

# Meta-analysis on the Effect of Physical Activity on Improving Anxiety and Depression of College Students during the COVID-19 Pandemic

Xiaxia Huang<sup>1, a</sup>, Xiangyin Meng<sup>1, b</sup>

<sup>1</sup>Kashigar University, Kashigar 510000, China

<sup>a</sup>huangxx.work@foxmail.com, <sup>b</sup>mxy\_jlbz666@163.com

\*Systematic Review Registration: PROSPERO CRD 42022378820

## Abstract

**Background:** The COVID-19 has creating panic among people around the world and is causing a huge public mental health crisis. A large number of studies showed that college students' detection rate of anxiety and depression during the epidemic is higher than before. **Method:** Systematic review the studies on physical activity (PA) interventions of anxiety and depression on college students during COVID-19 published from January 2020 to April 2023. **Result:** There were statistically significant differences between the PA intervention and control groups [SMD= - 0.95, 95% CI (-1.30, - 0.59), P<0.00001], which confirmed that PA intervention could significantly improved the anxiety and depression of college students during the epidemic. **Conclusion:** Through the intervention of Baduanjin, aerobic and other sports, the level of college students' mental health was promoted, which provide suggestions and opinions for the public health emergency and give the positive guidance to the mental health education for the university students.

## Keywords

COVID-19, Physical Activity, College Students, Anxiety, Depression.

## 1. Introduction

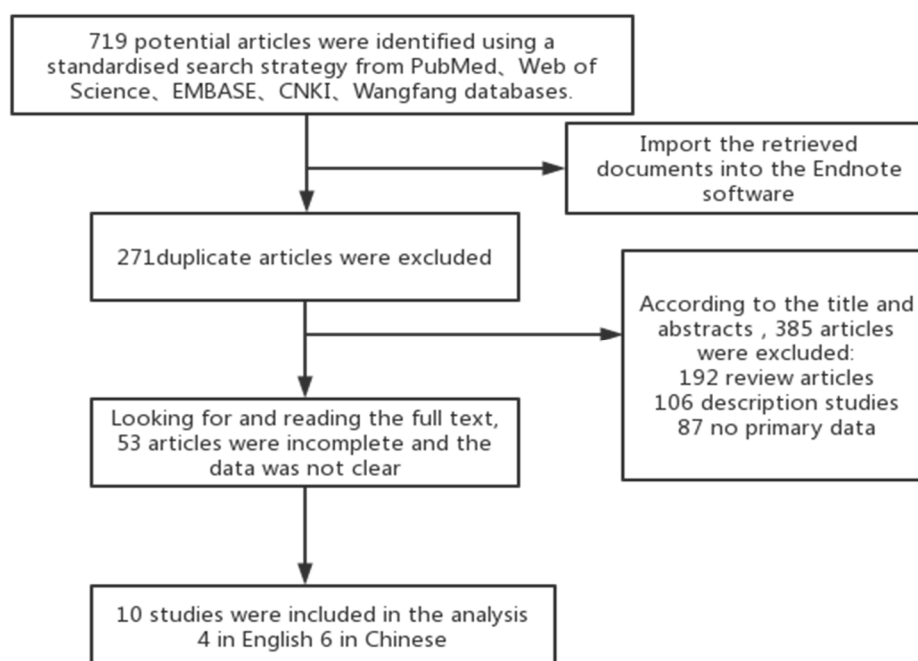
The World Health Organization published in a scientific brief that the pandemic has increased the prevalence of depression and anxiety globally by 25%[1]. It can be seen that the epidemics not only bring the threat of virus infection to life safety, but also bring public mental health problems such as anxiety and depression. Many studies have pointed out that the college students have more prominent mental health problems such as anxiety and depression in the case of home isolation, online learning, and campus closure and etc. Such as, French university students have different levels of tension and anxiety due to the lockdown management of the epidemic[2]. In the questionnaire results of 2031 American college students, it was found that more than 48% showed moderate or even severe depression levels, and more than 38% showed moderate or even severe anxiety levels[3]. And the other investigate the psychological impact of the pandemic on 478 university students and 478 general workers in Italy, and collect data through questionnaires, which showed that the college students were more likely to have symptoms of anxiety and depression[4]. Besides, during the epidemic, the closed management and online learning of "non-stop learning" have led to a high detection rate of negative emotions such as depression, anxiety symptoms, and stress among college students[5]. The mental health of college students during the epidemic should be more attention. Amatori et al. found that college students who participated in physical exercise during the epidemic can improve students' eating habits and promote nutrient absorption, thereby further forming a good

