The Effect of Home-based Physical Activity on Mood State during the COVID-19 Epidemic: The Mediating Role of Boredom

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Abstract

Objective: To analyze the impact of the COVID-19 epidemic on residents, and investigate the relationship between home-based physical activity, boredom and mood state. **Method:** A sample survey of 501 residents completed the Physical Activity Rating Scale-3, the Multidimensional State Boring Scale and Profile of Mood States. **Results:** In this epidemic, residents showed boredom and mood disturbance. In less severe areas, residents' negative psychological experiences are more severe than those in more severe areas. Home-based physical activity was negatively correlated with boredom and mood disturbance, and boredom is positively correlated with mood disturbance. Boredom mediated the relation between home-based physical activity and mood disturbance. **Conclusion:** The COVID-19 epidemic has caused residents to experience more boredom and mood disturbance; home physical exercise can not only improve emotional state directly, but also improve emotional state through boredom.

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【**Abstract** 】 **Objective:** To analyze the impact of the COVID-19 epidemic on residents, and investigate the relationship among home-based physical activity, boredom and mood state. **Methods:** A sample of 501 residents completed the Physical Activity Rating Scale-3, the Multidimensional State Boredom Scale and the Profile of Mood States. **Results:** Residents showed increased boredom and mood disturbance in the context of the epidemic. Negative psychological experience was more acute in residents in less severe areas than in those in severe areas. Home-based physical activity was negatively correlated with boredom and mood disturbance, and boredom was positively correlated with mood disturbance. Boredom mediated the relation between home-based physical activity and mood disturbance. **Conclusion:** The COVID-19 epidemic caused residents to experience more boredom and mood disturbance; home-based physical activity improved mood state not only directly but also through boredom.

【**Key words** 】 Physical Activity; Mood state; Boredom; COVID-19 Epidemic

Introduction

In early 2020, Chinese residents experienced a nationwide COVID-19 epidemic that had an enormous negative impact on the mental health of the general public (Chang, Huang, Zhao, Ma, Sun, Shi, & Fan, 2020). A

variety of psychological reactions emerged as workers were forced to delay their return to work, students could not attend school, and the general public was instructed to stay at home in a relatively confined space for an extended period. Such a situation will inevitably have a negative impact on the psychological state of residents and can easily lead to the development of negative emotions, including anxiety, depression, remorse, and anger, and may also produce hypochondriac, compulsive, or even stress-related physical symptoms, thereby affecting immune function.

Mood state is a weak, stable and long-lasting emotional state, that affects all of a person's mental activity (Lazarus, 1994). It is not a specific experience related to a certain thing, but an emotional tendency that affects the nature of all human experiences, that is, an undirected diffuse emotional experience. Although scholars (Alpert, & Rosen, 1990) have sought to distinguish the concepts of mood state and emotion, some recent studies (Athanasou, 2019; Dergaa, Fessi, Chaabane, Souissi, & Hammouda, 2019) do not do so; thus, it can be considered that mood and emotion are very similar to each other to some extent. Boredom is a negative emotional experience caused by a lack of activity and loss of interest in daily life (Zhou, Wang, & Dong, 2012), and is characterized by unpleasant feelings, lack of stimulation and low physiological arousal (Danckert, & Allman, 2005). With the continuous improvement of material and cultural living standards, people's demand for leisure time activities has increased correspondingly. If this demand is not met, then boredom will arise. However, during the COVID-19 epidemic, people were confined to their homes, and in addition to experiencing monotony and unchanging surroundings, they also had more free time; thus, the emotional experience of boredom became more common. According to a survey on the emotional state of Chinese and Americans conducted by the Institute of Psychology, Chinese Academy of Sciences, boredom was the most common emotional state of Chinese people during the epidemic. Tilburg et al. (2017) studied the difference between boredom and other negative experiences and pointed out that the lack of a sense of meaning and attention best distinguished boredom. Physical activity (e.g., push-ups and aerobics) involves the stretching of muscles against bones and the consumption of energy. It is a planned and repetitive physical activity that promotes health and improves sport skills (Xia, Ding, Zhuang & Chen, 2018).

