INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 14, Issue 3, (2025) E-ISSN: 2226-6348

Physical Activity, Motivational Regulation, and Perceived Barriers among Chinese University Students: A Cross-Sectional Study

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To Link this Article: http://dx.doi.org/10.6007/IJARPED/v14-i3/25954 DOI:10.6007/IJARPED/v14-i3/25954

Published Online: 28 July 2025

Abstract

To better understand the motivations and perceived barriers related to physical activity (PA) participation among Chinese university students, this cross-sectional study examined PA levels, motivational regulation, and perceived barriers among 1,618 undergraduate students at a university in southern China. Participants completed three standardized questionnaires, all of which demonstrated good reliability and validity. Results showed that the average weekly PA-MET was 2,595.3, indicating a moderate activity level, with females reporting higher PA levels than males. Most students exhibited autonomous motivation (identified, integrated, and intrinsic regulation). The most frequently reported barriers were lack of willpower (63.35%), lack of energy (59.77%), lack of time (43.63%), and lack of resources (39.25%). Autonomous motivation was positively correlated with PA levels (r = .360 to .623), whereas controlled motivation and amotivation showed negative correlations (r = –.566 to –.199). Perceived barriers were negatively correlated with PA (r = –.051 to –.687). Additionally, autonomous motivation was negatively associated with barriers, while controlled motivation and amotivation were positively associated. These findings highlight that, compared to motivation alone, addressing perceived barriers is equally essential in promoting physical activity engagement.

Keywords: Physical Activity, Motivational Regulation, Perceived Barriers, University Students, Cross-Sectional Study

Introduction

The decline in physical fitness among adolescents has become a critical social issue alongside China's modernization. National survey data indicate that student physical fitness has been deteriorating for over three decades (Wang, 2019). In response, the Chinese government launched the “Healthy China 2030” initiative in 2016 and subsequently introduced a series of education policies aimed at improving students’ physical health. This situation did not improve until 2020; however, the physical fitness of university students has shown little improvement over the past decade. According to the national sampling report on student physical fitness from 2016 to 2020, approximately 30% of university students failed to meet the required standards by 2020, and only 7% were rated as “good” or “excellent” in national

assessments (Wang, 2021). Several longitudinal studies have also indicated that the physical fitness of Chinese university students has not improved significantly. Sun et al. (2025) found that the physical fitness of college students in Anhui Province declined significantly over a ten-year period (2013–2023). Similarly, Dong et al. (2023) reported that physical fitness indicators (e.g., vital capacity, standing long jump, and 50-meter sprint) among male university students showed a significant downward trend from 2013 to 2019 in Chongqing and Hebei Provinces.

The factors contributing to the continuous decline in physical fitness among university students are likely multifaceted and complex. After entering university, many students are no longer under the supervision of parents or teachers, which may lead to behaviors such as binge eating, staying up late as a form of psychological retaliation, and excessive use of electronic devices. These behaviors are often accompanied by a lack of physical exercise, ultimately resulting in a decline in physical fitness (Shi, 2021). In addition, weak educational philosophies, insufficient physical education, and a lack of sports facilities and equipment in universities also contribute to this trend (Chen & Cheng, 2009). Other external environmental factors—such as severe internet addiction, the absence of a positive sports culture, limited knowledge of physical education, and deficiencies in educational management systems—may further negatively affect students' physical health (Wang, 2021).

However, the most direct cause and manifestation of declining physical fitness is the lack of sufficient physical activity (PA). A study assessing PA among 17,928 undergraduate students from 24 universities across 23 countries found that 41.4% of university students were physically inactive. Moreover, physical inactivity was associated with being overweight or obese, having negative health perceptions, and exhibiting low levels of physical self-control (Pengpid et al., 2015). Among students who did not engage in physical activity, only 1.6% achieved an "excellent" fitness rating, compared to 13.4% among those who exercised more than five times per week (Qiao, 2022). These findings suggest that previously acquired physical fitness can deteriorate without regular training, highlighting the crucial role of consistent physical activity in maintaining fitness levels (Mitrović et al., 2016).

Increasing physical activity is a key approach to improving physical fitness, since it can effectively enhance aerobic capacity, muscle strength, reduce obesity, and improve various health indicators (Poitras et al., 2016). Numerous previous studies have focused on promoting physical activity, with motivation-based interventions being a particularly important area. Motivation plays a crucial role in supporting sustained exercise, which in turn is associated with important health outcomes (Teixeira et al., 2012). Many scholars have applied motivational theoretical frameworks to investigate physical activity among Chinese university students, and related studies have confirmed the cultural applicability of such frameworks in the Chinese context (Chu & Zhang, 2022; Liu et al., 2017; Tao et al., 2018; Yuan et al., 2023; Liang et al., 2025). These studies have examined the types of motivation for PA and the effectiveness of various intervention strategies in promoting PA participation.