emotional state, enhancing self-confidence, and improving mental health[6].A systematic review contain eight studies about depressive symptoms and physical activity on college students, which demonstrated the effectiveness of participating PA during the pandemic in improving mental health[7].Accordingly, this study mainly focuses on college students , conducts an meta-analysis of the research on PA as an intervention to improve the anxiety and depression of college students during the epidemic, to discuss the exercise patterns of college students during the epidemic, and demonstrate the effectiveness and statistical significance of PA intervention in improving the anxiety and depression of college students during the epidemic.

## 2. Methods

### 2.1. Search Strategy

We searched the following databases such as: PubMed, ProQuest, IEEE Web of Science, Chinese National Knowledge Infrastructure (CNKI), Chongqing VIP database for Chinese Technical Periodicals, WANFANG DATA. To search the studies were published from 1 January 2020 to 1 April 2023. Searching the key words including:①“Physical Exercise”, “Physical Activities”, “Sports”, “Physical Fitness”, “Yoga”, “Baduanjin”, “Exercise”; ②“College Students”, “Mental Health”, “Mental Disorders”, “Anxiety”, “Depression”, “Distress”, “Stress”l ③“COVID-19”, “2019-nCoV”, “Stay-at-Home”, “Social Isolation”, “Lockdown”. According to the characteristics of different databases, the corresponding free words and subject words are used for combined search, and the retrieved documents are imported into the Endnote software to manage the studies. The literature selection process is shown in Fig. 1.



**Figure 1.** Selection process

### 2.2. Inclusion and Exclusion Criteria

The criteria for inclusion in the meta-analysis were: (a) anxiety and depression were assessed with Self-Rating Anxiety Scale (SAS), Self-Rating Depression Scale (SDS), Coronavirus Anxiety Scale(CAS ), Baker Anxiety Scale(BAI), and Baker Depression Scale(BDI). (b)information about prevalence, sample size, and time of investigation or time of submission; (c) the survey was conducted during the COVID-19; (d)the major are college students; (e) RCT study; (f) studies

published in either English or Chinese. The exclusion criteria were as follows: (a) incomplete outcome data or lack of valid data following contact with the original authors; (b) descriptive studies, qualitative studies, review articles, research protocols, case reports, and duplicated reports.

### 2.3. Data Extraction

Two coders (Meng and Huang) according to the inclusion and exclusion criteria of the literature to finish data extraction and collation independently. Information coding was carried out in the included articles about: first author, publication time, sample size, intervention time, PA intervention, measurement tools, population etc. And the data were extracted and checked by two independent reviewers (Meng and Huang) using a standardized data collection form 10 articles included. Finally, the two results were repeatedly proofread to verify the accuracy of the data, and it was found that the consistency of the coding was close to 98%, the differences have been re-verified and make sure the inclusion and study data for this meta-analysis.

### 2.4. Quality Assessment of the Studies

According to the Cochrane Risk of Bias tool . Domains on this checklist include: a.selection bias (including random sequence generation and allocation concealment), b.performance bias (including blinding of participants), c. detection bias (including blinding of outcome assessment), d. attrition bias (including incomplete outcome data), e. reporting bias (including selective results reporting) and f. other biases (any other bias noted). All inclusion studies took PA as the intervention, and randomly assigned to generate experimental and control groups, and reported relevant data before and after test, and the evaluation tools selected SDS/SAS/CAS/BAI/BDI. Therefore, most of the literature was of good quality and low risk; However, due to the different anxiety and depression levels of college students in different studies, there are individual differences in exercise habits, and the intensity and duration of intervention for different PA are also different, resulting in unclear or certain risks in some factors. The overall literature quality evaluation is shown in Fig. 2.

