

Life History Strategy and Overeating During COVID-19 Pandemic: a Moderated Mediation Model of Sense of Control and Coronavirus Stress

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Abstract

Background: This study examined the mediating effect of sense of control and the moderating effect of coronavirus stress on the relationship between life history strategy and overeating among Chinese college students during the COVID-19 period.

Methods: Thirty-three hundred and ten Chinese students (Mage = 19.74, SD = 1.50; 47% males) completed self-reported questionnaires regarding life history strategy, sense of control, overeating, and coronavirus stress. The data were analyzed using Pearson's r correlations and moderated mediation analysis.

Results: The results revealed that control sense mediated the link between life history strategy and college students' overeating. College students' coronavirus stress moderated the associations between life history strategy and college students' sense of control and between control sense and overeating. The association between life history strategy and sense of control was stronger for those with lower coronavirus stress, and the association between sense of control and overeating was stronger for those with lower coronavirus stress.

Conclusions: This study identified the critical factors associated with overeating; it supplies empirical support for existing theories and provides practical implications for interventions aiming to decrease Chinese college students' overeating during COVID-19 period.

Plain English Summary

One's response is not arbitrary when confronted with COVID-19 pandemic. Previous research has found that individuals with fast life history strategies still be more prone to overeat. We also know from other research that sense of control is the most salient aspect of overeating. However, no research has investigated whether the life history strategy of college students is significantly associated with overeating and examine the potential mediating and moderating mechanisms in this association. With the aid of 3310 participants, we found that, life history strategy was linked to college students' overeating. We also found that this relationship was partially explained by sense of control. In addition, the association between life history strategy and sense of control was stronger for those with lower coronavirus stress, and the association between sense of control and overeating was stronger for those with lower coronavirus stress. This study is an important step in unpacking how life history strategy relates to overeating of Chinese college students. However, they are limited by the cross-sectional nature of the study, meaning we cannot imply causality. We recommend that further research replicate our findings in people with diagnosed eating disorders using a longitudinal design.

1 Introduction

The novel coronavirus disease (COVID-19) is an infectious respiratory virus, declared a global pandemic on 11th March 2020 (World Health Organization, 2020). The global pandemic of COVID-19 has caused

radical changes in the structure of people's daily routines in most of the countries around the world, including people's food intake (Canello, 2020; Haddad, 2020; Martin-Neuninger, 2020). Previous studies have suggested an increase in anxiety and depressive symptoms among the general population during the COVID-19 pandemic (Vindegaard & Benros, 2020). Such negative impacts on psychological health could provoke the overeating of unhealthy food and result in weight gain (Khalid, Williams, & Reynolds, 2016; Hootman, 2018; Fernanda et al., 2019; Moynihan et al., 2015). Recent research reported that many individuals report increased binge eating, overeating, using food to cope with Coronavirus stress, and unhealthy food intake during the COVID-19 pandemic (Ammar, 2020; Phillipou, 2020; Wang, 2020). Previous study has determined that university students lack adequate and balanced meals due to their separation from their families, insufficient funds, or lack of time and information about healthy nutrition (Yilmaz, Aslan, & Unal, 2020).

Previous research has found that overeating is a relative term. Short-term overeating is a common human habit associated with feasting and celebration. In traditional societies this does no harm and may well do considerable good by replenishing body fat stores in environmental conditions in which extreme seasonality imposes a feasting and fasting mode of survival. Overeating becomes a health risk when it sustained over long periods. The fundamentals of the energy balance equation dictate that long-term overeating will always lead to body fat storage and obesity (Prentice, 1992). Overeating this article studies refers to the consumption of an energy intake that is inappropriately large for a given energy expenditure (Prentice, 2001). Overeating is not only a direct cause of obesity and eating disorders, but also an important risk factor for internalization and externalization problems such as depression, anxiety, self-harm, and substance abuse (Striegel-Moore & Bulik, 2007). As we all know, diet is a key driver of health (Global Burden of Disease Group 2019) and well-being (Govindaraju, 2018; Marx, 2017), not only through the provision of nutrients which support health (including immune health) (Calder, 2020) or patterns of consumption which influence disease risk (Global Burden of Disease Group 2019), but also the social health benefits of shared meals (Fischler, 2011). In other countries, the COVID-19 pandemic and associated containment strategies are thought to have affect eating behaviour (Dou et al., 2020; Yang et al., 2021; Zhao et al., 2020). In Italy, which experienced a severe outbreak early in the COVID-19 pandemic, one survey found that around 53% of respondents reported eating more during lockdown and 19.5% reported weight gain (Scarmozzino, 2020). Another survey of adults in Poland, more than 40 % respondents reported eating more and 42 % respondents reported weight change (loss or gain) (Sidor, 2020). Aside from the society-wide impact of confinement on diet, loss of the sense of taste and smell is a common side effect in those who infected with COVID-19 (Parma, 2020), which may also affect dietary intake.