Previous studies have shown that physical activity can promote individual cognitive function (Cox, O'Dwyer, Cook, Vetter, Cheng, Rooney, & O'Connor, 2016; Ekkekakis, 2003) and further play a positive role in promoting psychological state, improving mood and regulating emotions (Hyde, Maher, & Elavsky, 2013; Monteiro-Junior, Rodrigues, Campos, Flávia, & Machado, 2017; Mishra, & Klasnja, 2017). Regular participation in sports can cultivate positive emotions and dispel negtive emotions, and regardless of the duration of the exercise, it can effectively produce mood improvement (Crush, Frith, & Loprinzi, 2018). Even a one-time sports activity can have positive emotional benefits (Zhang, & Zhou, 2013). Zenko et al. (2016) tested a novel method for improving the affective experience of exercise, to further complete the research in this field. During the COVID-19 epidemic, the physical activity that the average resident could engage in was restricted to indoors, and it is unknown how much of an impact this home-based physical activity can have on the mood state. Although physical activity can directly affect mood state, there may be other variables that intervene between physical activity and mood state. This problem deserves further study and is of more practical significance in the context of sheltering in place during the epidemic. Tsapelas et al. (2009) suggest that individuals with a tendency to be bored have more negative emotions than other people. In addition, anxiety and depression, two negative emotions, are strongly correlated with boredom, and their clinical symptoms are very similar (Barbalet, 1999). Boredom also causes negative emotions such as anxiety and depression (Chen, 2016), which have a negative impact on people's overall mental activity (Jin, Lu, Zhang, Zhang, Liu, & Li, 2016). Zhou Hao et al. (2012) find a significant correlation between boredom and individual behavior. They proposed an external coping strategy for boredom – making changes, that is, increasing the degree of novelty of stimuli and adjusting the difficulty of tasks to increase the sense of excitement and control, thus eliminating the state of boredom. Therefore, physical activity is an effective way to reduce individual boredom experience, and can improve the mood state, further playing a positive role in promoting the state of mind.

Based on previous research (Wen, & Ye, 2014), a mediating model diagram (see figure 1) was constructed to explore the mechanism affecting the mood state of people living at home. In this study, in which people

confined to their homes during the epidemic period were taken as the subjects, the effect of the epidemic severity level on boredom and mood state were investigated and the effect of physical activity on mood state improvement and the mediating effect of boredom were discussed to provide a new perspective for the improvement of mood state in the general public.

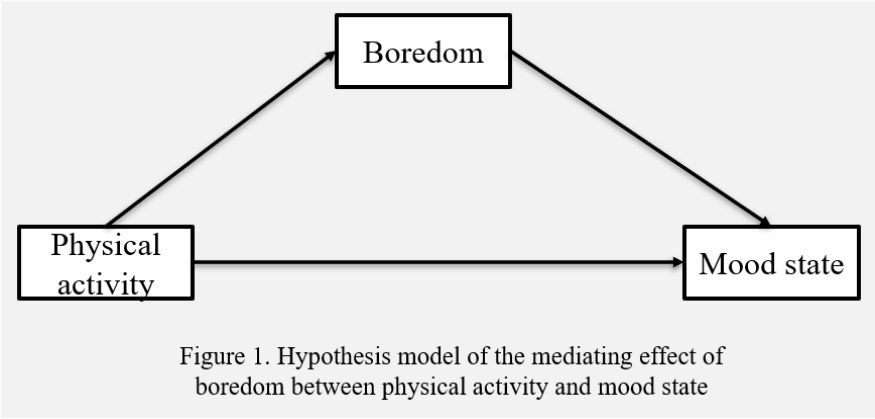

Figure 1. Hypothesis model of the mediating effect of boredom between physical activity and mood state

Subjects & methods

Subjects

A convenience sampling method was adopted. The questionnaire was built on Questionnaire Star and distributed online. In total, 523 questionnaires were recovered; 22 questionnaires with excessively short response times and obvious errors were deleted, and 501 valid questionnaires were ultimately obtained, for an effective rate of 95.7%. Among the respondents, 194 (38.7%) were males and 307 (61.3%) were females. The age distribution was as follows: 15 respondents were under 18 years old (3%), 340 were between 18 and 30 years old (67.9%), 46 were between 31 and 40 years old (9.2%), 73 were between 41 and 50 years old (14.6%), and 27 were over 50 years old (5.4%). The specific information is shown in table 1.