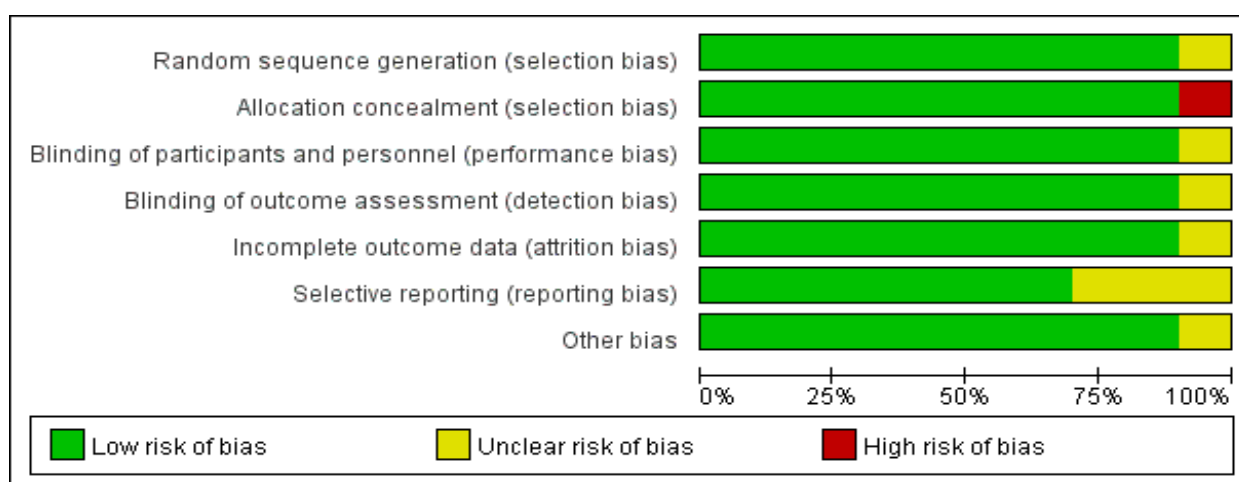


Figure 2. Quality evaluation

### 2.5. Outcome Measures

The primary outcome is about the anxiety and depression among college students before and after PA intervention during the COVID-19. After careful reading the literature by two independent reviewers (Meng and Huang), the means, standard deviations and sample sizes required for continuous variable analysis are extracted and sorted into Excel and analyze by RevMan 5.4 software to discuss and evaluate the statistical significance of each effect size. The

secondary outcomes is about the PA programs and exercise time suitable for college students during the epidemic or any public health emergency.

### 3. Results

#### 3.1. Characteristics of the Included Studies

Through the search of Chinese and English databases with the university students as research subjects from 1 January 2020 to 1 May 2023, a total of 719 relevant literature was retrieved; duplicate articles were eliminated, non-RCTs and review literature were eliminated according to the title and abstract, and incomplete full texts, unclear report data, and non-standard symbols were excluded, and 10 articles were finally determined to be included in this Meta-analysis. The basic characteristics of the included Studies shown in Table 1.

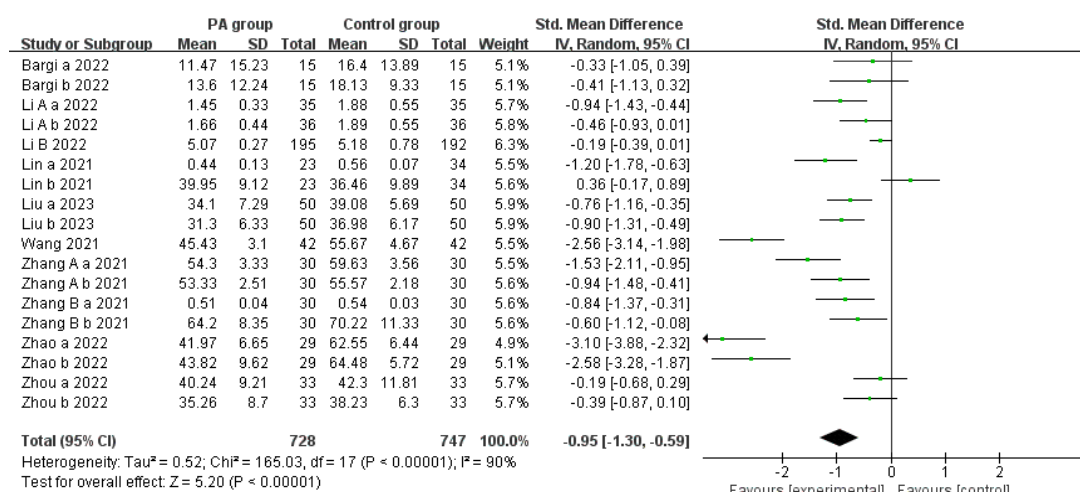
**Table 1.** Included Trial Characteristics