From a psychosocial perspective, the outbreak of the COVID-19 can be likened to an acute stressful or traumatic event, involving potential threat to self and close others' survival. As such, COVID-19 can lead to the emergence of various sorts of psychological problems (Lima et al., 2020; Torales et al., 2020; Zheng, 2020). Individuals is different in their reaction propensity to experience negative life events. Whereas some react strongly to negligible life stressors; others seem to remain relatively calm even in the most adverse situations (Folkman, 1984). When confronted with challenge or environmental uncertainty

(e. g. COVID-19 pandemic), one's response is not arbitrary. In the recent literature, evolutionary-informed theories aimed to explain such individual differences have become more prevalent (Del Giudice, Ellis, & Shirtcliff, 2011; Ellis et al., 2011; Figueredo et al., 2006). One of those theories is the Life History (LH) theory, which was initially focused on explaining differences in reproductive strategies between species (Wilson, 1975). At the core of life history theory (LHT) is the appreciation for the enduring influence of information in early development being utilized as a forecast in service of meeting the environmental demands of later development (Ellis & Bjorklund, 2012; Mittal & Griekvicius, 2014). Life history strategies exist along a "slow" to "fast" continuum – terms that indicate the relative tempo of one's development and reproduction (Ellis & Bjorklund, 2012). The fast strategy and the slow strategy constitute the two poles of the life history strategy continuum. The weighing result of the individual determines its position in the continuum, and leads to the formation of corresponding personality traits as the executive body, coordinating behavior and the environment to work together to complete the adaptation task (Geng et al., 2014). Slow strategists are characterized by stable relationships (kin, romantic, social exchange partners) and a propensity for long term planning, risk averseness, and prosocial behavior (Del Giudice & Belsky, 2011). Fast life histories are marked by the opposite pattern. Fast strategists accelerate development and develop an orientation toward succeeding in the here and now, so they are more inclined to enjoy the current pursuit of instant gratification. These include risk taking, short term decision making, and decreased the level of prosocial (Del Giudice & Belsky, 2011; Ellis et al., 2003; Simpson & Belsky, 2008). In other words, when individuals are facing the negative effect of the COVID-19 epidemic, individuals with a slow life history strategy will solve the problem in a more constructive way, while individuals with a fast life history strategy will do the opposite. Although food scarcity has been improved in the modern world, individuals with fast life history strategies may still be more prone to overeat, because fast life history strategies are associated with high levels of impulsivity and instant gratification, and delicious foods can satisfy an individual's need for instant gratification (Luo et al., 2020). In addition, both cross-sectional and longitudinal studies found a positive association between fast life history strategies and addictive behavior such as smoking and alcohol abuse (Chang et al., 2019b; Lu & Chang, 2019), as well as problematic eating behaviors (Maner et al., 2017; Salmon, Figueredo & Woodburn, 2009). Maner et al. (2017) found that fast life history strategies, overeating and body mass index are three closely related variables in an online survey of 400 participants. Salmon et al. (2009) found that the fast life history strategy significantly predicted increased eating disorder symptoms. In other words, individuals with fast life history strategies during the COVID-19 epidemic may be more inclined to overeating.

Given this theoretical framework, the aim of the present study is to investigate whether the life history strategy of college students is significantly associated with overeating and examine the potential mediating and moderating mechanisms in this association.

1.1 Sense of control as a mediator

In examining the overeating, it is important to consider the possible mediators that may play a role in decreasing the levels of overeating. In particular, sense of control may be a subsequent consequence of different life history strategy as well as being an antecedent of overeating. Sense of control is a central

construct in psychology, and describes a basic motivational variable shaping one's adaption to life and coping with life stress. As Bandura (2001) observed, "among the mechanisms of personal agency, none is more central or pervasive than people's beliefs in their capacity to exercise some measures to control their own functioning and environmental events" (p. 10). "Sense of control" refers to subjective perceived control, rather than the objective control of events themselves, and this quality has both state-specific and dispositional elements (Skinner, 1996). Sense of control is a psychological driving factor for behaviors related to life history strategies (Mittal, 2014). Previous study shows that sense of control is significantly related to life history strategies (Dodge, 1990), and the fluctuating changes and levels of the sense of control are the result of internal trade-offs in the individual's life history. Fast strategists often maintain their sense of control through irrational behaviors such as current squandering and instant gratification (Wright, 2013), while slow strategists tend to maintain and improve their sense of control by reducing risky behaviors (Frey, 2017).