Although previous studies have proposed various interventions from a motivational perspective and confirmed that motivational incentives can play a positive role in enhancing university students' physical activity (PA) participation and improving physical fitness levels, the practical outcomes remain unsatisfactory. Currently, Chinese university students generally demonstrate low levels of physical activity, with little improvement in overall

fitness. The proportion of students achieving a “good” or “excellent” fitness status remains relatively low. Clearly, motivational interventions alone are insufficient to produce significant changes in students’ physical behavior and fitness outcomes. Other underlying factors may be limiting the effectiveness of these interventions. Moreover, existing empirical studies often lack systematic theoretical frameworks and practical intervention pathways, making it difficult to comprehensively reveal the complex relationships among motivation, barriers, and PA behaviors. Many current interventions fail to consider the psychological and behavioral challenges students face in real-life contexts, such as time pressure, lack of motor skills, and low self-efficacy. These factors may significantly undermine the stability and sustainability of intervention outcomes.

Therefore, there is a pressing need to integrate motivational regulation mechanisms with real-world barriers to PA into a cohesive framework to more effectively enhance students’ intrinsic motivation and long-term engagement in physical activity. Based on this rationale, the present study aims to comprehensively and accurately examine the current levels of physical activity, exercise motivation, and participation barriers among Chinese university students, as well as the relationships among these factors, to provide valuable insights for the development of targeted and effective intervention strategies.

Materials and Methods

Participants

A total of 1,618 university students participated in an online survey. The participants were all undergraduate students enrolled in Hanshan Normal University in China, of which 31.6% (n = 512) were male and 68.4% (n =1,106) were female, with an average age of around 20 years (Mean age = 19.8). Female respondents are significantly more than men, which is related to the objective situation that the respondents are from an educational university, and there are more female students than male students. Most of the participants are freshmen n = 697, sophomores n = 567, and juniors n = 354.

Instruments

Three questionnaires were employed in the research and served as the primary research instrument of this study. The International Physical Activity Questionnaire-Long Form Chinese version (IPAQ-LC) was adopted to measure the physical activity level of university students. IPAQ was available in multiple language versions (www.ipaq.ki.se) and had been tested for reliability and validity across 12 countries. Jia et al. (2008) examined the reliability and validity of IPAQ-LC and reported intraclass correlation coefficients (ICC) ranging from .737 to .972 after one week, .473 to .925 over a four-week interval, indicating good reliability. Spearman correlation coefficients between moderate, vigorous, and total Physical Activity Metabolic Equivalent Task (PA-MET) scores were .394, .657 and .538, respectively, suggesting good validity. In this study, a four-week test–retest was conducted among 158 university students, and the results demonstrated good reliability and validity. The ICCs for walking, moderate, vigorous, and total PA-MET ranged from .725 to .883, and the Spearman correlation coefficients (ρ) ranged from .728 to .839. The data collected through the questionnaire were scored using both continuous and categorical approaches according to the *Guidelines for Data Processing and Analysis of IPAQ* (www.ipaq.ki.se/scoring.pdf). Each individual's PA MET-minutes/week score was used to determine whether their PA level was low, moderate, or high.

The Chinese version of the Behavioural Regulation in Exercise Questionnaire (BREQ-3C) was employed to assess participants' motivation. The BREQ-3C consisted of six factors with 24 items measuring amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic regulation. In this study, the subscales' Cronbach's α values ranged from .690 to .938, and composite reliability (CR) values ranged from .757 to .939, indicating good reliability. The results of confirmatory factor analysis (CFA) showed that the scale demonstrated good validity. The standardized factor loading coefficients ranged from .716 to .935, and the AVE values ranged from .475 to .794, indicating good convergent validity. The square roots of the average variance extracted (AVE) values ranged from .689 to .89, all of which were greater than the inter-factor correlation coefficients, demonstrating good discriminant validity of the BREQ-3C among Chinese university students.

The Barriers to Being Active Quiz (BBAQ) was developed by the Centers for Disease Control and Prevention (CDC) of the United States in 1999 to identify reasons why individuals did not engage in as much physical activity as they believed they should. The BBAQ consisted of seven categories and 21 items. In this study, the results of CFA showed that Cronbach's α was .908 and KMO was .958. The model demonstrated a good fit, with factor loading coefficients ranging from .536 to .774, AVE values ranging from .369 to .50, and CR values ranging from .66 to .77, indicating good reliability and acceptable validity among university students.

Data Collection

This study adopted a quantitative research approach, and an online survey method was employed. The questionnaire link was distributed to target participants via WeChat groups. Interested students and voluntarily agreed to participate accessed the survey platform (Wenjuanxing) and completed the questionnaires. A total of 1,776 responses were received. After excluding 158 invalid scales (filling in incorrect information, or choosing the maximum or minimum value for each item, or the response time less than 200 seconds), 1,618 valid scales remained.

Data Analysis

SPSS v27.0 and AMOS v26.0 software were used as statistical tools for data analysis in this study. The intraclass correlation coefficients (ICC), Cronbach's α, and Spearman-Brown coefficient were applied to reflect the reliability of the questionnaires. CFA was carried out to analyze the construct validity of the questionnaires. Independent samples t-tests and analysis of variance (ANOVA) were used for comparative analyses, while correlation analysis was employed to examine the relationships among variables.