Author	Year	N	Research Object	Intervention Duration	Means of Intervention	Outcome Measure
Lin[8]	2021	69	College students	12weeks; 4times/weeks, ≥30 min/time	Aerobic exercise	SAS、SDS、
Bargi[9]	2022	31	College students	4weeks; 5times/weeks, ≥60 min/time	Aerobic exercise	BAI、BDI
Zhao[10]	2022	86	College students	16weeks; 3times/weeks, ≥50 min/time	Aerobic exercise	SDS
Wang[11]	2021	258	College students	3weeks; 5times/weeks, ≥40 min/time	Fitness clock	SAS
Li A[12]	2022	70	Medical students	14weeks; 3times/weeks, ≥30 min/time	Ba duanjin	SAS
Li B[13] <sup>[13]</sup>	2022	387	College students	12weeks; 5times/weeks, ≥45 min/time	Ba duanjin	CAS、PWBS
Zhang A[14]	2021	90	College students	12weeks; 5times/weeks, ≥60 min/time	Aerobic exercise	SAS、SDS
Zhang B[15]	2021	60	College students	8weeks; 2times/weeks, ≥90 min/time	Ba duanjin	SAS、SDS
Zhou[16]	2021	66	College students	6weeks; 3times/weeks, ≥40 min/time	Aerobic exercise	SAS、SDS
Liu[17]	2023	100	College students	12weeks; 3times/weeks, ≥30 min/time	Aerobic exercise	SAS、SDS

SAS = self-rating anxiety scale; SDS = self-rating depression scale; CAS = Coronavirus Anxiety Scale; BAI= Becks Anxiety Inventory; BDI= Becks Depression Inventory .

#### 3.2. The Results of Meta-analysis

A total of 18 effect sizes met the Meta-analysis criteria, with a total of 1475 participants. effect sizes were pooled by using a random-effects model due to high heterogeneity ( 90%).There were statistically significant differences between the PA intervention and control groups [SMD= - 0.95, 95% CI (-1.30, - 0.59), P<0.00001], 95% CI results fell to the left of the null line. which shown that PA intervention could significantly improve the anxiety and depression of college students during epidemic.This is shown in fig. 3.



**Figure 3.** The results of meta-analysis

### 3.3. The Subgroup Analysis

Subgroup analysis was performed according to different measurement tools, showed in fig. 4. The effect values of CAS, BDI, and BAI intersect the invalid line and the single result was meaningless. However, the result of SAS and SDS showed the great statistically significant, SAS [SMD= - 0.99, 95% CI (-1.61, - 0.36)], SDS[SMD= - 1.18, 95% CI (-1.72, - 0.63)]. It has been showed that PA intervention could significantly improve the anxiety and depression of college students, tespecially to the depression.