While past studies have evidenced that sense of control predicts a diverse range of overeating, no studies to date have directly investigated the mediating role of sense of control in the association between life history strategy and overeating in college students. While past studies have evidenced that sense of control is the most salient aspect of overeating (Telch, 1998), and that this feature is more strongly associated with psychiatric symptomatology than the quantity of food consumed (Wolfe, 2009). In the fields of obesity and eating disorders, it has been found that the ability to inhibit control is important for the regulation of dietary behavior. For example, studies have found that low control ability can cause people to experience overeating symptoms (Brooks, 2012). Previous studies have shown that there is a negative correlation between sense of control and poor eating behavior (e.g., overeating). The higher the level of individual control, the higher the level of regulation of their overeating behavior (Lu, 2015; Wu, 2015; Zhu, 2013).

Given the uncertainty associated with the course of COVID-19, it stands to reason those students with low life history strategy may engage in more sense of control, which in turn may decrease their risk for overeating.

1.2 Coronavirus stress as a moderator

Although life history strategy may impact college students' level of overeating through the mediating role of sense of control, and individuals with different life history strategies respond differently to stressors, not all college students with low life history strategy may engage in a high level of sense of control. One key buffering mechanism may be Coronavirus stress.

COVID-19 is a health threat identified as a significant stressor threatening the mental health and well-being of many individuals around the world (Bhuiyan et al. 2020; Brooks et al. 2020; Satici et al. 2020). It has been suggested that COVID-19 stress can trigger mild to severe levels of psychosocial problems, such as depression, somatization, and anxiety (Arslan & Yildirim, 2020; Bhuiyan et al. 2020; Gunnell et al. 2020; Satici et al. 2020). There is extensive evidence that stress undermines the individual's sense of control (Fisher, 2015; Keinan, 2002; Wang, 2011). In Malinowski's research, for fishermen who feel higher

stress, they have lower sense of control over life events (Case, 2010; Malinowski, 1954). This is because stress coping involves the control of attention, thinking, and emotions, and this process itself is a process of consuming sense of control (Muraven, 2000; Pan, 2017; Tan, 2012). Previous studies have found that for those who abstain from alcohol, the more stressful events they experience in a day, the more likely they are to break the rules (Muraven et al., 2005); and test stress will weaken the individual's sense of control in the laboratory and real-world situations (Oaten & Cheng, 2005). Based on past researches, uncertainties triggered by the COVID-19 crisis might bring about adverse outcomes especially for individuals who have a low sense of control, including an increase in the likelihood of these individuals' unhealthy behaviors (Zhu et al., 2020) (e.g., overeating). Thus, the relationship between life history strategy and sense of control may be diminished for college students with higher Coronavirus stress. In other words, when the level of college students' Coronavirus stress is low, as individuals' life history strategies change from fast to slow, their sense of control will increase rapidly, in contrast, their sense of control increase slower.

In addition, the psychological impact of stress is reflected in the fact that stress can lead to changes in the individual's cognition, emotions, and coping styles, thereby affecting food choices. These changes can occur alone or interact (Kandiah et al., 2006). Born et al. (2009) has found that subjects who experienced more stress pursued a richer taste experience than those in the control group who experienced less stress. This is in line with the view of escape theory. Central to escape theory is the notion of multiple levels of meaning, which are linked to multiple ways of being aware of oneself and one's activities (Baumeister, 1990a; Pennebaker, 1989; Vallacher & Wegner, 1987). In this view, the reason why an individual has overeating behavior in a stressful situation is there is a significant gap between the individual's actual state and the ideal standards. In order to avoid the negative internal experience brought about by this gap, individuals shrink their attention to the negative stimulus in environment, and this effort to avoid unpleasant emotions by narrowing the cognitive range will weaken the usual inhibitions around food (Heatherton & Baumeister, 1991; Heatherton, Herman, & Polivy, 1991; Qi, 2019). In other words, overeating is a defense mechanism when individuals face stress. Based on previous researches, when the level of college students' Coronavirus stress is lower, as their sense of control increase, their levels of overeating tend to decline rapidly; when the level of college students' Coronavirus stress is higher, as their sense of control increase, their levels of overeating tend to decline slower. To date, no previous studies examined whether Coronavirus stress as a moderator in the indirect relation between life history strategy and overeating via sense of control.

1.3 Present study

The purposes of this research were twofold: (a) to test whether sense of control would mediate the relation between life history strategy and overeating in college students, and (b) to test whether the direct and indirect relations between life history strategy and overeating via sense of control were moderated by Coronavirus stress. The proposed model is illustrated in Fig. 1. Based on the review of literature, we posit the following hypotheses:

Hypothesis 1. Sense of control will mediate the relation between life history strategy and overeating.

Hypothesis 2. Coronavirus stress will moderate the direct and indirect relations between life history strategy and overeating via sense of control.