Before formal data analysis, Harman's single-factor test was conducted to verify whether there was a Common Method Bias (CMB), due to the survey adopting the online self-report method and all data from a single source. The results presented that 16 factors with eigenvalues greater than 1 were separated, which explained 63.08% of the total variance. The variance interpretation of the first factor was 25.21%, which was less than 50% of the total variance, indicating no serious problem of CMB in this study (Podsakoff & Organ, 1986). Additionally, following the comments of Kim (2013), Brown (2006), and Kline (2011), when sample sizes bigger than 300, the data with a skewness between ±3 and a kurtosis between

±10 could be considered to be approximately normally distributed. The results of the Kolmogorov-Smirnov (K-S) test in this study showed that the variables' Skewness values ranged from -0.573 to 2.177, between ±3, and their kurtosis values ranged from -0.777 to 6.808, between ±10, illustrating that the data were approximately normally distributed.

Ethical Approval

Ethical approval for this study was granted by the Human Research Ethics Committee of Universiti Pendidikan Sultan Idris (UPSI) (Approval No.: 2024-0348-01). Informed consent was obtained from all participants prior to data collection. The committee approved the collection of data strictly aligned with the research objectives and required analyses.

Results

Physical Activity of University Students

The IPAQ-LC defined respondents' PA-MET as a composition of three PA intensity types, enabling researchers to assess PA-MET in greater detail. These three PA intensity types were Walking-MET, Moderate-MET, and Vigorous-MET. The statistical results in Table 1 demonstrated that the mean PA-MET value of all respondents was 2595.37, at a moderate level, of which the mean PA-MET value of males was 2310.65 and females was 2727.17. Among the three intensity types, the highest for males was Moderate-MET, which was 841.53. For females was 985.64 in Vigorous-MET. The PA-MET mean of females was higher than that of males in all classification types, which suggested that female respondents engaged in more physical activity than male respondents.

Table 1
Respondents' PA-MET of Three Intensity Types

Gender		Three intensity types			Total PA-MET
		Walking-MET	Moderate-MET	Vigorous-MET	
Male	*M*	678.85	841.53	798.55	2310.65
	SD	557.07	674.28	833.45	1618.54
Female	*M*	790.92	958.42	985.64	2727.17
	SD	551.27	564.4	789.76	1311.79
ALL	*M*	755.46	921.43	926.43	2595.37
	SD	555.4	603.59	808.28	1428.76

Note, M, Mean, SD, Standard Deviation.

To gain a more comprehensive understanding of the respondents' physical activity levels, an independent sample t-test was employed to analyze the differences between males and females across different PA-MET levels, and the results were presented in Table 2. Levene's test for equality of variances indicated that the assumptions of homogeneity of variance were met for Walking-MET and Vigorous-MET ($p = .992$ and $p = .297$, respectively), so standard independent samples t-tests were used. The test results of other variables were heterogeneity of variance, and Welch's T-test was adopted. The test results showed that the p values of all PA-MET were less than .05, suggesting that there were significant differences between male and female respondents in these three variables. In addition, the value of Cohen's d ranged from .194 to .294, illustrating small differences between genders.

Considering that female respondents exhibited higher PA-MET values than their male counterparts, it can be inferred that female university students engaged in significantly more physical activity than male university students.

Table 2
Differences in PA-MET Types Between Male and Female

Variables	Gender	M	SD	*F* (*P*)	Welch'sT (*P*)	T (*P*)	Cohen's d
Walking-MET	Male	678.85	557.07	0		3.791	0.203
	Female	790.92	551.27	(0.992)		(0.000**)	
Moderate-MET	Male	841.53	674.28	8.441	-3.409		0.194
	Female	958.42	564.40	(0.004**)	(0.001**)		
Vigorous-MET	Male	798.55	833.45	1.088		-4.354	0.233
	Female	985.64	789.76	(0.297)		(0.000**)	
Total PA-MET	Male	2310.65	1618.54	35.653	-5.099		0.294
	Female	2727.17	1311.79	(0.000**)	(0.000**)		

Note, M, Mean; SD, Standard Deviation; F, F-test; T, Independent sample t-test. **, and * represent the significance levels of 1%, 5%. Cohen's d, 0.20, 0.50 and 0.80 correspond to small, medium and large critical points, respectively.

Motivation for Physical Activity among University Students

The relative autonomy index (RAI) proposed by Ryan and Deci (2000) was obtained by applying a weighting to each subscale and then summing these weighted scores. However, Chemolli and Gagne (2014) presented cogent theoretical and statistical arguments against the use of the RAI, since the weights attached to the subscales would lead to the details being lost. Referring to their recommendations, the original scoring method was utilized in this study, and the score of each subscale was the sum of the scores of each item that constituted the subscale. The Likert 5-point was adopted in BREQ-3C, with each item scoring from 0 (completely inconsistent) to 4 (completely consistent). Each subscale consists of four items, with a value range of 0 to 16. A subscale score of 8 or above was interpreted as indicating that the corresponding motivational type was a dominant form of regulation for the respondent.

