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The Mediation Role of Mobile Phone Addiction to the Relationship between Physical Activity and Autistic Traits among College Students

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Abstract: This study taking physical activity (PA) as the independent variable and autistic traits (AQ) as the dependent variable, we explored the relationship between the three in depth, further verified the mediating role of mobile phone addiction (MPA) between the two , and constructed a hypothesized mediation model of mobile phone addiction in the relationship between physical activity and autistic traits.Method: This study takes the characteristics and correlations of physical activity (PA), autistic traits (AQ) and mobile phone addiction (MPA) as the research objects, follows the principle of convenience sampling , and uses questionnaire survey method and mathematical statistics method to conduct a survey on Zhanjiang City, Guangdong Province. Three universities conducted stratified sampling , and finally conducted a survey and research on 382 college students . The " International Physical Activity Scale -Short (IPAQ -SF)", "Autism Trait Scale(AQ)" and "Mobile Phone Addiction Tendency Scale(MPATS)" were used. An electronic questionnaire produced by "Questionnaire Star" was used to conduct an online survey on college students' physical activity, autistic traits and mobile phone addiction tendencies, etc., and SPSS24.0 was used for statistical processing and analysis.Result:1. The BMI difference between PAand AQ of college students was significant ($p < 0.01$). 2. There was a significant difference between the PA level and the level of college students with high and low AQ ($p < 0.01$). 3. The results of correlation analysis showed that there was a significant negative correlation between PA and AQ ($r = -0.48$**, Sig.000) and MPA (r=-0.22**, Sig.000), and a significant positive correlation between AQ and MPA (r=0.37**, Sig.000). 4. PA had a significant mediating effect on AQ through MPA, and MPA had a significant mediating effect between PA and AQ; the direct effect of PA on AQ was significant; the total effect of PA on AQ was significant.Conclusion:1.Physical activity can significantly and negatively predict autistic traits and mobile phone addiction; 2. Mobile phone addiction significantly and positively predicts autistic traits ;3. Mobile phone addiction ranks between physical activity and autistic traits has a significant mediating effect.

Keywords: College Students, Physical Activity, Autistic Traits, Mobile Phone Addiction, Mediating Role.

1. Introduction

Autistic traits are not a disease but a personality trait that is widely present in autism spectrum disorders and the general population.Studies have shown that individuals with autistic traits have psychosocial difficulties in many areas, such as more Difficulties in interpersonal relationships, lower self-esteem, and less confidence in decision-making abilities (Kanne et al., 2009), and high autistic traits in individuals are related to lower overall satisfaction with interpersonal relationships (Bolis et al., 2021), prefer to be alone, and lack confidence in communication skills (Demizu et al.,2022; Schuwerk et al., 2019).

In today's digital and intelligent era, the proportion of Chinese netizens using mobile phones to access the Internet is as high as 99.7% . Mobile phones have become the main device for Chinese netizens to access the Internet (CNNIC.2022) . While the use and popularization of mobile phones bring us convenience, they also lead to the emergence of various physical and mental health problems, such as mobile phone addiction, a significant increase in sedentary lifestyles such as sitting still or sitting for a long time , and the problem of insufficient physical activity has become increasingly prominent . At present, the problem of college students' mobile phone addiction and insufficient physical activity has become the focus of attention around the world.

Mobile Phone Addiction (MPA), also known as mobile phone dependence, problematic use of mobile phones, fear of not having mobile phones, etc., is a negative psychological or behavioral addiction state of individuals using mobile phones (Zou Z et al.,2017). As the main users of mobile phones, college students are more likely to choose to escape reality through mobile phones when psychological problems occur than other adult groups due to their poorer self-control and adjustment abilities, which makes them more likely to become addicted to mobile phones (Li et al.,2018).

Physical activity (PA) refers to any physical activity that consumes energy through human musculoskeletal activities (Thorp et al.,2011).Including various activities such as sports, study, work, housework, etc. In recent years, with the advent of the 5G era and the rapid development of informatization and intelligence, comfortable and convenient lifestyles have made insufficient physical activity a global health problem. Sedentary lifestyles such as sitting still and moving too little, and sitting still for long periods have increased significantly, and the problem of insufficient physical activity has become increasingly prominent. This phenomenon is most common on university campuses.In 2023, 87.0% of students aged 11-17 worldwide are not physically active enough. In China, insufficient physical activity among teenagers is a very serious problem, with the number of insufficient people as high as 84.3% (Rg A et al., 2020). According to the Global

Burden of Disease Study 2023, physical inactivity is contributing to rising mortality rates, which have increased by 29% compared to mortality rates in the past 10 years. Physical inactivity is a major cause of death from non-communicable diseases such as ischemic heart disease, ischemic stroke, type 2 diabetes, and cancers of the colon, rectum, and breast. Studies have shown (Fessia et al., 2018) that through planned and scientific physical activities, positive effects can be achieved on children with autism spectrum disorder (ASD). Not only can children's motor skills be improved, but also they can produce a Positive psychological environment and behavioral changes (Ketcheson et al.,2017).

