, 1998). For example, environmental uncertainty may decrease future orientation and increase present orientation (Hoornaert, 1973). People who have experienced abuse or neglect in childhood are likely to have a negative perspective towards the past and a fatalistic perspective towards the present (Zimbardo & Boyd, 1999). Based on these findings, we hypothesized that the COVID-19 outbreak might also affect people's attitudes toward time, and BTP may mediate the association between COVID-19 event and health behaviors. In fact, some studies have indicated that the TPs played a mediating role in the association between childhood trauma and symptoms of PTSD in 432 adult patients (Hosseini et al., 2019). Linden et al. study also shows that in College students a PN time perspective mediated the relationship between anxiety, depression and alcohol-use behaviors (Linden et al., 2014).

Gender as a moderator

Previous studies have indicated significant gender differences in stress. Some evidence suggested that women are generally more sensitive to stress than men (Gibson et al., 2014; Newhouse & Albert, 2015). The reason for this may be men are generally more physiologically reactive (Kudielka & Kirschbaum, 2005), whereas women self-report more psychosocial distress (Taylor et al., 2000). Data from the 6th Spanish National Working Conditions Survey (2015) also showed that 20.5% of working women have stress, whereas 14.3% of working men do (Chela-Alvarez et al., 2020). From 1994 to 2014 meta-analysis results showed that the prevalence of depression is higher among women, and there is still a gender effect on the prevalence of depression (Lim et al., 2018).

Of the limited studies to explore potential gender differences in TP, the available evidence is mixed. For example, Zimbardo et al. (1997) observed that college men were more present-oriented than women and more hedonistically oriented. Evidence also showed that men were found to have a greater future orientation than women (Greene & Debacker, 2004). In contrast, Codina and Pestana (2019) found that women reported higher scores in PP, PH and F time perspective than men. Findings on gender differences in BTP are also mixed. For example, while Chen et al. (2016) reported a more BTP in females relative to males, a more recent study suggests the converse profile. Moreover, several studies have failed to find any significant differences between males and females in terms of BTP (Fuentes et al., 2022; Guo et al., 2017). Based on above empirical studies on gender differences in stress and TPs, this study assumed that gender might moderated the relationship between COVID-19 event intensity and TPs.

The present study

Taken together, in order to empirically investigate the association and the mediating mechanisms, the goal of the present research was (1) to investigate whether there is significant difference in the level of event intensity, BTP and health behaviors based on gender. (2) to examine whether perceptions of the pandemic (i.e. novelty, disruption, and criticality) can cause health behaviors, and whether DBTP mediating this association. (3) to test the moderating role of gender in the relationship between COVID-19 intensity and TPs. Hypothesized model is shown in Fig. 1. The present study was aimed to provide empirical evidence for promoting health behaviors in the later stage of the epidemic from the perspective of time and enrich the research on TP and stress from the perspective of gender in Chinese cultural context.
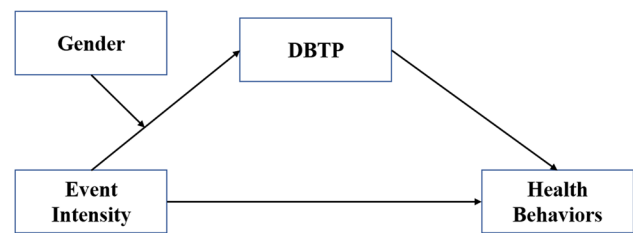

Fig. 1 Hypothesized model

Materials and methods

Participants

A combination of random sampling and snowball sampling was used for on-line sampling. A questionnaire survey was conducted on full-time students in 4 universities of China (2 in Shandong Province and 2 in Heilongjiang Province) from January to April 2022. At this time, most universities in China were in a state of closed management. First, we selected the advantageous majors with a large number of students in this University for sampling, four classes per major (freshman to senior). Then, these students invited their college friends to fill in the online questionnaire. This can ensure the representativeness of the sample to a certain extent.

More than 90% of the answers are the same option, continuous and regular answers and those with answering time shorter than 60s were excluded from the study. A total of 1012 questionnaires were issued and 924 (91.30%) were collected, for a recovery rate of 91.3%. Among them, there are 348 males and 576 females, 296 freshmen, 186 sophomores, 288 juniors, and 148 seniors, 181 students majored in liberal arts, 495 in engineering, 175 in science, 31 in art and 42 were other majors. All the participants gave informed consent after receiving information about the goals and the methods of the investigation.