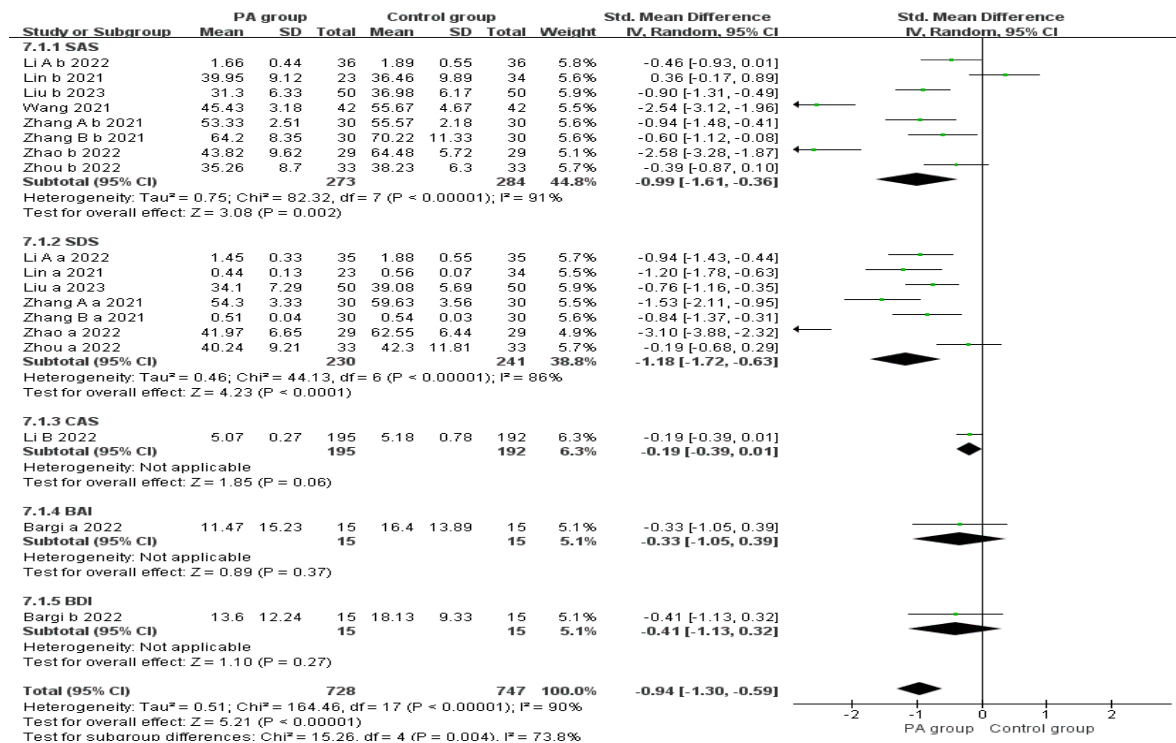


Figure 4. Subgroup analysis

### 3.4. Publication Bias

There are few articles included in this Meta-analysis, which may affect the results of the study. However, the left and right of the funnel plot are basically symmetrical, the effect values are distributed above the funnel plot, and the effect values on both sides are basically symmetrical, so the possibility of publication bias is small. See in fig. 5

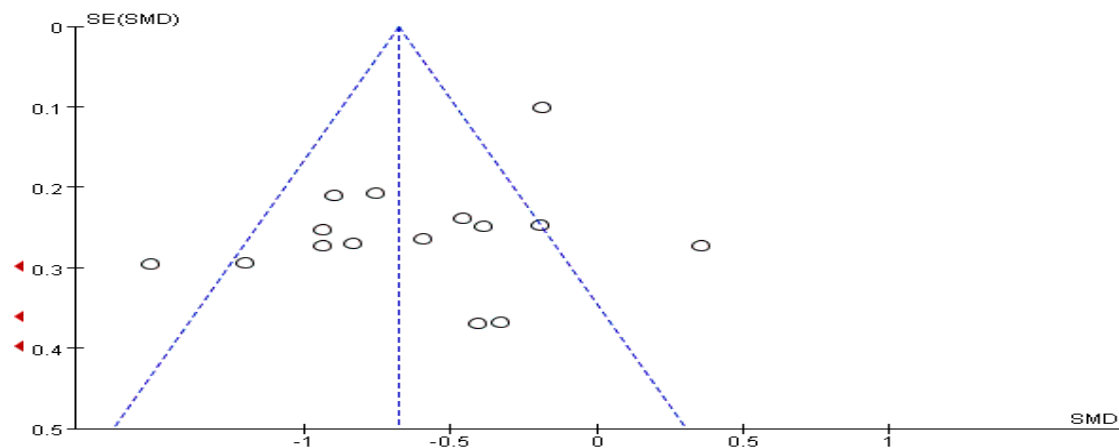


Figure 5. Publication bias

## 4. Discussion

This Meta-analysis mainly summarized the studies on the intervention of PA in college students' anxiety and depression during the epidemic, and the main effect of Meta-analysis were statistically significant differences between the PA intervention group and the control group before and after the experiment. Which suggests that PA interventions can be effective in improving the anxiety and depression of college students under public health emergencies. And provide reference for the mental health education of college students under the influence of public health emergencies in the future.