Table 3
Frequency of Motivation in Different PA-MET Levels

Variables	Groups	PA-MET levels			Total
		High (%)	Moderate (%)	Low (%)	
Amotivation	NO [0, 8)	542 (90.94)	603 (68.84)	1 (0.68)	1146 (70.83)
	YES [8, 16]	54 (9.06)	273 (31.16)	145 (99.32)	472 (29.17)
External regulation	NO [0, 8)	493 (82.72)	537 (61.30)	1 (0.68)	1031 (63.72)
	YES [8, 16]	103 (17.28)	339 (38.70)	145 (99.32)	587 (36.28)
Introjected regulation	NO [0, 8)	348 (58.39)	452 (51.60)	3 (2.05)	803 (49.63)
	YES [8, 16]	248 (41.61)	424 (48.40)	143 (97.95)	815 (50.37)
Identified regulation	NO [0, 8)	49 (8.22)	134 (15.30)	62 (42.47)	245 (15.14)
	YES [8, 16]	547 (91.78)	742 (84.70)	84 (57.53)	1373 (84.86)
Integrated regulation	NO [0, 8)	97 (16.28)	304 (34.70)	143 (97.95)	544 (33.62)
	YES [8, 16]	499 (83.72)	572 (65.30)	3 (2.05)	1074 (66.38)
Intrinsic regulation	NO [0, 8)	51 (8.56)	280 (31.96)	146 (100)	477 (29.48)
	YES [8, 16]	545 (91.44)	596 (68.04)	0 (0.0)	1141 (70.52)

Note, YES, the number of respond who reported and the score is 8 or above in this subscale; NO, the number of respond who not reported or the score is less than 8 in this subscale.

As shown in Table 3, the respondents' reported motivational regulations, ranked from most to least frequent, were as follows: Identified regulation (n = 1,373), Intrinsic regulation (n = 1,141), Integrated regulation (n = 1,074), Introjected regulation (n = 815), External regulation (587), and Amotivation (472). Among respondents with High PA-MET level, the number of reports for Identified regulation (n = 547), Intrinsic regulation (n = 499), and Integrated regulation (n = 545) were higher than that for Amotivation (n = 54), External regulation (n = 103), and Introjected regulation (n = 248). In contrast, within the low PA-MET group, the number of reports for Amotivation (n = 145), External regulation (145), and Introjected regulation (n = 143) was more frequently reported than for Identified regulation, Intrinsic regulation, and Integrated regulation. This indicated that respondents with moderate to high PA-MET predominantly exhibited autonomous motivational regulation, whereas those with low PA-MET tended to display controlled motivation or amotivation.

Table 4
Differences in Motivational Regulation Between Male and Female

Variables	Gender	Mean	SD	F	Welch's T	Cohen's d
Amotivation	Male	5.447	4.5	66.266	T=-3.272	0.187
	Female	4.701	3.721	*P=0.000***	*P=0.001***	
External regulation	Male	6.08	4.417	34.766	T=-2.915	0.166
	Female	5.426	3.685	*P=0.000***	*P=0.004***	
Introjected regulation	Male	7.967	3.646	8.367	T=-7.259	0.383
	Female	6.536	3.773	*P=0.004***	*P=0.000***	
Identified regulation	Male	10.482	2.914	16.183	T=5.698	0.315
	Female	9.619	2.653	*P=0.000***	*P=0.000***	
Integrated regulation	Male	9.092	4.192	46.722	T=2.658	0.151
	Female	8.524	3.525	*P=0.000***	*P=0.008***	
Intrinsic regulation	Male	8.859	5.524	99.409	T=-0.761	0.045
	Female	9.07	4.301	*P=0.000***	*P=0.447*	

Note, **, and * represent the significance levels of 1%, 5%. SD, Standard Deviation; F, F-test. Cohen's d, 0.20, 0.50 and 0.80 correspond to small, medium and large critical points, respectively.

The data in Table 4 illustrate the gender differences in different motivational regulations. After the homogeneity of variance test, the assumption of homogeneity of variance was violated in all variables, so Welch's t-test was used. The results presented that except for Intrinsic regulation, the p values of each motivation regulation were below .05, indicating that there were significant gender differences on these variables, and the Cohen's d values of the difference were .187, .166, .383, .315 and .151, which less than .5, indicated that the difference was small. The p value for intrinsic regulation was .447, so the statistical results were not significant, indicating that there was no significant difference between male and female in Intrinsic regulation.

One-way ANOVA was conducted to identify differences in motivational regulation among PA levels. The analysis results (Table 5) demonstrated that Welch's F-test was adopted since each variable did not meet the homogeneity of variances. The p value of the analysis results was all .000, less than .05. Therefore, the statistical results were significant, indicating that there were significant differences in all motivational regulation variables among PA levels. Moreover, These Variables' Cohen's f values ranged .356 to .861, indicating medium to large effect sizes among PA levels.