Measures

COVID-19 event intensity scale

Adapted from Morgeson's Event Intensity Scale (Morgeson et al., 2015), all the "events" in the original title were changed to "COVID-19 pandemic events" in actual operation. There are 11 items in the scale, divided into three dimensions of novelty, disruption and criticality. Likert 7 points are used to score from "1= totally disagree" to "7= totally agree". The higher the score, the stronger the intensity of the COVID-19 epidemic. In this survey, Cronbach's α coefficient of this scale is 0.854, and Cronbach's α coefficient

of novelty, criticality and disruption is 0.856, 0.760 and 0.765 respectively. Scale's validity tested by Confirmatory Factor Analysis (CFA), $\chi^2/df = 6.352$, CFI = 0.961, IFI = 0.961, GFI = 0.958, TLI = 0.938, RMSEA = 0.076, indicating that the overall model fit was acceptable, and the questionnaire had a good structural validity.

The Zimbardo Time Perspective Inventory (ZTPI)

TP was measured using the Chinese version of ZTPI, it comprised 25 items which was constituted by the five sub-scales of PN, PP, PI, PF and F (Wang, 2016). The "Present Hedonistic" was renamed as "Present Impulsive". The construction of the revised version is consistent with the original one. The results show that ZTPI of Chinese version has a reliable and valid measurement for assessing TP (Li & Lv, 2022). Each item was on a five-point Likert scale where individuals rated on a five point from 1 (very uncharacteristic) to 5 (very characteristic). Higher scores indicate a certain temporal bias. In the present sample, Cronbach's alpha of the ZTPI was 0.784, 0.745 0.683.0.769 and 0.622 for PN, PI, F, PP and PF, respectively.

A number of studies have found BTP show more stronger relationships with well-being relative to any individual TP (Boniwell et al., 2010; Griffina & Wildbur, 2020). Therefore, in this study, we focused on BTP. The calculation of BTP was based on ZIPI as indexed by the deviation from a balanced time perspective (DBTP) (Stolarski et al., 2011). DBTP was calculated to measure the distance of each individual from the optimal TP profile as previously developed (Stolarski et al., 2011; Zhang et al., 2013), while DBTP was opposite to the BTP. The formula was as follows.

$$DBTP = \sqrt{(oPN - ePN)^2 + (oPP - ePP)^2 + (oPF - ePF)^2 + (oPI - ePI)^2 + (oF - eF)^2}$$

where oPN − ePN was (optimal Past Negative) − (an individual's empirical Past Negative); this procedure was repeated for each TP dimension. The optimal points are 1 for Past Negative, 5 for Past Positive, 1 for Present Fatalism, 1 for Present Impulsive and 5 for Future (Li & Lv, 2022). The lower the DBTP value was, the higher the BTP value would be.

The healthy lifestyle scale

College Students' health behaviors were assessed by the Healthy Lifestyle Scale, which was compiled by Wang Dong et al., (2011) and revised by Jiao Jianpeng (2013). The healthy lifestyle scale included 33 items and was divided into eight dimensions: exercise behavior, regular living behavior, diet and nutrition behavior, health hazard behavior, health responsibility behavior, interpersonal support behavior, stress management behavior and life appreciation behavior. A higher score indicated a healthier lifestyle. The total Cronbach's alpha of the

healthy lifestyle scale was 0.911 for the current sample and Cronbach's α of each dimension ranges from 0.605 to 0.858.

Statistical analysis

Data of the present study were analyzed with both SPSS 24.0 (SPSS Inc., Chicago, Illinois) and PROCESS 3.3. First, we conducted a common method bias test, descriptive analyses, and Pearson correlation analyses using SPSS 24.0. Second, we test the mediation effect of DBTP in the relationship between event intensity and health behaviors with the bias-corrected and percentile bootstrap based on 5000 samples. If the value zero was not in the 95% confidence interval (CI), it indicated that the result was significant and the mediation model was supported. During this step, some demographic variables like gender, grade and home location were set as control variables. Third, the moderated model and the moderated mediation model of gender were test using SPSS PROCESS 3.3 (model 7). All the data presented were standardized.