The experimental studies at home and abroad included in this Meta-analysis point out that as a representative of traditional Chinese martial arts, Baduanjin sports can effectively regulate the coordinated development of individuals physically and mentally and alleviate anxiety and depression[12][13],[15]. In the case of home isolation and closed management of the epidemic, the targeted aerobic exercise intervention were also the main measure to improve the mental health of college students during the epidemic[8][16]. The PA intervention groups in the included studies all had regular exercise cycles ranging from 3 to 16 weeks. The PA intervention group spent more than 2 sessions per week, and each exercise time was greater than 30 minutes. And the control group did not participate in the any exercises. Many studies have shown that PA can alleviate anxiety, depression, and loneliness caused by home isolation during the epidemic, and some studies have highlighted that aerobic exercise training has effectiveness in improving depressant and anxiety[18]. All in all, the mechanism of PA on the mental health of college students: a. Physical exercise improves greatly students' physical fitness and maintenance of mental health. b. PA for college students for people physical function and mental health play a two-way regulating role. c. PA can relieve it and reduce psychological anxiety and depression. d. Physical exercise can cultivate and maintain a good psychological feeling[19]. Accordingly, in terms of schools, it is necessary to create a good sports cultural environment, enrich the aerobics, Baduanjin, yoga and other exercise courses, enhance students' knowledge and awareness of sports, and stimulate students' interest in sports, and attract more students to participate in physical exercise. In addition, we should vigorously promote a healthy and civilized lifestyle, popularize health knowledge, urge college students to form good living habits, gradually establish a reasonable lifestyle, and improve their own physical fitness and health level. On the other hand, college students should establish positive awareness of physical exercise and mental hygiene, correctly understand the positive effects of physical exercise on physical and mental health, and actively participate in physical exercise and sports competitions to strengthen their bodies and enhance psychological resilience; In addition, we must correct our attitudes, scientifically understand the impact of public health emergencies, adjust our rational emotions and attitudes, seize opportunities in challenges, and further improve ourselves and develop ourselves.

## 5. Limitations

There are some limitations to this study. Firstly, Due to the different experimental directions, experimental content and experimental paths of researchers, there are certain differences in the literature included in the studies, resulting in certain differences in the research subjects, sample size, etc. The investigator's intervention method, intervention intensity, intervention period, intervention frequency, etc. will also affect the experimental results. And, the time frame of the literature search for this Meta-analysis was short, and there may be some references that were not searched. This study mainly focuses on the assessment tools of anxiety and depression of college students, and more abundant assessment tools can be considered include research in future. In addition, RevMan is a relatively basic meta-analysis tool, and there is a certain



subjectivity in the process of literature quality evaluation and publication bias analysis, and follow-up research can use other relatively comprehensive analysis tools.

## 6. Conclusions

Under the influence of the epidemic, the mental health problems such as anxiety and depression of college students are generally prominent, which need to be intervened and solved in time. The results of this Meta-analysis show that PA intervention can effectively alleviate college students' mental health problems such as anxiety and depression during the epidemic. In addition, no adverse effects were reported in 10 RCTs in this study, which shows that the intervention of PA for college students has a high safety profile. It will provide a reference for the mental health work of college students under the influence of public health emergencies. And appropriately sets up online and offline physical education courses in the school curriculum such as Baduanjin, yoga, and aerobics, guiding students to actively participate in physical exercise, cultivate students' positive psychological quality, and continuously improve the level of mental health.

## Acknowledgments

Dr. Yu Peng provided support and contributed to the reviewing and proof reading the article.

## Foundation

This research was funded by "A study on online presence, participation and sense of harvest in online course learning of college students in Southern Xinjiang under the background of COVID-19 "(Project No. : NFG2202).