Table 5
Differences in Motivational Regulation Across Physical Activity Levels

Variables	PA levels	Mean	SD	Welch's F	Cohen's f
Amotivation	High	2.919	2.839	F=1714.312	0.798
	Moderate	5.107	3.499	*P=0.000***	
	Low	12.151	1.406		
External regulation	High	4.044	3.178	F=792.721	0.678
	Moderate	5.61	3.48	*P=0.000***	
	Low	12.26	2.031		
Introjected regulation	High	6.468	3.593	F=225.564	0.359
	Moderate	6.667	3.728	*P=0.000***	
	Low	11.048	2.263		
Identified regulation	High	10.831	2.808	F=187.528	0.356
	Moderate	9.647	2.609	*P=0.000***	
	Low	7.534	1.537		
Integrated regulation	High	10.336	3.312	F=836.98	0.575
	Moderate	8.47	3.436	*P=0.000***	
	Low	3.445	1.419		
Intrinsic regulation	High	11.633	3.135	F=4293.335	0.861
	Moderate	8.669	4.112	*P=0.000***	
	Low	0.274	0.67		

Note, **, and * represent the significance levels of 1%, 5%. M, Mean; SD, Standard Deviation; F, F-test. Cohen's f, 0.10, 0.25 and 0.40 correspond to small, medium and large critical points, respectively.

Barriers to Physical Activity Among University Students

Table 6 presents the respondents' self-reports on their barriers to doing more physical activities. Only barriers that were reported and scored 5 or more were counted. A respondent may report multiple barriers or none. lack of willpower (57.42%), lack of energy (54.89%), and lack of time (36.52%) were the top three barriers reported by male respondents. A similar pattern was observed among female respondents, with 67.27% identifying lack of willpower, 60.85% reporting lack of energy, and 44.03% indicating lack of time as their primary barriers to physical activity. Additionally, Lack of resources was the fourth most frequently reported barrier among all respondents. In contrast, neither male nor female respondents perceived Fear of injury, Lack of skill, or Social influence as significant barriers to increasing their physical activity participation.

Table 6
Barriers to Physical Activity of Respondents

Gender	Reported	Barries Categories						
		Lack of time n (%)	Social influence n (%)	Lack of energy n (%)	Lack of willpower n (%)	Fear of injury n (%)	Lack of skill n (%)	Lack of resources n (%)
Male	YES	219 (42.77)	177 （34.57）	294 (57.42)	281 (54.88)	159 (31.05)	159 (31.05)	187 (36.52)
	NO	293 (57.23)	335 (65.43)	218 (42.58)	231 (45.12)	353 (68.95)	353 (68.95)	325 (63.478)
Female	YES	487 (44.03)	336 (30.38)	673 (60.85)	744 (67.27)	324 (29.29)	392 (35.44)	448 (40.51)
	NO	619 (55.97)	770 (69.62)	433 (39.15)	362 (32.73)	782 (70.71)	714 (64.56)	658 (59.49)
All	YES	706 (43.63)	513 (31.71)	967 (59.77)	1025 (63.35)	483 (29.85)	551 (34.05)	635 (39.25)
	NO	912 (56.37)	1105 (68.29)	651 (40.24)	593 (36.65)	1135 (70.15)	1067 (65.95)	983 (60.75)

Note, YES, the number of respond who reported and the score is 5 or above in this subscale; NO, the number of respond who not reported or the score is less than 5 in this subscale.

An independent sample t-test (Table 7) was conducted to analyze the differences in barriers to physical activity between male and female. Male and female did not meet the homogeneity of variances in the variables Lack of time, Social influence, Lack of energy, Lack of willpower and Fear of injury, so Welch's t-test was used. The results showed that the p values for all comparisons were greater than .05, indicating no statistically significant differences between male and female participants on these perceived barriers. On the other hand, Levene's test indicated that the assumption of homogeneity of variances was met in Lack of skills and Lack of resources, and the independent sample t-test was used. The significant result p values were less than .05, so the statistical results were significant. indicated that there was a significant difference between gender, and Cohen's d values were .109 and .248, reflecting small to small-to-medium effects.

Table 7
Differences in Barriers for Physical Activity Between Male and Female

Variables	Gender	M	SD	*F*	Welch's T	T	Cohen's d
Lack of time	Male	4.312	2.353	47.868	T=1.325		0.077
	Female	4.156	1.888	*P=0.000***	*P=0.186*		
Social influence	Male	3.85	2.441	24.946	T=2.438		0.139
	Female	3.546	2.065	*P=0.000***	*P=0.015***		
Lack of energy	Male	4.957	2.627	129.631	T=0.686		0.041
	Female	4.868	1.928	*P=0.000***	*P=0.493*		
Lack of willpower	Male	4.895	2.421	74.533	T=-0.361		0.021
	Female	4.939	1.933	*P=0.000***	*P=0.718*		
Fear of injury	Male	3.268	2.135	8.723	T=-1.43		0.079
	Female	3.427	1.965	*P=0.000***	*P=0.153*		
Lack of skill	Male	3.047	2.102	0.61		T=-4.632	0.248
	Female	3.555	2.03	*P=0.435*		*P=0.000***	
Lack of resources	Male	3.904	1.746	2.897		T=-2.037	0.109
	Female	4.087	1.643	*P=0.089**		*P=0.042***	

Note, **, and * represent the significance levels of 1%, 5%. M, Mean; SD, Standard Deviation; F, F-test; T, t-test. Cohen's d, 0.20, 0.50 and 0.80 correspond to small, medium and large critical points, respectively.