2 Method

2.1 Participants

A total of 3310 college students in China (Mage = 19.74, SD = 1.50, range = 16 - 25, 53.3% Female) participated in this study. Participation in this study was entirely voluntary and no compensation was given to participants for their participation. To abide by local government policies, the study questionnaire was distributed to potential participants electronically via Survey Star (Changsha Ranxing Science and Technology, Shanghai, China) and no face-to-face contact was made. All participants consented to participation and data were anonymized. Furthermore, 35.4% of these participants were 1st year standing, 26.4% were 2nd year standing, 19.8% were 3rd year standing, and 18.4% were 4th year standing.

2.2 Measures

2.2.1 Life history strategy

The Chinese-version (Wang et al., 2017) of Mini-K (Figueredo et al., 2014) consists of 20 items (e.g., I have frequent contacts with my friends). Participants rated each item on a seven-point scale ranging from 1 (very inconsistent) to 7 (very consistent). The Mini-K provides a single score that indicates LH strategy ranging from a faster strategy (lower Mini-K scores) to a slower strategy (higher Mini-K scores). In this study, the internal consistency coefficient $\alpha = 0.93$.

2.2.2 Overeating

The overeating was measured by loss of control eating subscale of three-factor eating scale (Stunkard & Messick, 1985). This scale comprises 9 items (e.g., when I smell a delicious food, I find it very difficult to keep from eating, even if I have just finished a meal.), and all items are limited to the time after the outbreak of the new coronavirus disease. Participants rated each item on a four-point scale ranging from 1 (very inconsistent) to 4 (very consistent) with higher scores showing higher levels of overeating. The scale has good reliability, validity and applicability in the study of Chinese population (Chen, Luo & Chen, 2020a; Luo et al., 2020). In this study, the internal consistency coefficient $\alpha = 0.899$. Confirmatory factor analysis (CFA) suggested that the one-factor model fit the data well: RMSEA = 0.045, CFI = 0.997, TLI = 0.984, SRMR = 0.01.

2.2.3 Sense of control

Sense of control was assessed by the Chinese-version (Li., 2012) of the Sense of Control Scale (Lachman & Weaver, 1998) which consists of 12 items and includes two dimensions: personal mastery, and perceived constraints (e.g., “I can do almost anything I am determined to do”, “what I can and cannot do is mostly determined by others”). Participants rated each item on a seven-point scale ranging from 1 (very inconsistent) to 7 (very consistent). The scale has good reliability, validity and applicability in the study of Chinese population (Chen & Zhao, 2017; Geng et al., 2019; Meng et al., 2019). In this study, the internal consistency coefficient $\alpha = 0.907$

2.2.4 Coronavirus stress

The Coronavirus stress was assessed by Coronavirus Stress Measure (CSM) (Arslan et al., 2020). The scale has 5 items (e.g., how often have you felt that you were unable to control the important things in your life due to the COVID-19 pandemic?). Participants rated each item on a five-point scale ranging from 0 (never) to 4 (always) with higher scores showing higher levels of Coronavirus stress. In this study, the internal consistency coefficient $\alpha = 0.930$. Confirmatory factor analysis (CFA) suggested that the one-factor model fit the data well: RMSEA = 0.044, CFI = 0.999, TLI = 0.995, SRMR = 0.004.

2.2.4. Procedure

This study was approved by the Research Ethics Committee of the first author’s institution. We obtained consent from all participating college students before data collection. Participants were given the survey questionnaire which they provided demographic information and completed the measurements listed above.

2.2.5. Data analysis

The purpose of this study was to explore whether sense of control played a mediating role between the life history strategy and overeating of college students, and whether Coronavirus stress played a moderating role in the indirect path between the life history strategy and sense of control and the indirect path between sense of control and overeating. These research hypotheses were tested in three steps.

First, the descriptive statistics and bi-variate Pearson correlations were calculated. Second, the mediating effect of sense of control was examined by using PROCESS macro for SPSS (Model 4) (Hayes, 2017). Third, the analyses of the moderating effect of Coronavirus stress on the indirect links between life history strategy and overeating were constructed applying the PROCESS macro (Model 58). All study continuous variables were standardized, and the models utilized 5,000 resamples through bootstrapping confidence intervals (CIs) to determine whether the effects in Model 4 and Model 58 were significant (Hayes, 2017).

3 Results

3.1. Preliminary analyses

The means and Pearson-correlations among the study variables are presented in Table 1. Both life history strategy and sense of control were negatively associated with college students' Coronavirus stress ($r = -0.20, p < 0.001$; $r = -0.19, p < 0.001$) and positively associated with overeating ($r = 0.40, p < 0.001$). Overeating was negatively associated with college students' life history strategy ($r = -0.25, p < 0.001$) and sense of control ($r = -0.24, p < 0.001$). Sense of control was positively associated with life history strategy ($r = 0.45, p < 0.001$)

Table 1
Descriptive statistics and correlations among variables (N = 3310).