## References

- [1] World Health Organization (2020). WHO Coronavirus Disease (COVID-19) Dashboard [Online]. Available online at: <https://covid19.who.int/> (accessed July 1, 2020).
- [2] Bourion-Bédès S, Tarquinio C, Batt M, et al.: Stress and associated factors among French university students under the COVID-19 lockdown: The results of the PIMS-CoV 19 study, *J Affect Disord* (2021),2021;283:108-114.
- [3] Wang X, Hegde S, Son C, Keller B, Smith A, Sasangohar F.: Investigating Mental Health of US College Students During the COVID-19 Pandemic: Cross-Sectional Survey Study,*J Med Internet Res* (2020), 22(9):e22817.
- [4] Romeo Annunziata, Benfante Agata, Castelli Lorys, Di Tella Marialaura: Psychological Distress among Italian University Students Compared to General Workers during the COVID-19 Pandemic, *International Journal of Environmental Research and Public Health*(2021),18(5).
- [5] Yan Chunmei, Mao Ting, Li Richeng, Wang Jiankai, Chen Yarong: Analysis of mental health status and influencing factors of college students during the closed management of new crown pneumonia epidemic, *Chinese Journal of School Health*(2022),43(07).
- [6] Zeppa Sabrina, Preti Antonio, Gervasi Marco, Gobbi Erica, Ferrini Fabio, Rocchi Marco B L, Baldari Carlo, Perroni Fabrizio, Piccoli Giovanni, Stocchi Vilberto, Sestili Piero, Sisti Davide: Dietary Habits and Psychological States during COVID-19 Home Isolation in Italian College Students: The Role of Physical Exercise, *Nutrients*(2020),12(12).
- [7] Luo Qingyuan, Zhang Peng, Liu Yijia, Ma Xiujie, Jennings George: Intervention of Physical Activity for University Students with Anxiety and Depression during the COVID-19 Pandemic Prevention and

- Control Period: A Systematic Review and Meta-Analysis, *International Journal of Environmental Research and Public Health*(2022),19(22).
- [8] Luo Lin, Song Naiqing, Yang Hao, Huang Jiahong, Zhou Ling, Zhang Liping: Intervention Effect of Long-Term Aerobic Training on Anxiety, Depression, and Sleep Quality of Middle School Students With Depression After COVID-19, *Frontiers in Psychiatry*(2021),12
- [9] Bargi, G.: Effectiveness of physical activity counseling in university students educated by distance learning during COVID-19 pandemic: A randomized-controlled trial, *Basic Clin. Health Sci.*(2022), 6, 40-50.
- [10] Zhao Yuanhui, Wang Wenxing, Wang Mengdie, Gao Fang, Hu Chun, Cui Bowen, Yu Wenlang, Ren Hong: Personalized individual-based exercise prescriptions are effective in treating depressive symptoms of college students during the COVID-19: A randomized controlled trial in China , *Frontiers in Psychiatry*(2023),13.
- [11] Wang Hong, Wang Ziyu: Study on the effect of exercise intervention on anxiety symptoms of college students in home isolation during the new crown pneumonia epidemic, *Sports Science and Technology Literature Bulletin*(2021),29(09):154-156.
- [12] Li Yan: Experimental study on the effect of fitness qigong and Baduan Jin practice on the physical and mental health of nursing students, *Wushu Research*(2022),7(02):101-103.
- [13] Li Keqiang, Walczak Kozłowska Tamara, Lipowski Mariusz, Li Jianye, Krokosz Daniel, Su Yuying, Yu Hongli, Fan Hongying: The effect of the Baduanjin exercise on COVID-19-related anxiety, psychological well-being and lower back pain of college students during the pandemic, *BMC sports science, medicine & rehabilitation*(2022),14(1).
- [14] Zhang Le: The effect of traditional fitness exercises on the psychological state of college students during the new crown epidemic, *Journal of Yan'an University(Natural Science Edition)* (2021), 40(01): 94-98.
- [15] Zhang Yuzheng: An empirical study on the improvement effect of fitness qigong and Baduan jin on depression and anxiety in college students, *Wushu Research*(2021),6(12):131-133.
- [16] Zhou Xiao, Yan Huiqian, Li Linhua: The effect of home fitness on bad mood and sleep under the background of new crown pneumonia epidemic, *Chinese Sports Science Society, The 12th National Congress of Sports Science(Sports Social Science Branch*2022),280-282.
- [17] Liu Yuanxin, Zhou Fuxin, Yang Guojun: The effect of physical exercise on the physical and mental health of students in vocational colleges under the background of the new crown epidemic, *Journal of Henan Medical College*(2023),35(01):114-116.)
- [18] Salmon P: Effects of physical exercise on anxiety, depression, and sensitivity to stress: a unifying theory, *Clinical psychology review*(2001),21(1).
- [19] Daniel Zhang, Sun Gaofeng: Study on the efficacy of physical exercise in promoting the mental health of college students, *Journal of Beijing Sport University*(2006)(01):56-57+69.)