Table 1. Distribution of male and female respondents in each age group

gender	under 18 years old	between 18 and 30 years old	between 31 and 40 years old	between 41 and 50 years old	o
male	4	120	16	35	
female	11	220	30	38	8
total	15	340	46	73	2

Research tools

Physical Activity Rating Scale-3, PARS-3

The Physical Activity Rating Scale (PARE-3) was compiled by Kumio Hashimoto and revised by Liang Deqing et al (2020). The scale includes three dimensions of physical activity, namely, physical activity intensity, physical activity time, and physical activity frequency, with one item per dimension. Physical activity intensity and physical activity frequency were scored on a 5-point scale ranging from 1 to 5, and physical activity time was scored on a 5-point scale ranging from 0 to 4. The total amount of physical activity was scored as follows: intensity × time × frequency. Thus, the highest score for the amount of physical activity was 100, and the lowest score was 0. The physical activity levels were categorized as follows: an exercise quantity score less than or equal to 19 was considered a low amount of exercise; a score between 20 and 42 was considered a moderate amount; and a score greater than or equal to 43 was considered a large amount. The internal consistency coefficient of this scale is 0.82; in this survey, it was 0.79.

Multidimensional State Boredom Scale, MSBS

The Chinese Revised Version of the Multidimensional State Boredom Scale (MSBS), compiled by Fahlman and Eastwood et al., was translated by Liu Yong et al (2013). The questionnaire includes five subscales: lack of attention, time perception, low arousal, high arousal and disengagement. The total boredom score is the sum of the scores of each subscale. The higher the score is, the more boring the current state. The internal consistency coefficient of this scale is 0.90; in this survey, it was 0.95.

Profile of Mood States, POMS

The Profile of Mood States (POMS), which was compiled by Grove and revised by Zhu Beili (1995). It is composed of seven subscales, namely, tension, anger, fatigue, depression, energy, panic and self-esteem. Responses are given on a five-point scale from 'almost none' to 'very'; the items are all positively scored. The original scores of each subscale are summed, and the T score of each subscale is calculated with reference to the norm. TMD (total mood disturbance) = the sum score of the 5 negative emotions (stress, anger, fatigue, depression, panic) minus the sum score of the two positive emotions (energy, self-esteem) + 100. The internal consistency coefficient ranges from 0.62 to 0.82, with an average r=0.71. The internal consistency coefficient in this survey was 0.94.

Data processing

SPSS24.0 statistical software was used for analysis. Exploratory factor analysis was used for the common method bias test, the independent samples t test was used to investigate the impact of epidemic severity on boredom and mood state in disaster areas, and Pearson's product-moment correlation analysis was used to investigate the correlation among physical activity, boredom and mood state. The mediating role of boredom between physical activity and mood state was examined using the PROCESS 3.3 macro. p <0.05 indicates statistical significance.

Results

Common method bias test

To avoid test for the presence of common method bias caused by the self-report method used to collected the data, the Harman single factor test method was used to carry out exploratory factor analysis without rotation for all the questionnaire items. The results yielded 12 common factors with eigenvalues greater than 1, and the first common factor explained 31.89% of the total variance, which is less than the recognized judgment standard of 40%. Therefore, there was no obvious common method bias in this study.

The effects of epidemic severity on boredom and mood state

The national epidemic map on February 28, 2020, was referenced to divide participants based on epidemic severity. Those in areas with fewer than 500 confirmed COVID-19 patients were considered to live in a less severe area (Gansu Province, Qinghai Province, etc.), and those in areas with more than 500 confirmed patients were considered to live in a severe area (Sichuan Province, Jiangxi Province, Anhui Province, etc.).