Results

Common method deviation test

To test whether there was common methodological bias in the present study, the Harman single-factor test was applied (Podsakoff et al., 2003). The results showed that there were eleven factors with the characteristic root greater than 1, and the variation explained by the first factor is 20.79%, which was lower than the maximum critical value 40%, indicating no obvious common methodological bias.

Descriptive statistic

An independent-sample t-test was performed to explore the gender differences in event intensity, DBTP, and health behaviors. Table 1 presents that gender difference in event intensity ($t = 2.856$, $p < 0.01$) and DBTP ($t = 2.191$, $p < 0.05$) were statistically significant. Although male had higher health behavior scores than female, there was no significant difference between them ($t = 1.755$, $p > 0.05$). Specifically, the male's disruption ($t = 3.656$, $p < 0.01$), criticality ($t = 2.032$, $p < 0.05$), score were higher than the female. There was no gender difference in novelty ($t = 0.909$, $p > 0.05$). Compared with male (M = 4.46, SD = 1.04), female (M = 4.31, SD = 0.97) showed lower DBTP score denoting a more balanced time perspective.

The person correlations are shown in Table 2. The results indicated that event intensity was significant and positive related to DBTP ($r = 0.115$, $p < 0.05$) and health behavior ($r = 0.556$, $p < 0.01$). DBTP negatively related to health

Table 1 Results of independent-sample t-test in different gender among variables ($n = 898$)

Variables	Male ($n = 348$)	Female ($n = 576$)	t	P
Novelty	22.57 ± 3.94	22.32 ± 4.18	0.909	0.364
Disruption	20.35 ± 4.67	19.19 ± 4.71	3.656**	0.000
Criticality	16.50 ± 3.13	16.04 ± 3.34	2.032*	0.042
Event Intensity	59.42 ± 9.73	57.55 ± 9.52	2.856**	0.004
DBTP	4.46 ± 1.04	4.31 ± 0.97	2.191*	0.029
Health Behaviors	123.71 ± 17.58	121.74 ± 15.83	1.755	0.080

*$P < 0.05$, **$P < 0.01$

behaviors ($r = -0.081$, $p < 0.05$). That is, people with better time balance are more likely to adopt healthy behaviors. Furthermore, gender, grade and home location were partially related to event intensity and DBTP ($r = -0.145 \sim 0.077$, $ps < 0.05$). Therefore, they were included as control variables in the following statistics.

Testing the mediation role of DBTP

After controlling for gender, grade and home location of college students, Model 4 in SPSS compiled by Hayes (2012) was used to test the mediating effect of DBTP. The mediation analyses confirmed that DBTP is a statistically significant mediator of the relationship between event intensity and health behaviors. As shown in Table 3, event intensity had a significant

positively predictive effect on health behaviors (B = 0.56, $t = 20.06$, $p < 0.01$) and DBTP (B = 0.11, $t = 3.48$, $p < 0.01$). In addition, the direct predictive effect of event intensity on health behavior was still significant (B = 0.57, $t = 20.85$, $p < 0.01$) and DBTP had a negatively predictive effect on health behaviors (B = -0.15, $t = -5.42$, $p < 0.01$) when the mediating variables were included. This indicated that DBTP plays a partial mediating role between event intensity and behaviors (Indirect Effect = -0.02, SE = 0.006, 95%CI = [-0.03, -0.01]).

Testing of the moderated mediation model

After controlling for grade and home location of college students, Model 7 in SPSS PROCESS compiled by Hayes (2012) was used to test the moderated mediation model. The results (Table 4) showed that the interaction of event intensity and gender had significant negatively predictive effects on DBTP (B = -0.19, $t = -2.81$, $p < 0.01$). This result indicated that the association between event intensity and DBTP were moderated by gender. Furthermore, simple slope analysis (Fig. 2) displayed that event intensity was positively related to DBTP in males (simple slope = 0.23, t = 4.37, $p < 0.01$). However, for the female group, event intensity was not significantly linked with DBTP (simple slope = 0.04, t = 1.01, $p = 0.314$).