The study used one-way ANOVA to test the differences in barriers to PA in different PA levels. The analysis results are shown in Table 8, except for the variable Lack of resources, which satisfies the homogeneity of variance; one-way ANOVA was used. High, Moderate, and Low PA levels did not meet the homogeneity of variance in other barrier variables, so Welch's F-test was used. Except for the p value of Lack of resource was .049, the p values of all other variables were .000 less than .05. Moreover, the Cohen's f values ranged from .302 to .83, demonstrating medium to large effect sizes. Therefore, the statistical results were significant and indicated that different PA levels had significant differences in barriers to physical activity. The different PA levels had significant differences in Lack of resources at the .05 level, but no significant differences at the .01 confidence level. Its Cohen's f was .061, suggesting a negligible effect.

Table 8
Differences in Barriers Across Physical Activity Levels

Variables	PA levels	M	SD	Welch's F	F	Cohen's f
	High	3.008	1.541	F=764.966		
Lack of time	Moderate	4.424	1.646	*P=0.000***		0.83
	Low	7.781	1.262			
	High	2.555	1.591	F=504.111		
Social influence	Moderate	3.797	1.972	*P=0.000***		0.692
	Low	7.151	1.573			
	High	3.51	1.667	F=880.047		
Lack of energy	Moderate	5.263	1.786	*P=0.000***		0.807
	Low	8.356	1.125			
	High	3.661	2.035	F=2055.308		
Lack of willpower	Moderate	5.241	1.53	*P=0.000***		0.756
	Low	8.185	0.39			
	High	2.856	1.781	F=191.727		
Fear of injury	Moderate	3.387	2.049	*P=0.000***		0.367
	Low	5.438	1.344			
	High	2.797	1.918	F=146.509		
Lack of skill	Moderate	3.545	2.121	*P=0.000***		0.302
	Low	4.932	1.172			
	High	3.97	1.652		F=3.015	
Lack of resources	Moderate	4.111	1.701		*P=0.049***	0.061
	Low	3.781	1.621			

Note, **, and * represent the significance levels of 1%, 5%. M, Mean; SD, Standard Deviation. F, F-test. Cohen's f, 0.10, 0.25 and 0.40 correspond to small, medium and large critical points, respectively.

Correlation between Motivational and Physical Activity among University Students

Table 9 displays the correlation coefficients between respondents' motivational regulation and their physical activity levels. As shown in Table 9, the correlation coefficient between motivation regulation and Total PA-MET ranged from -.566 to .623. Controlled motivation and amotivation were negatively correlated with Total PA-MET, with *r* values ranging from –.566 to –.199, while autonomous motivation types showed positive correlations, ranging from *r* = .360 to *r* = .623.

In terms of strength, intrinsic regulation exhibited a strong positive correlation with Total PA-MET (*r* = .623). Identified regulation (*r* = .360) and integrated regulation (*r* = .483) showed moderate positive correlations. Conversely, amotivation (*r* = –.566) and external regulation (*r* = –.473) showed moderate negative correlations. Introjected regulation had a weak negative correlation with Total PA-MET (*r* = –.199).

Table 9
Correlation Between Motivational Regulation and Total PA-MET

Variances	Amoti-	Exter-	Intro-	Iden	Integ-	Intrin-	Total PA-MET
Amoti-	1						
Exter-	0.751**	1					
Intro-	0.306**	0.470**	1				
Iden-	-0.488**	-0.256**	0.262**	1			
Integ-	-0.569**	-0.372**	0.138**	0.685**	1		
Intrin-	-0.741**	-0.562**	-0.103**	0.604**	0.794**	1	
Total PA-MET	-0.566**	-0.473**	-0.199**	0.360**	0.483**	0.623**	1

Note, **, and * represent the significance levels of 1%, 5% (2-tailed). Amoti-, Amotivation; Exter-, External regulation; Intro-, Introjected regulation; Iden-, Identified regulation; Inte-, Integrated regulation; Intri-, Intrinsic regulation.

Correlation between Barriers and Physical Activity among University Students

The data in Table 10 showed that respondents' barriers were negatively correlated with their PA-MET, with correlation coefficient (r) values ranging from -0.051 to -0.687. Specifically, lack of time (r = –.621), social influence (r = –.564), lack of energy (r = –.687), and lack of willpower (r = –.659) demonstrated strong negative correlations with Total PA-MET. Fear of injury and Lack of skills were negatively correlated with Total PA-MET, with r values of -.271 and -.275. Lack of resources showed almost no linear correlation with Total PA-MET, with an r value of -.051.