Compared with those reported in prior research (Liu, Chen, Jiang, Xu, Liu, & Eastwood, et al, 2013; Zhu, 1995), the total scores of boredom and mood disturbance were higher among residents in this study. To analyze whether epidemic severity affects boredom and mood state, an independent samples t test was conducted with regional epidemic severity (less serious, serious) as the independent variable and boredom and its dimensions (lack of attention, time perception, low arousal, high arousal and disengagement) as the dependent variables (see table 2). The results showed no significant difference for the total boredom score or for any of dimension scores (p >0.05).

Table 2. Descriptive statistics *(M±SD)* and results of the independent samples *t* test on the effect of epidemic severity on boredom

epidemic severity	n	lack of attention	time perception	low arousal	high arousal	disengagement	boredom

epidemic severity	n	lack of attention	time perception	low arousal	high arousal	disengagement	boredom
total	501	18.62± 7.59	18.56± 7.82	17.30± 7.82	11.65± 6.22	19.13± 7.12	85.26± 31.59
less severe	131	19.29± 7.26	17.97± 7.84	17.88± 7.98	12.13± 6.64	19.91± 6.88	87.18± 32.30
severe	370	18.38± 7.70	18.77± 7.82	17.10± 7.77	11.48± 6.06	18.85± 7.19	84.58± 31.35
t		1.18	-1.00	0.98	1.04	1.47	0.81
Partial η^2		0.24	0.32	0.33	0.30	0.14	0.42

Another independent samples t test was conducted with epidemic severity (less serious, serious) as the independent variable, and mood state and its dimensions (tension, anger, fatigue, depression, energy, panic and self-esteem) as the dependent variables (see table 3). The results showed no significant difference for the TMD score or the dimension scores (p >0.05).

Table 3. Descriptive statistics *(M±SD)* and results of the independent samples *t*test on the effect of epidemic severity on mood state

epidemic severity	n	tension	anger	fatigue	depression	energy	panic	self-esteem	moo
total	501	7.85± 5.00	7.60± 6.26	6.55± 4.56	6.89± 5.44	12.35±4.50	6.56± 4.17	9.10± 3.47	114
less severe	131	8.13± 5.46	7.40± 6.75	6.76± 4.96	7.05± 5.79	12.76±4.70	7.17± 4.45	9.11± 3.91	114
severe	370	7.76± 4.83	7.66± 6.08	6.48± 4.41	6.83± 5.32	12.22±4.42	6.35± 4.04	9.09± 3.30	113
t		0.72	-0.41	0.62	0.40	1.14	1.93	0.04	0.35
Partial η^2		0.47	0.68	0.54	0.69	0.26	0.05	0.97	0.73

Correlation analysis of physical activity, boredom and mood state

Descriptive statistics were calculated and Pearson's product-moment correlation analysis was carried out for physical activity, boredom, mood disturbance, positive mood and negative mood, as shown in table 4. Physical activity was negatively correlated with boredom, negative mood and mood disturbance and positively correlated with positive mood; boredom was positively correlated with negative mood and mood disturbance; and mood disturbance was negatively correlated with positive mood and positively correlated with negative mood.

Table 4. Correlation analysis of physical activity, boredom and mood state

	M	*SD*	1	2	3	4	4	5
physical activity	15.03	20.58	1					
boredom	85.26	31.59	-0.11*	1				
positive mood	21.46	7.57	0.17**	-0.07	1			
negative mood	35.46	23.93	-0.12**	0.62**	0.08	1		
mood disturbance	114.00	24.59	-0.17**	0.63**	-0.23**	0.95**	1	1

Note: $^{*}p$ <0.05,$^{**}p$ <0.01, the same below.