In summary; physical activity provides a new perspective for studying the formation and development of autistic traits, it is hypothesized that mobile phone addiction has a mediating role between physical activity and autistic traits in college students and that there is also a relationship between the two. The role of mutual influence. Therefore, this study uses physical activity as the independent variable and autism characteristics as the dependent variable to construct a structural equation model with mobile phone addiction as the mediator to further explore the relationship between the above three.Assume the path is as shown in Figure 1:

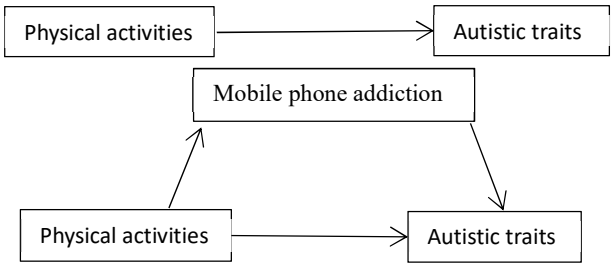

Figure 1. Research hypothesis model

Hypotheses.

Null Hypothesis (Ho).

(1) There is no relationship between autistic traits, physical activity, and mobile phone addiction.

(2) There is no significant mediating effect between autistic traits and physical activity on mobile phone addiction.

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2. Methodology

This study will use a convenience sampling method to investigate college students in all levels, freshmen, sophomore, junior and senior from three schools in Zhanjiang City, Guangdong Province (Lingnan Normal University, Zhanjiang University of Science and Technology, and Guangdong institute arts and sciences).College students in China have ages from 18 and above. The aim was to create an inclusive participant group that reflected a diversity of perspectives and experiences. This study uses stratified sampling. Based on the total student population size of the three schools is 67,764, calculated with a 95% confidence level and a 5% confidence interval, and based on the sample size calculation formula, 382 questionnaires need to be collected.

2.1. Research Instruments

This study takes the characteristics and correlations of physical activity (PA), autistic traits (AQ) and mobile phone addiction (MPA) as the research objects, follows the principle of convenience sampling , and uses questionnaire survey method and mathematical statistics method to conduct a survey on Zhanjiang City, Guangdong Province. Three universities conducted stratified sampling , and finally conducted a survey and research on 382 college students . The " International Physical Activity Scale -Short (IPAQ -SF)", "Autism Trait Scale (AQ)" and "Mobile Phone Addiction Tendency Scale(MPATS)" were used. An electronic questionnaire produced by "Questionnaire Star" was used to conduct an online survey on college students' physical activity, autistic traits and mobile phone addiction tendencies, etc., and SPSS24.0 was used for statistical processing and analysis.

3. Findings and Discussions

The aim of this study is to explore the relationship between physical activity and autistic traits among college students, and to investigate whether mobile phone addiction plays a mediating role between autistic traits and physical activity.

3.1. The Level of the Respondents to Physical Activity

Table 1. Physical activity level of the respondents

PA	Frequency	Percent
High	65	17.02
Middle	307	80.37
Low	10	2.61
Total	**382**	**100.0**

Table 1 infers the frequency and percentage distribution of the physical activity level of the respondents, which shows that the majority (f=307, 80.37%) of the respondents belong to the moderate physical activity level, and a few (f=65, 17.02%) belong to the high level. Regarding physical activity level, a small number (f=10, 2.61%) belong to low physical activity level, which shows that most of the respondents' physical activity level belongs to medium to low physical activity level.

3.2. The Level of the Respondents to Autistic Traits

Table 2. Autistic Traits level of the respondents

AQ	Frequency	Percent
LAQ	42	11
HAQ	100	26.18
Total	382	100.0

Table 2 infers the frequency and percentage distribution of respondents' AQ, which shows that a minority (f=42, 11%) of respondents belong to the low autistic trait and a minority (f=100, 26.18%) belong to the high autistic trait Trait, most (f=240, 62.83%) belong to the medium autistic trait, which shows that most of the AQ of the respondents in this study belong to the medium to low autistic trait level.