Variables	<i>M</i>	<i>SD</i>	1	2	3	4
1.Life history strategy	5.42	0.80	---			
2.Sense of control	5.12	0.61	0.45 ^{***}	---		
3.Overeating	2.07	0.54	-0.25 ^{***}	-0.24 ^{***}	---	
4.Coronavirus stress	2.00	0.80	-0.20 ^{***}	-0.19 ^{***}	0.40 ^{***}	---
Note. * $p < .05$, ** $p < .01$, *** $p < .001$						

3.2. Testing for mediation effect

Table 2
Testing the mediation effect of sense of control on overeating

Predictors	Model 1 (SC)		Model 2 (Overeating)	
	β	<i>t</i>	β	<i>t</i>
LHS	0.40	28.87 ^{***}	-0.16	-9.52 ^{***}
SC			-0.16	-8.74 ^{***}
R^2	0.20		0.45	
<i>F</i>	833.32 ^{***}		833.32 ^{***}	
Note: N = 3310. Each column is a regression model that predicts the criterion at the top of the column. LHS = Life history strategy. SC = Sense of control; *** $p < 0.001$.				

Hypothesis 1 assumed that sense of control mediates the relation between life history strategy and overeating. To test this hypothesis, we used Model 4 of the SPSS macro-PROCESS compiled by Hayes (2017). The regression results for testing mediation are reported in Table 2. Results indicated that life

history strategy were positively related to sense of control. The residual direct effect of life history strategy on overeating remained negative. These results showed that sense of control partially mediated the association between life history strategy and overeating (indirect effect = - 0.06, $SE = 0.085$, 95% $CI = [-0.081, -0.048]$), and the mediation effect accounted for 27.27% of the total effect of life history strategy on overeating. Therefore, Hypothesis 1 was supported.

3.3. Moderated mediation effect analysis

Table 3
Testing the moderated mediation effect of LH on Overeating

Predictors	Model 1 (SC)		Model 2 (Overeating)	
	β	t	β	t
LHS	0.37	26.85 ^{***}	-0.11	5.68 ^{***}
CS	-0.08	-5.69 ^{***}	-0.28	-9.29 ^{***}
LH × CS	-0.12	-7.79 ^{***}		
SC			-0.09	-5.31 ^{***}
SC × CS			0.15	8.96 ^{***}
R^2	0.23		0.22	
F	323.53 ^{***}		232.29 ^{***}	

Note: N = 3310. Each column is a regression model that predicts the criterion at the top of the column; LHS = life history strategy, SC = Sense of control, CS = Coronavirus stress; **p < 0.01, ***p < 0.001.

Hypothesis 2 proposed that the direct and indirect relationships between life history strategy and overeating via sense of control would be moderated by Coronavirus stress. To examine this moderated mediation model, we used Model 58 of PROCESS macro developed by Hayes (2017). The results of parameters for three regression models are shown in Table 3. Model 1 of Table 3 showed that the product (interaction term) of life history strategy and Coronavirus stress had a significant negative association with sense of control.

Following the methodology from a previous study (Wang et al., 2017), we plotted predicted sense of control against life history strategy, separately for low and high levels of Coronavirus stress (one SD below the mean and one SD above the mean, respectively) (Fig. 2). Simple slope test demonstrated that for college students with high levels of Coronavirus stress, life history strategy was positively associated with sense of control, $b_{\text{simple}} = 0.27$, $p < 0.001$. For college students with low Coronavirus stress, life history strategy yielded a stronger positive association with sense of control, $b_{\text{simple}} = 0.48$, $p < 0.001$.

Simple slope tests demonstrated that the lower the level of Coronavirus stress, the stronger the association between life history strategy and sense of control.

Moreover, as Model 2 of Table 3 illustrates, the effect of life history strategy on overeating was significant. In addition, Model 2 of Table 3 also indicated that the direct association between sense of control and overeating remain significant, and the product (interaction term) of sense of control and Coronavirus stress had a significant negative association with overeating ($p < 0.001$), which suggests the effect of sense of control on overeating was moderated by Coronavirus stress.

For a clear demonstration of the moderating role of Coronavirus stress, this study plotted the predicted overeating against sense of control, separately for low and high levels of Coronavirus stress (one SD below and one SD above the mean, respectively; Fig. 2). Simple slope tests revealed that for college students with lower level of Coronavirus stress whose sense of control significantly correlated with overeating ($b_{\text{simple}} = -0.23, p < 0.001$). For college students with higher Coronavirus stress levels, life history strategy yielded a weaker association with sense of control, $b_{\text{simple}} = 0.04, p = 0.14$. In other words, the relation between sense of control and overeating appeared to be stronger for those reporting low Coronavirus stress than those reporting high Coronavirus stress.