The effects of physical activity on mood states: a mediating model test of boredom

First, the mediating effect of boredom between physical activity and mood disturbance was tested using Model 4 in PROCESS 3.3 (Model 4 is a simple mediating model). As shown in table 5, physical activity

had a significant negative predictive effect on mood disturbance (β =-0.17, t =-3.91, p <0.01), and after the mediating variable was added, the negative effect remained significant (β =-0.10,t =-2.94, p <0.01). Physical activity had a significant negative predictive effect on boredom (β =-0.11,t =-2.55, p <0.05), and boredom had a significant positive predictive effect on mood disturbance (β =0.61, t =17.62,p <0.01). In addition, the 95% bootstrap confidence intervals for the direct effect of physical activity on mood disturbance and the mediating effect of boredom did not contain 0. As shown in table 6, physical activity can not only directly predict mood disturbance but can also predict emotional turmoil through boredom; its direct effect (-0.10) and mediating effect (-0.07) accounted for 59.51% and 40.49% of the total effect (-0.17), respectively.

Table 5. Mediating model test of boredom on physical activity and mood disturbance

Regression equations (n=501)	Regression equations (n=501)	Fitting indexes	Fitting indexes	Fitting indexes	Coeffi
outcome variables	predictive variables	R	R^2	F	β
mood disturbance		0.17	0.03	15.26^{**}	
	physical activity				-0.17
boredom		0.11	0.01	6.52^{*}	
	physical activity				-0.11
mood disturbance		0.63	0.40	167.52^{**}	
	boredom				0.61
	physical activity				-0.10

Note: Each variable in the model adopts a standardized variable in the regression equation, the same below.

Table 6. Decomposition table for the direct effect, mediating effect and total effect

	Coefficient	Boot SE	Boot ULCI	Boot LLCI	Relative coefficient	
direct effect	-0.10	0.04	-0.03	-0.18	59.51%	59.51%
mediating effect	-0.07	0.03	-0.01	-0.13	40.49%	
total effect	-0.17	0.04	-0.09	-0.26		

Note: Boot SE, Boot ULCI and Boot LLCI refer to the standard error, upper limit and lower limit, respectively, of the 95% confidence interval of the indirect effect estimated by the percentile bootstrap method with deviation correction, the same below.

Second, the mediating effect of boredom between physical activity and negative mood was tested using Model 4 in PROCESS 3.3 (Model 4 is a simple mediating model). As shown in table 7, physical activity had a significant negative predictive effect on negative mood (β =-0.12,t =-2.70, p <0.01), and after the mediating variable was added, the negative effect was no longer significant (β =-0.05, t =-1.42, p >0.05). Physical activity had a significant negative predictive effect on boredom (β =-0.11, t =-2.55, p <0.05), and boredom had a significant positive predictive effect on negative mood (β =0.61, t =17.39, p <0.01). In addition, the 95% confidence interval for the direct effect of physical activity on negative mood contained 0, but that for the mediating effect of boredom did not. As shown in table 8, physical activity predicts negative mood through the mediating effect of boredom (-0.07), accounting for 58.12% of the total effect (-0.12).

Table 7. Mediating model test of boredom on physical activity and negative mood

Regression equations (n=501)	Regression equations (n=501)	Fitting indexes	Fitting indexes	Fitting indexes	Coeffi
outcome variables	predictive variables	R	R^2	F	β
negative mood		0.12	0.01	7.30^{**}	
	physical activity				-0.12

Regression equations (n=501)	Regression equations (n=501)	Fitting indexes	Fitting indexes	Fitting indexes	Coeffi
boredom		0.11	0.01	6.52*	
	physical activity				-0.11
negative mood		0.62	0.39	157.03**	
	boredom				0.61
	physical activity				-0.05

Table 8. Decomposition table for direct effect, mediating effect and total effect

	Coefficient	Boot SE	Boot ULCI	Boot LLCI	Relative coefficient	
direct effect	-0.05	0.04	0.02	-0.12	41.88%	41.88%
mediating effect	-0.07	0.03	0.01	-0.13	58.12%	
total effect	-0.12	0.04	-0.03	-0.21		

Finally, since there was no significant correlation between positive mood and boredom in the correlation analysis, it was concluded that physical activity does not predict positive mood through the mediating effect of boredom.