Table 10
Correlation Between Barriers and PA-MET

Variances	Lack of time	Social influence	Lack of energy	Lack of willpower	Fear of injury	Lack of skill	Lack of resources	Total PA-MET
1. Lack of time	1							
2. Social influence	0.720**	1						
3. Lack of energy	0.735**	0.698**	1					
4. Lack of willpower	0.665**	0.639**	0.722**	1				
5. Fear of injury	0.559**	0.577**	0.497**	0.444**	1			
6. Lack of skill	0.524**	0.590**	0.500**	0.486**	0.685**	1		
7. Lack of resources	0.230**	0.253**	0.199**	.201**	0.351**	0.374**	1	
8.Total PA-MET	-0.621**	-0.564**	-0.687**	-0.659**	-0.271**	-0.275**	-0.051*	1

Note, **, and * represent the significance levels of 1%, 5% (2-tailed).

Correlation between Motivation and Barriers Among University Students

Table 11 presents the correlation between the respondents' motivational regulation and physical activity barriers. The data illustrated that their r ranged from -.674 to .688 between the respondents' six motivational regulations and seven physical activity barriers. Amotivation, External regulation, and Introjected regulation were positively correlated with barriers to physical activity, with correlation coefficients ranging from .092 to .688. In contrast, Identified regulation, Integrated regulation, and Intrinsic regulation were negatively correlated with all barriers, with r ranging from -.037 to -.674. In terms of correlation strength, most motivation variables exhibited moderate to strong correlations with barrier variables, except for Introjected regulation and Lack of resources which were weakly correlated to barriers**.** The variable Introjected regulation had an r value between -.09 and -.32 with all barrier variables, which was weakly negatively correlated. The barrier variable, Lack of resources, had an absolute value of r < .2 with all motivational regulation variables, which was also weakly negatively correlated. And, its r value with other barrier variables ranged from .230 to .374, which was weakly positively correlated.

Table 11

Correlation Between Motivational Regulation and Barriers for Physical Activity

Variances	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Amoti-	1												
2. Exter-	0.751**	1											
3. Intro-	0.306**	0.470**	1										
4. Iden-	-0.488**	-0.256**	0.262**	1									
5. Inte-	-0.569**	-0.372**	0.138**	0.685**	1								
6.Intri-	-0.741**	-0.562**	-0.103**	0.604**	0.794**	1							
7. Lack of time	0.657**	0.623**	0.322**	-0.351**	-0.462**	-.0605**	1						
8. Social influence	0.688**	0.672**	0.280**	-0.376**	-0.482**	-0.612**	0.720**	1					
9. Lack of energy	0.656**	0.564**	0.167**	-0.463**	-0.581**	-0.674**	0.735**	0.698**	1				
10. Lack of willpower	0.605**	0.542**	0.188**	-0.416**	-0.538**	-0.639**	0.665**	0.639**	0.722**	1			
11. Fear of injury	0.552**	0.512**	0.208**	-0.304**	-0.322**	-0.406**	0.559**	0.577**	0.497**	0.444**	1		
12. Lack of skill	0.539**	0.481**	0.131**	-0.363**	-0.385**	-0.448**	0.524**	0.590**	0.500**	0.486**	0.685**	1	
13. Lack of resources	0.164**	0.173**	0.092**	-0.049**	-0.048	-0.037	0.230**	0.253**	0.199**	0.201**	0.351**	0.374**	1

Note, **, and * represent the significance levels of 1%, 5%, (2-tailed). Amoti-, Amotivation; Exter-, External regulation; Intro-, Introjected regulation; Iden-, Identified regulation; Inte-, Integrated regulation; Intri-, Intrinsic regulation.

Discussion

The findings revealed that the total PA-MET of Chinese university students were 2595.3, with the majority of respondents engaging primarily in moderate or vigorous-intensity PA. This situation was similar to that of university students at Wuhan city (2632.7) in China (Li, Wang, & Xu, 2020), Turkish university students (2584.3) (Bednarek, 2016) and Spanish university students (2277.82) (Sánchez-Herrera, 2022), but significantly lower than that of German university students (3798) (Edelmann et al., 2022) and American university students (6051.60) (Chiang et al., 2013). This indicated that current PA levels among Chinese university students were insufficient, with substantial areas for improvement.

Additionally, this study found that female students had significantly higher PA-MET than male students. This result slightly contrasted with previous research, which generally demonstrated that male students had higher PA-MET than females (Li et al., 2020; Edelmann et al., 2022; Chiang et al., 2013). However, Zhang et al. (2022) also reported that female students had higher PA-MET scores than their male counterparts, suggesting that this finding is not unusual. This may be attributable to the school where the respondents come from, and it is also possible that Chinese female university students were relatively less affected by the external environment to do more Physical activities.

Identified regulation, Intrinsic regulation, and Integrated regulation were the key motivations influencing PA participation among university students. University students with moderate to high PA intensity tended to show autonomy-based motivational regulation, while those with lower PA levels exhibited more controlled motivation or amotivation. And this difference was statistically significant. This result aligned with previous studies that emphasized the importance of intrinsic and autonomous motivations in promoting physical activity, as they were associated with more sustained and voluntary engagement in exercise (Deci & Ryan, 2000; Teixeira et al., 2012). Specifically, autonomous motivation, which included intrinsic and identified regulation, was shown to foster long-term adherence to physical activity because it reflected internalized goals and personal enjoyment (Ryan & Deci, 2002). A meta-analysis further confirmed that autonomous motivation had a positive effect on exercise adherence and mental health (Vasconcellos et al., 2020).