The bias-corrected percentile bootstrap analysis further indicated that the indirect effect of life history strategy on overeating through sense of control was moderated by Coronavirus stress. Particularly, for college students low in Coronavirus stress, the indirect effect of life history strategy on overeating via sense of control was significant, $b = -0.11, SE = 0.01, 95\% CI_{\text{boot}} = [-0.14, -0.09]$. The indirect effect for college students with high Coronavirus stress was weaker, $b = 0.01, SE = 0.01, 95\% CI_{\text{boot}} = [-0.003, 0.023]$. Results indicated that sense of control mediated the effect of life history strategy on overeating, but Coronavirus stress weakened the mediating effect of sense of control. Because Coronavirus stress moderated the indirect effects. Hypothesis 2 was supported.

4 Discussion

While several empirical studies have shown the effect of life history strategy on overeating (Luo et al., 2020; Maner et al., 2017; Salmon et al., 2009), the underlying mediation and moderation mechanisms remain less clear. Investigating the degree to which these underlying mechanisms of the overeating levels of college students with different life history strategy is vitally important during the COVID-19 period. The present study examined a novel moderated mediation model to test how life history strategy generate harmful overeating, whether this relation was mediated by sense of control, and how Coronavirus stress impact the effects of life history strategy on sense of control and the effects of sense of control on overeating. Our results indicated that the impact of life history strategy on overeating was significant and negative among Chinese college students, and this relation can be partially explained by heightened sense of control. That is, slow life history strategy increased sense of control, which in turn, decreased overeating. Furthermore, the indirect relation was moderated by Coronavirus stress in the first and second

stage of the mediation process. These two relations became weaker for college students with lower levels of Coronavirus stress.

4.1. The mediating role of sense of control

Mediation results of this study suggested that sense of control was not only an outcome of life history strategy but also a partial catalyst for overeating. For the first stage of the mediation process (i.e., life history strategy → sense of control), this study indicated that low life history strategy promoted the activation of sense of control mechanisms during the COVID-19 period. This finding is in line with prior literature on sense of control and overeating, whereby sense of control are partly mutable in response to overeating (Brooks, 2012; Telch, 1998; Wolfe, 2009). Individuals with fast life history strategy think that they cannot change anything and future is beyond their control. Therefore, they feel less sense of control over life and their future during the COVID-19 period. Individuals with slow strategy have more successful life experience and make them believe that they can decide own future, and thus have a stronger sense of control over their life (Dewall, 2011; Geng, 2019). Indeed, those who have fast life history strategy may be more sensitive to the influence of external environment (e. g. COVID-19) which may lead to loss sense of control.

For the second stage of our mediation model (i.e., sense of control → overeating), the present study found that sense of control was associated with overeating. In the context of the COVID-19 crisis, individuals' sense of control is more difficulty to maintain (Zhu et al., 2020). According to an experimental study, individuals who loss of sense of control showed a trend towards eating faster, and reported greater desire to eating, feelings of hunger, and liking of higher carbohydrate food intake than control group (Kurz, 2017), In other words, the sense of control affects the individual's overeating. In summary, individuals with slow life history strategy tend to have long-term goals which led to higher levels of sense of control and avoid overeating behaviors, while individuals with a fast life history strategy tend to pursue timely satisfaction which led to lower levels of sense of control and more overeating behaviors during the COVID-19 period.

It is also worth noting, however, that sense of control only partially mediated the association between life history strategy and overeating. That is, life history strategy remained a significant, direct predictor of overeating even upon controlling for sense of control. The remaining direct and negative association between life history strategy and overeating may suggest that slow life history strategy are uniquely salient factors that could significantly decrease the prevalence of overeating during the COVID-19 period. Thus, each of the separate paths in the mediation model was noteworthy and social interventions may be necessary at various stages of managing one's life history strategy to mitigate susceptibility to overeat.