3.3. The Tendency of the Respondents to Mobile Phones Addiction

Table 3 infers the frequency and percentage distribution of respondents' MPA, which shows that most (f=306, 80.10%)

of the respondents do not have mobile phone addiction tendencies, and a small number (f=76, 19.90%) of the respondents are There is a tendency to be addicted to mobile phones, which shows that most of the MPATS respondents in this study have no tendency to be addicted to mobile phones.

Table 3. MPA tendency of the respondents

MPA	Frequency	Percent
YES	76	19.90
NO	306	80.10
Total	382	100.0

Note: YES=Has a tendency to become addicted to mobile phones(MPATS≥48);NO=No tendency towards mobile phone addiction(MPATS<48).

3.4. For PA, AQ and MPA, Correlation Analysis between the Three

Table 4. PA, AQ and MPA, correlation analysis between the three

Variables		PA	AQ	MPA	Decision	Interpretation
PA	Pearson Correlation	1	-0.48**	-0.22**	Reject Ho	Significant
	Sig.(2-tailed)		.000	.000		
	N	382	382	382		
AQ	Pearson Correlation	-0.48**	1	0.369**	Reject Ho	Significant
	Sig.(2-tailed)	.000		.000		
	N	382	382	382		
MPA	Pearson Correlation	-0.22**	0.37**	1	Reject Ho	Significant
	Sig.(2-tailed)	.000	.000			
	N	382	382	382		

**.Significantly correlated at the .01 level (2-tailed).

Table 4 shows the PA, AQ and MPA of the respondents, and there is a clear correlation between the three. The calculated results are between PA and AQ (r=-0.48** , Sig.000), between PA and MPA (r=-0.22** , Sig.000), and between AQ and MPA (r=0.37**, Sig.000) rejects the null hypothesis of not being significant. Therefore, there is a significant correlation between the PA, AQ and MPA of the respondents. This means that there is a negative correlation between PA and AQ, that is, the higher the PA, the lower the AQ. There is a negative correlation between PA and MPA, that is, the higher the PA, the lower the MPA. There is a positive correlation between AQ and MPA, that is, the higher the AQ, the higher the MPA. For those with higher levels of AQ and MPA, they can continuously increase the level of physical activity to reduce the level of autistic traits and tendency to use mobile phones,thereby reducing overreliance on mobile phones.

Furthermore, Chen, YL et al. (2015) pointed out that there is an inverse relationship between autistic traits and Internet addiction. At the same time, the research results of Xiao, W et al. (2022) showed that among young people, there is a moderate negative correlation between PA and MPA. In her findings, Ketcheson, L (2017) illustrates the importance of incorporating physical activity into early intervention services for young children with autism spectrum disorder.

3.5. Analysis of the Mediating Effect of MPA between PA and AQ

The correlation analysis results in Table 4 show that there is a significant correlation between physical activity, autistic traits and mobile phone addiction among college students, so the mediating role of mobile phone addiction can be tested. In order to test the mediating effect of mobile phone addiction between physical activity and autistic traits, this study used Model 4 in the PROCRSS plug-in of the SPSS PROCESS macro program developed by Hayes (2013) to conduct the mediating effect test. The specific results are shown in Table 5.

Table 5. Regression analysis of MPA between PA and AQ

Regression Equation (N=382)		Overall Fit Index			Regression Coefficient Significance			
Outcome Variable	Predictor Variable	R	R^2	F	β	t	Decision	Interpretation
AQ	PA	0.55	0.31	38.28***	-0.48	-10.45***	Reject Ho	Significant
MPA	PA	0.23	0.05	6.78***	-0.21	-4.15***	Reject Ho	Significant
AQ	PA				-0.42	-9.41***	Reject Ho	Significant
	MPA	0.55	0.31	41.61***	0.28	6.31***	Reject Ho	Significant

According to the regression analysis results in (Table5), PA significantly negatively predicted AQ (β= -0.48, P < 0.001) and MPA (β= -0.21, P<0.001); MPA significantly positively predicted to predict AQ (β=0.28, P< 0.001).

The bias-corrected non-parametric percentile Bootstrap test method was used, and 5,000 samples were repeatedly drawn, with a default confidence interval of 95%.