Discussion

The "psychological eye of the hurricane" of the COVID-19 epidemic

The study found that, in general, during the epidemic, residents showed increased levels of boredom and mood disturbance. There was no significant difference in boredom and mood state by epidemic severity level. However, according to the descriptive statistics, the boredom and mood disturbance levels reported by residents in the less severe areas were generally higher than those reported by residents in severe areas. This may reflect a slight "psychological eye of the hurricane" effect. Under this phenomenon, the closer a person is to the risk center, the calmer the person will feel and the lower the level of risk perception will be (Xu, Zheng, Rao, Kuang, Yang, Ding, Li, & Li, 2020).

This phenomenon was first observed during the Wenchuan earthquake (Li, Rao, Ren, Bai, Zheng, & Li, et al, 2009). The survey results show that the estimation of the severity of the disaster is higher among non-disaster-area residents than among disaster-area residents, suggesting that the former is more worried about the disaster than the latter and supporting the existence of a "psychological eye of the hurricane". At present, from a comprehensive perspective, the possible mechanisms explaining and predicting this phenomenon proposed by the academic community can be summarized into four categories: benefit judgment, psychological immunity, cognitive dissonance, and experience-description (Xu, Zheng, Rao, Kuang, Yang, Ding, Li, & Li, 2020).

Direct effect of physical activity on mood state

This study found that physical activity has a significant negative predictive effect on TMD and negative mood and a significant positive predictive effect on positive mood. In other words, with the increase in physical activity, the mood state of residents is correspondingly improved. This effect is achieved through the reduction of negative emotions and activation of positive emotional experiences (Strasser, & Fuchs, 2015). In addition, physical activity intensity, physical activity time, and physical activity frequency all affect the emotional experience of residents (Qiu, & Zhang, 2019). However, during the COVID-19 epidemic, residents' outdoor activities were severely restricted, thus hindering and limiting many physical activities. However, to maintain a good emotional experience and mood state, residents should maintain a moderate amount of physical activity, and even simple activities like stair climbing can have a positive impact on the mood state (Andreas, Adam, Emily, & Liana, 2019). Jiang Changhao et al. (2014) explored the cognitive mechanism

of the influence of physical activity on mood state, and pointed out that physical activity can promote the release of certain neurotransmitters, thus improving mood state.

The mediating effect of boredom between physical activity and mood state

This study found that physical activity can not only directly predict mood state, but can also indirectly predict mood state through boredom, that is, boredom plays a mediating role between physical activity and mood state.

Physical activity can significantly affect boredom, which is consistent with a previous study (Viira, & Raudsepp, 2000; Ekkekakis, Parfitt, & Petruzzello, 2011). The research of Pekrun et al. (2010) shows that boredom has specific emotional components; therefore, it can be considered a specific negative emotion similar to anger and depression. Physical activity can effectively alter the emotional state of individuals. When individuals engage in sports activities, they reduce the empty leisure time in their lives and enrich their emotional experience. Therefore, moderate physical activity can reduce the boredom of individuals.

In addition, previous studies have shown that boredom is associated with several negative emotions (Ejaz, Schur, & Noelker, 1997; Van Hooft, & Van Hooff, 2018). Isacescu et al. (2017) found that boredom was associated with various forms of cognitive and emotional dissonance. Huang Shihua et al. (2011) summarized previous psychological studies on boredom and pointed out that boredom can significantly predict negative emotions such as despair, loneliness and anxiety. The correlation between positive mood and boredom is not significant, which indicates that physical activity does not predict positive mood through the mediating effect of boredom. Individuals should do as much as possible to engage in moderate physical activity within their capacity during home confinement to reduce feelings of boredom and further reduce negative mood.

Conclusion

(1) In the context of the epidemic, residents showed more boredom and mood disturbance, and negative psychological experience was more acute among residents in less severe areas than among residents in severe areas; (2) home-based physical activity was negatively correlated with mood disturbance and boredom, and boredom was positively correlated with mood disturbance; and (3) physical activity improved the mood state of residents not only directly, but also indirectly through boredom. (4) Residents are therefore advised to engage in moderate physical activity at home.

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