4.2. The moderating role of coronavirus stress

A study in the United States shows that individuals who experience high levels of COVID-19 related pressures believe that their eating habits are worse than before the COVID-19 epidemic (Khubchandani, Kandiah & Saiki, 2020). Our findings suggested that coronavirus stress could moderate the relation

between life history strategy and sense of control as well as the path between sense of control and overeating. For the first stage of the moderated mediation model pattern were consistent with the Drop in the bucket model which means that the moderating variable could increase the adverse effect of the independent variable on the moderate variable (Li, 2012) and showed that the favorable effects of life history strategy on sense of control were weaker among college students with high coronavirus stress than in those with low coronavirus stress. Coronavirus stress may serve as a risk factor that enhance the positive effect of life history strategy on sense of control during the COVID-19 period. There is a possible explanation for this finding. For people with fast life history strategy, coronavirus stress makes college student`s desire for instant gratification stronger and more difficult to rationally plan for future events, and lower sense of control. Thus, coronavirus stress acting as a risk enhance fast life history strategy on sense of control among college students. For the second stage of the moderated mediation model pattern were consistent with the charcoal in the snow model (Li, 2012) and showed that the adverse effects of sense of control on overeating were weaker among college students with high coronavirus stress than in those with low coronavirus stress. Coronavirus stress may serve as a risk factor that enhance the adverse effect of sense of control on overeating. The escape theory is a possible explanation for this finding. For people with lower sense of control, coronavirus stress makes college students to have more difficulty to control themselves which may led to more overeating behaviors. Thus, coronavirus stress acting as a risk increasing sense of control on overeating among college students during COVID-19 period.

Based on the life history theory, this study reveals the influence of psychological instinct on individual behaviors, and provides an evolutionary explanation for this path. The findings have theoretical and practical contribution. In the context of the COVID-19 epidemic, the study deepens the theory's application and interpretation in the field of eating behaviors in the Chinese context. By exploring the role of the cognitive tendency of life history strategies, we can provide evidence for the intervention of cognitive strategies for overeating; it can also reduce the possibility of overeating by enhancing the individual's sense of control; reducing the individual's coronavirus stress can also reduce the possibility of overeating.

4.3. Limitations and future directions

Interpretation of the findings of this study must consider the following limitations. Firstly, the fact that this study is a cross-sectional survey study does not allow inference of causality. Future studies may examine longitudinal data as they become available to infer causality of the findings in this study. Secondly, the measures are based on a Chinese college student sample and the extent to which results may be generalizable to other cultural contexts or demographics is limited. Future studies may collect data from multiple informants (e.g., teacher, peer, or parent) across different cultures to further examine the robustness of our findings. Additionally, the current study did not collect information regarding students' majors nor family socioeconomic status. Prior studies have identified both healthcare related majors and family socioeconomic status to be relevant factors in COVID-19-related stress and behaviors (Tan et al., 2020; Tran et al., 2020) and future studies may incorporate this. Future studies may also examine the robustness of the model presented in this paper in other populations that may be exposed to

qualitatively different COVID-19 stressors in both frequency and intensity (e.g., frontline healthcare workers), and longitudinal studies of eating behaviour and other behavioural risk factors are needed to understand both short-term and long-term mental and physical health impacts

5 Conclusion

Although further replication and extensions are needed, this study is an important step in unpacking how life history strategy relate to overeating of Chinese college students. Because sense of control served as one potential mechanism by which life history strategy were associated with overeating, it remains important to directly or indirectly reduce coronavirus stress to enhance the impact of sense of control on overeating. Accordingly, intervention programs should aim at helping people to maximize their experience of mental well-being rather than devaluing them, by dealing with COVID-19 related stressors diminishing mental well-being. Psychological assistance under the COVID-19 epidemic should start from reducing the individual's coronavirus stress, such as using cognitive behavioral therapy (Goossens et al., 2011), etc. This method is not only suitable for disaster-affected backgrounds, but also helps to positively improve the psychology and behavior of residents after the disaster.

Abbreviations

LHT: life history theory

LHS: life history strategy

SC: Sense of control

CS: Coronavirus stress

Declarations

- Ethical Approval and Consent to participate

This study was approved by the Research Ethics Committee of the first author's institution. We obtained consent from all participating college students before data collection. Participants were given the survey questionnaire where they provided demographic information and completed the measurements listed above. The ethics review approval code is IRB-JXNU-PSY-2020002.

- Consent for publication

N/A.

- Availability of supporting data

This study data is available to researchers.

- Competing interests

All authors report no conflicts of interest.

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- Authors' contributions

Baojuan Ye and Ruining Wang conceptualized the study. Ruining Wang completed the statistical analyses. Baojuan Ye, Ruining Wang, Mingfan Liu, Xinqiang Wang and Qiang Yang contributed to the drafting and revising of the manuscript. All authors read and approved the final manuscript.