Additionally, the bootstraps (5000 times) analysis showed that the mediating effect was moderated by gender. Specifically, the conditional indirect effect was significantly for male students (B = -0.03 95% CI = [-0.06,

Table 2 Descriptive statistics and intercorrelation between variables

Variables	M	SD	1	2	3	4	5	6	7
1. Gender:	1.63	0.49	1						
2. Grade	2.33	1.11	0.126**	1					
3. Home location	1.50	0.50	0.097**	0.104**	1				
4. Major	2.20	0.94	−0.025	0.019	0.072*	1			
5. Event Intensity	58.26	9.64	−0.094**	−0.145**	−0.061	0.012	1		
6. DBTP	4.37	1.00	−0.072*	−0.012	0.077*	0.064	0.115*	1	
7. Healthy Behaviors	122.49	16.53	−0.058	−0.056	−0.051	−0.007	0.556**	−0.081*	1

*$P < 0.05$, **$P < 0.01$

Table 3 The mediation model test of DBTP ($n = 924$)

Outcome variable	Predictor variable	B	t	95%CI	R^2	F
Health Behaviors	Event Intensity	0.56	20.06**	[0.50, 0.61]	0.31	103.06**
DBTP	Event Intensity	0.11	3.48**	[0.05, 0.18]	0.03	5.94**
Health Behavior	Event Intensity	0.57	20.85**	[0.52, 0.63]	0.33	90.86**
	DBTP	−0.15	−5.42**	[−0.20, −0.09]		

Results were controlled for gender, grade and home location. B = unstandardized regression coefficient; t = Student's t-value; 95% CI = 95% Confidence Interval; R^2 = explanation rate; F = Analysis of variance of F-value. Fitness Index for the Structural Equation: $\chi 2/df = 2.457$, CFI = 0.993, IFI = 0.993 GFI = 0.998, TLI = 0.949, RMSEA = 0.040

*$P < 0.05$, **$P < 0.01$

Table 4 The moderated mediation model test (n=924)

Outcome variable	Predictor variable	R^2	F	B	t	95%CI
DBTP		0.03	6.36**			
	Event Intensity			0.42	3.70**	[0.20, 0.64]
	Gender			−0.14	−2.01*	[−0.27, −0.01]
	Event IntensityxGender			−0.19	−2.81**	[−0.32, −0.06]
Health Behaviors		0.33	113.54**			
	Event Intensity			0.57	20.94**	[0.52, 0.63]
	DBTP			−0.15	−5.39**	[−0.20, −0.09]

Results were controlled for grade and home location. R^2 =explanation rate; F=Analysis of variance of F-value. B=unstandardized regression coefficient; t=Student's t-value; 95%CI=95% Confidence Interval

*$P<0.05$, **$P<0.01$

−0.01]) but not for female students (B = − 0.01, 95% CI = [−0.02, 0.01]).

Discussion

In this study, a moderated mediation model was constructed to analyze the relationship between COVID-19 event intensity and health behaviors in college students. The results indicated that BTP played a mediating role, and the gender played a moderating role in the relation between event intensity and BTP.

COVID-19 event intensity and health behaviors

The COVID-19 event intensity was positively linked with health behaviors, which indicated that the greater the intensity of COVID-19 events perceived by individuals, the more they will pay attention to their own health and adopt a healthier lifestyle. This was consistent with previous studies and theory of the HBM. For example, Lv et al. (2008) investigated the difference of health-related behavior among public population during and after SARS epidemic, showing

that the SARS epidemic encouraged people to develop and adopt healthy behaviors such as washing hands before meals and avoiding others when coughing and sneezing. Shewasinad et al. (2021) also found that perceived susceptibility and perceived severity of COVID-19 were significant determinants of health behaviors. Existing research studies have already shown that the COVID-19 pandemic has significantly aroused the people' health consciousness and effectively improved the rationality of people's health perceptions (Niu et al., 2021). Specific to our study, the mean score of event intensity of COVID-19 was 58.26 (±9.64 SD). Fifty-two percent (51.6%) of the college students were above the mean score, and their perceived severity of COVID-19 promoted health behaviors.