Table 6. Mediation effect test results

Effect path	Effect size	BootSE	95%CI	Relative intermediary proportion	Interpretation
PA⇒MPA⇒AQ	-0.0606	0.0155	[-0.0933 ,-0.0329]	2.48%	
Mediating effect	-0.0002	0.0001	[-0.0003,-0.0001]	13.33%	Some intermediaries
Direct effect	-0.0013	0.0001	[-0.0016 ,-0.0011]	86.67%	
Total effect	-0.0015	0.0001	[-0.0018 ,-0.0012]	100%	

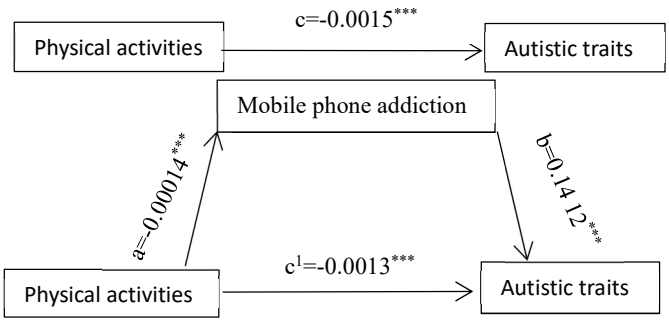

Figure 2. Path diagram of the mediating effect of MPA between PA and AQ

According to the results in (Table6): (1) The mediating effect of physical activity on autistic traits through mobile phone addiction is (β=-0.0606,95%CI: [-0.0933,-0.0329]), and the interval does not include "0" , indicating that the mediating effect is significant, and the mediating effect accounts for 2.48%; (2) The mediating effect of mobile phone addiction on physical activity and autism traits is (β=-0.0002, 95% CI: [-0.0003,-0.0001]), interval Excluding "0", indicating that the mediating effect is significant, and the mediating effect accounts for 13.33%; (3) The direct effect of physical activity on autistic traits is (β=-0.0013, 95% CI: [-0.0016,-0.0011]), The interval does not include "0", indicating that the direct effect is significant, and the direct effect accounts for 86.67%; (4) The total effect of physical activity on autistic traits is (β=-0.0015, 95% CI: [-0.0018,-0.0012]) , the interval does not include "0", indicating that the total effect is significant. Based on this, in order to interpret

the internal correlation between variables from an intuitive level, a simple mediation model as shown in Figure 2 was constructed.

This study used 382 college students as a sample to re-test the correlation between physical activity and autistic traits, further verified the simple mediating role of mobile phone addiction, and provided new insights into the intrinsic link between physical activity and autistic traits. Evidence makes the relationship between physical activity and autistic traits clearer.

(1) Discussion on the direct effect of physical activity on autistic traits among college students

According to this study, physical activity can negatively predict the level of autistic traits in college students. According to the health behavior theory of exercise psychology, individual behavior is not only affected by psychological factors, but also by external environmental factors, with the latter being more decisive (SuChuanling, 2012). Bandura's three-dimensional reciprocal determinism believes that environment, individual and behavior influence each other. Physical activity, as an important external environmental stimulus, can not only effectively improve the physical health of college students, but also have a positive impact on their mental health and well-being. Social adaptation has a significant impact (Bandura A, 1989), thereby regulating social impairment, language impairment, etc. caused by higher levels of individual autistic traits. Therefore, improving the autistic trait level of college students through physical activity is a feasible way.

(2) Analysis of the mediating effect of mobile phone addiction among college students between physical activity and autistic traits

Mediation effect analysis showed that mobile phone addiction has a mediating effect between physical activity and autistic traits. Individuals with higher levels of mobile phone addiction tend to have poor inhibitory control abilities (Gao L et al. 2020). Physical activity is an effective intervention to improve individual inhibitory control (HuHaixu et al. 2018). Relevant studies have proven that 30 minutes of acute physical activity intervention effectively improves the performance of individuals who require inhibitory control function involvement in the Go/no-go task (Fan H, et al. 2021), and regular long-term physical activity intervention can also significantly improve Improve individual performance in executive tasks involving inhibitory control (Smiley-Oyen A L, et al. 2008). In addition, participating in physical activities can not only reduce college students' screen time and sedentary behavior, reduce students' dependence on mobile phones, but also improve the withdrawal and loss of control symptoms of mobile phone addiction patients, and reduce their anxiety, Negative emotions such as depression and loneliness (Zhu Ganfang. 2017). In summary, physical activity brings positive benefits to college students in improving their mobile phone addiction, and it may also be the result of good psychological intervention. Therefore, it is a feasible way to improve college students' mobile phone addiction and autistic traits through physical activity.

4. Conclusion

1) Physical activity can significantly and negatively predict autistic traits and mobile phone addiction;

2) Mobile phone addiction significantly and positively predicts autistic traits;

3) Mobile phone addiction has a significant mediating effect between physical activity and autistic traits.

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