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Figures

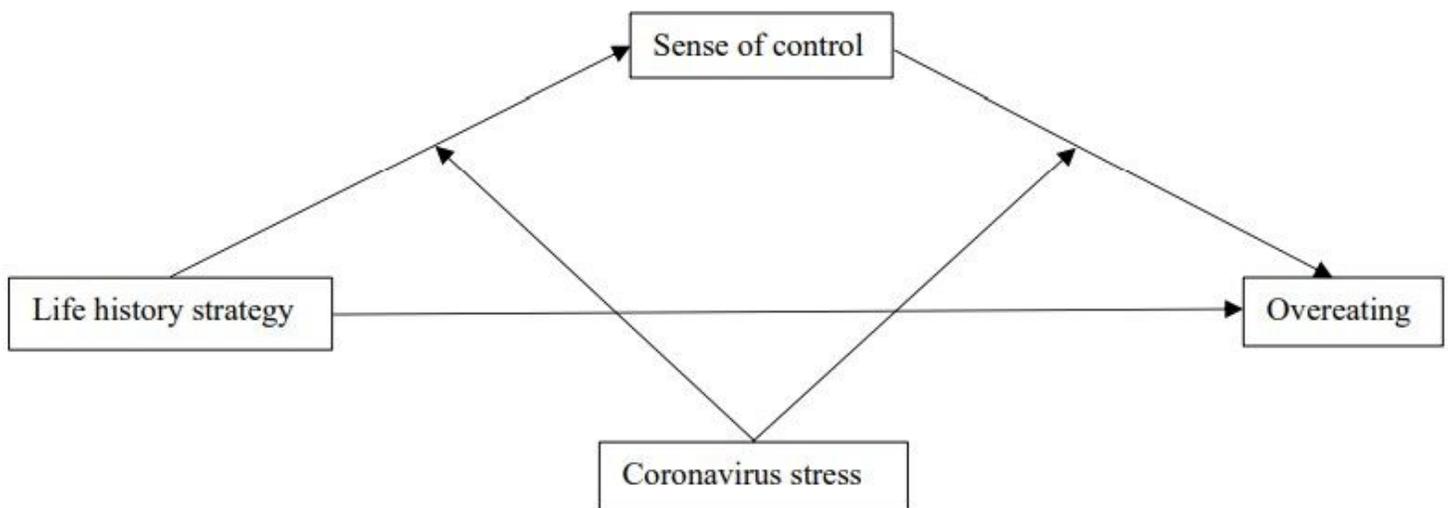


Figure 1

The proposed moderated mediation model.

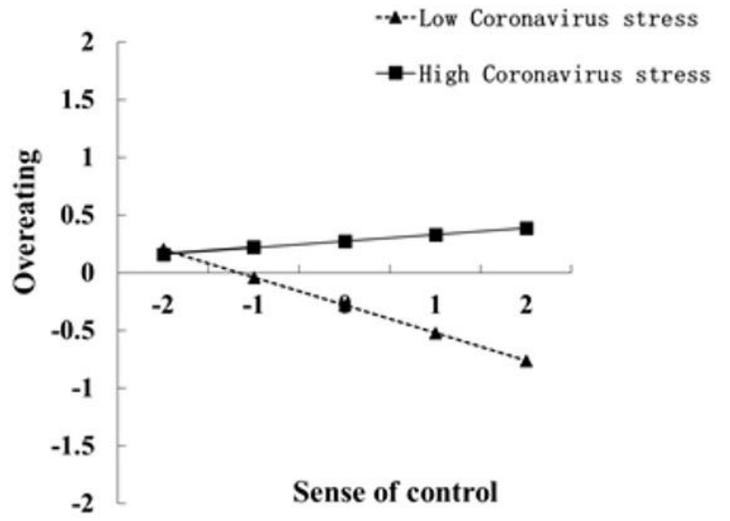
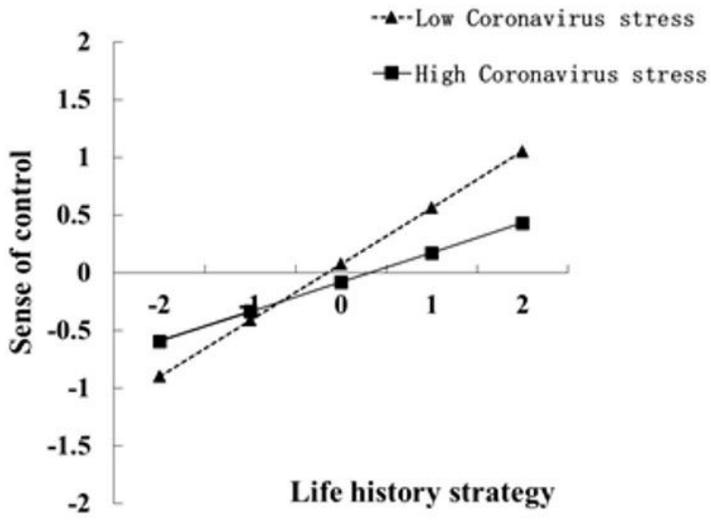


Figure 2

Interaction graphs for indirect paths.