The mediating role of BTP

The current study examined DBTP as a potential explanation for the link between COVID-19 event intensity and health behaviors. The results showed that more event intensity of COVID-19 was related to greater DBTP (less BTP), which likely resulted in less health behaviors. These findings supported TP theory (Frank, 1939; Zimbardo & Boyd, 1999),

Fig. 2 the interaction between event intensity and gender on DBTP
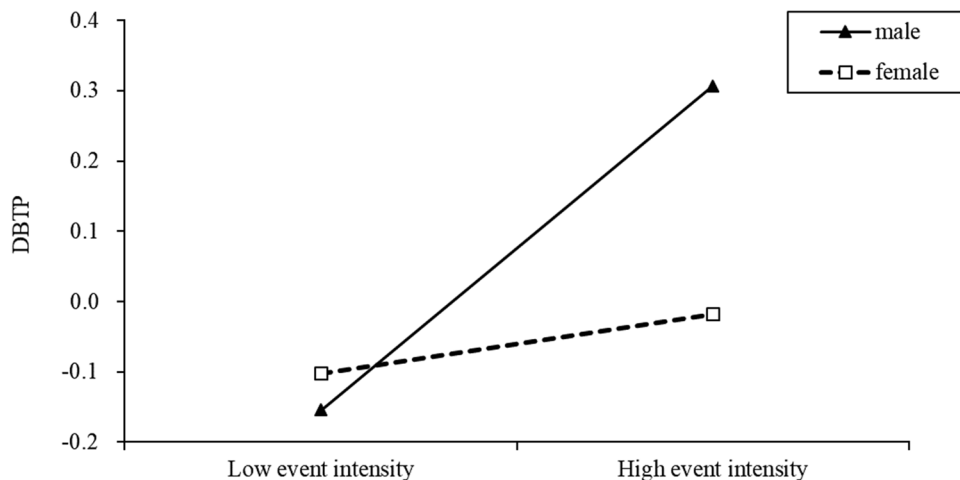
whereby TP were most likely influenced by situational forces, such as status change, challenging life events (e.g., traumas) or altered states of consciousness. COVID-19 pandemic, as a new type of traumatic event, may influence individuals' global perspectives regarding time—that is, their perception of the past, present, and future. Frank (1939) proposed that individuals with greater DBTP (less BTP) may have a biased focus on the negative past, which controls the present perspective. A biased focus on the negative past may also distort the future perspective, which further compromises the present. Both of these circumstances likely result in unhealth behaviors in the present. Because when individuals were more focused on the future, they would better regulate their behaviors and tend to take planned and purposeful behaviors to achieve their goals. However, when individuals focus only on the past and present, they do not form reasonable expectations about the future results of their actions, but tend to engage in impulsive behaviors.

In addition, previous research has demonstrated that having a more BTP is associated with greater self-control ability (Stolarski et al., 2011). Furthermore, greater self-control ability has been found to be associated with health behaviors (Hagger et al., 2019; Li et al., 2022). Therefore, individuals with a higher DBTP (less BTP) may associate with less health behaviors.

This study also found that DBTP partially mediated the relationship between COVID-19 intensity and health behaviors. It means that event intensity can directly contribute to the formation of health behaviors, as well as indirectly, by improving the individual's BTP. The current findings were consistent with Stolarski and Cyniak-Cieciura (2016) who reported that individuals exposed to more severe trauma revealed a negatively biased TP, which likely resulted in the development of PTSD. More recently, Tomich et al. (2021) also reported that the link between lifetime trauma exposure and optimism was partially mediated by DBTP, such that more lifetime trauma exposure was related to more DBTP, which likely resulted in less optimism. These findings supported the notion that BTP was an important factor in pathway between trauma exposure and positive effect, with implications for intervention strategies. Notably, working with clients to cultivate a BTP is the focus of TP Therapy (Sword et al., 2014). TP Therapy has been used successfully to treat those suffering from depression, PTSD and daily life adjustments (Sword et al., 2014). In future studies, TP Therapy can be used to intervene the BTP of individuals to examine its impact on health behaviors and further verify the accuracy of the theory in this study. In addition, BTP represented an individual's cognitive ability (Zajenkowski et al., 2016), cognitive behavior therapy (CBT), especially Internet-based CBT (ICBT) that would prevent the spread of infection during the pandemic, can also be used to promote BTP. Researches suggested that ICBT was effective in reducing psychological distress and improving mental health during the pandemic (Shirotsuki et al., 2022; Ying et al., 2021).