When associating PA-MET with motivation types, the results indicated that PA-MET was positively correlated with intrinsic motivation, integrated regulation, and identified regulation, while it was negatively correlated with amotivation, external regulation, and introjected regulation. These findings are consistent with prior studies highlighting the positive and negative correlations of total PA-MET and its relationship with both the most autonomous forms of motivation and amotivation. (Sevil, 2018; Práxedes et al., 2016; Ullrich-French et al., 2013). In addition, each dimension of motivation had a low to moderate relationship with PA-MET. Total PA-MET was positively correlated with identified regulation, integrated regulation, and intrinsic motivation, with correlation coefficients of .360, .483, and .623. It was negatively correlated with introjected regulation, external regulation, and amotivation, with correlation coefficients of -.199, -.473 and -.566.

This finding was similar to the research of many scholars. For example, Liu et al. (2017) suggested that all motive components were moderately or highly correlated with one another ($r = .37 \sim .74$; $p < .01$), and these variables were significantly, yet low correlated to physical activity ($r = .12 \sim .24$; $p < .05$). Zhao et al. (2023) revealed that there was a positive correlation between exercise motivation and exercise behavior ($r = .240$, $p < .01$) among university students in China. Liu et al. (2023) found that the correlation coefficient between Chinese university students' exercise motivation and physical activities was .431, $p < .01$. Sevil (2018) suggested that in high-intensity PA, the correlation coefficient between motivation and PA was .391, Intrinsic motivation and PA was 0.407, and the extrinsic motivation and PA was .135.

Evidently, motivation was an important factor influencing physical activity. However, the strength of this relationship was often reported as low to moderate in many studies. This finding suggested that some additional variables played an intermediary role between motivation and PA, which has been a focal point of numerous studies, including the present study. Therefore, it is essential to examine potential mediating variables and to better understand the mechanisms underlying the relationship between university students' motivation and their PA participation.

The findings revealed that the most commonly reported barriers were Lack of willpower (63.35%), Lack of energy (59.77%), Lack of time (43.63%), and Lack of resources (39.25%). These were also the most common barriers across different PA levels and genders. In contrast, most of the respondents did not consider Fear of injury, Lack of skills, or Social influences as significant barriers to more physical activities. And statistical analysis revealed no significant gender differences for most barriers. However, significant differences were observed across PA levels, with higher PA levels being associated with fewer perceived barriers.

All types of barriers were negatively correlated with PA levels, and a stronger negative correlation with lack of time, social influences, lack of energy, and lack of willpower, while it exhibited a weaker negative correlation with Fear of injury, Lack of skills, and Lack of resources. These results were consistent with previous research highlighting an inverse relationship between physical activity and perceived barriers to PA. Dishman et al. (2005) found that students who regularly engaged in PA reported fewer psychological and logistical barriers, such as lack of motivation and time constraints. Similarly, Sallis et al. (2000) emphasized that active people are better at overcoming perceived barriers, particularly those related to time management and social influences. Al Salim (2023) found that Saudi Arabian students who participated in regular exercise reported lower levels of perceived resource and motivation-related barriers. Gyurcsik et al. (2006) demonstrated that university students with higher PA levels were less likely to perceive social invitations and academic workload as barriers to exercise. These studies reinforce the idea that higher PA engagement is associated with a lower perception of barriers, particularly those related to psychological and time constraints.

Further analysis revealed that autonomous motivation was negatively correlated with barriers, while controlled motivation was positively correlated with barriers. Most motivational variables exhibited moderate to strong correlations with barriers, except for Introjected regulation, which had only a weak correlation. These findings underscore the

importance of fostering autonomous motivation and addressing key barriers to enhance university students' participation in physical activity.

Conclusion

The average weekly PA-MET score of Chinese university students is 2,595.3, at a moderate level and requires further improvement. The primary motivational drivers for engaging in physical activities among university students are Identified regulation, Intrinsic regulation, and Integrated regulation. Higher levels of physical activity are associated with more autonomous motivation, whereas lower levels tend to correspond with controlled motivation or amotivation. However, the correlation between motivation and physical activity was only low to moderate in strength. Despite the prevalence of autonomous motivation, students frequently reported barriers such as Lack of willpower, Lack of energy, Lack of time, and Lack of resources. These perceived barriers are strongly negatively correlated with physical activity levels and significantly hinder students' participation in more physical activities. Therefore, in developing targeted and effective interventions to promote physical activity among university students, it is essential not only to accurately identify their motivational orientations but also to reduce and manage perceived barriers to physical activity. The primary contribution of this study lies in its systematic examination of the relationships among exercise motivation, perceived barriers, and physical activity levels among university students based on a large sample. This research fills a gap in the literature concerning the joint influence of motivation and barriers on physical activity behavior. In addition, the findings provide practical implications for university administrators by helping them more accurately identify key obstacles that hinder students' participation in physical activity. These insights can inform future policy-making and intervention design, emphasizing not only the enhancement of motivation but also the reduction of perceived barriers, thereby improving the scientific validity and practical effectiveness of health promotion strategies on campus.

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