The moderating role of gender

This research indicated that the moderating role of gender between event intensity and DBTP. Simple analysis showed that event intensity was significantly related to DBTP in the male group, while event intensity was not associated with DBTP in the female group. These findings may indicate that female's BTP might not be as effective as male in increasing health behaviors.

Two possible explanations are as follows: First, female had a significantly more BTP profile (lower DBTP) than male (Chen et al., 2022; Chen et al., 2016). Female reported greater cognitive flexibility (Torniainen et al., 2011), and cognitive ability (e.g., cognitive flexibility) supports BTP (Zajenkowski et al., 2016), enabling the individual to switch seamlessly between different time perspectives depending on task demands and situational constraints. Chen et al. (2022) found the reason of gender difference in BTP from the aspect of neural mechanism. Neuroimaging findings suggested that, relative to male, female showed smaller grey matter volumes in the bilateral precuneus, which was associated with more BTP. This may indicate that compared with male, female's BTP are less affected by the external environment, such as the intensity of COVID-19 event. Second, female tend to be more risk averse, and adopt less risky behaviors than male (Ferrin, 2022). Studies have reported that female's risk behavior might be less dependent on the context (that is, for example, on how big the effective risk of infection is) than male, as female typically behave more safely than male even in the absence of risks. While male's risk behavior will be more influenced by risk perception and expected benefit than female's (Ferrin, 2022). Therefore, female's health behaviors are less affected by the intensity of the COVID-19 event. The reason for their health behavior during the pandemic is not that they have a more balanced time perspective, but that female tends to be more risk averse, and adopt less risky behaviors (Galasso et al., 2020; Ferrin, 2022).

Limitations and future direction

Three limitations to these findings warrant note. Firstly, given the globalization of the current pandemic crisis, our results' generalizability can extend to other contexts. Still, further replications should be performed to validate our hypothetical model either in developed, developing or under-developed contexts. Second, the mediation analyses employed here are cross-sectional in nature, which limits

any firm conclusions regarding causality. Future research where longitudinal prospective studies are needed to rule out alternative explanations of the observed effects. For example, Chudzicka-Czupala et al. (2022) showed that a reduction in the level of the measured subjective distress and in the frequency of checking COVID-19 news-related information across three periods during the pandemic in Poland. These results indicated that individuals' cognition and behavior will change with the surrounding environment. Therefore, a simple cross-sectional study can only show the current results, rather than the past or future. Longitudinal study is necessary if one wants to find out the accurate relationship between variables. Finally, since TP may be influenced by other characteristics such as age, education level, cultural factors, and so on (Liu, 2011), our work only focused on college students. More research needs to be done to those who are not in college to verify the accuracy of the results.

With the emerging literature on the mental and physical exhaustion in relation to COVID-19-related restrictions and adherence and the constant state of alert and uncertainty, a number of pandemic-related burnout/ fatigue terms have been coined by scholars, such as "COVID-19 burnout" (Yildirim & Solmaz, 2022). Chinese college students are subjected to COVID-19 burnout partly because of the dramatic shifts in educational and learning environments caused by strict and persistent pandemic-prevention measures (Wang et al., 2022). Although the Chinese government has stopped the dynamic zero-COVID-19 policy at the end of 2022, the impact of the pandemic on college students' physical and mental health will not disappear immediately, and the aftereffects of COVID-19 burnout still needs attention in the future.

Conclusion

This study probed the relationship between COVID-19 intensity and health behaviors among Chinese college students. Furthermore, we examined the mediating effect of BTP and the moderating effect of gender in this relation. The results showed that COVID-19 intensity was significantly and positively correlated with health behaviors. Moreover, for male students, COVID-19 intensity was positively correlated with DBTP, which in turn, negatively correlated with health behaviors. For female students, COVID-19 intensity was not associated with DBTP, and DBTP not mediated the relationship between COVID-19 intensity and health behaviors. This result reminds us that it is crucial to raise male's perception of risk associated with COVID-19 and BTP to improve their health behaviors.

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