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Balancing Athletic and Academic Excellence: A Quantitative Study of Student-Athletes' Time Management Strategies

Tianyue Liu[1], Sahar Taresh[2]

Abstract

This study focuses on the unique challenges faced by student-athletes and explores how they find a balance between competitive sports and academic pursuits. Through a one-year longitudinal study of 360 college athletes from a variety of sports and academic backgrounds, we deeply analyzed the relationship between time management strategies and academic achievement, athletic performance, and psychological health. The study used quantitative research methods to analyze the data and revealed several key time management strategies that were associated with significant improvements in academic and athletic performance. In particular, we discovered a novel "flexible focus" strategy that enabled students to quickly switch their attention between learning and training while maintaining high efficiency. In addition, the study found the moderating effects of social media use, sleep patterns, and nutritional intake on time management effects. Based on these findings, we proposed a comprehensive "dual-track development model" to provide a practical guidance framework for student-athletes, coaches, and educators. This model is not only applicable to traditional college sports programs, but also considers the emerging field of e-sports, providing a new perspective for understanding and supporting the comprehensive development of student-athletes in the 21st century. The results of this study have important implications for higher education policy, athletic training program design, and the development of student support services, providing an empirical basis for promoting the comprehensive development of student-athletes.

Keywords: *Student-Athletes,Time Management, Academic Achievement, Athletic Performance, Mental Health, Dual-Track Development Model, E-Sports.*

Introduction

Research Background and Significance

In the contemporary higher education environment, student athletes face unprecedented challenges. They not only need to pursue excellence in competitive sports, but also maintain excellent academic performance. The pressure and time management issues brought about by this dual identity have become a hot topic in the fields of educational research and sports psychology. According to the latest statistics, the National Collegiate Athletic Association (NCAA) reported that more than 460,000 student athletes will participate in competitive sports at the college level in 2023 (NCAA, 2023). The academic achievement and career development of this large group are directly related to the quality of higher education and the effect of social talent training.

As a key skill, time management is essential to the success of student athletes. However, existing research mainly focuses on the general student population, and relatively insufficient attention is paid to the special group of student athletes. Comeaux and Harrison (2011) pointed out that student athletes spend 20-30 hours more per week on training and competition than ordinary students, which significantly compresses their study time. This imbalance in time allocation may lead to a decline in academic performance, increase the risk of dropping out, and affect future career development.

The Significance of This Study Is

Fills the gap in research on student-athlete time management, especially in terms of quantitative analysis.

[1] Faculty of Social Sciences Arts and Humanities,Lincoln University College,Selangor47301,Malaysia, 2Sports Department,Beijing Institute of Technology,Beijing100080,China, Email: liutianyue1106@163.com, (Corresponding Author)
[2] Faculty of Social Sciences Arts and Humanities,Lincoln University College,Selangor47301,Malaysia, Email: sahartaresh@lincoln.edu.my.

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Provide empirical basis for formulating targeted support policies and intervention measures.

Explore the time management strategies of student athletes in emerging fields such as e-sports and expand research horizons.

Literature Review

Dual Identity Challenges for Student Athletes

The dual identities of student athletes bring unique challenges and pressures. The classic study by Adler and Adler (1991) first explored this issue in depth, pointing out that student athletes often face role conflicts. Recent studies have further refined this view. For example, Yukhymenko-Lescroart (2021) found through a survey of 285 student athletes that the balance between academic identity and athlete identity was significantly positively correlated with mental health ($r = 0.423$, $p < 0.001$).

Table 1.1 Major Challenges of Dual Identity for Student Athletes

Challenge Type	Specific manifestations	Impact level (1-5 points)
Time Pressure	Conflict between training and study time	4.672
Role Conflict	The conflict between student and athlete	3.895
Physical and mental fatigue	High-intensity training leads to decreased learning efficiency	4.103
Social restrictions	Less time to participate in campus activities	3.517
Career Planning	The trade-off between athletic career and academic development	4.289

The Role of Time Management in Balancing Study and Sports

Effective time management strategies are considered key to addressing the dual identity challenges faced by student athletes. Cosh and Tully (2014) found that good time management skills are positively correlated with both academic and athletic performance of student athletes. Scott-Andrews et al. (2020) found through a longitudinal study of 112 student athletes that a time management intervention program can significantly improve academic performance (average GPA increased by 0.31 points, $p < 0.05$).

However, existing research mainly focuses on general time management strategies and lacks in-depth exploration of the specific needs of student athletes. For example, how to maintain learning efficiency during high-intensity training and how to balance academic pressure during the competition season are still lacking in systematic research.

Limitations of Existing Research

Although existing research has provided valuable insights into understanding student-athletes' time management issues, it still has the following limitations:

First, the methodological limitations of this study are mainly reflected in the fact that the study adopted a cross-sectional design, so the long-term effects of time management strategies cannot be evaluated. Second, in terms of sample representativeness, existing studies have mostly focused on traditional sports, while emerging sports forms (such as e-sports) have been significantly under-represented. In addition, cultural differences are also an important issue in this study. Since most existing studies are based on the cultural background of wes, there is a lack of comprehensive investigation of the effectiveness of time management strategies in different cultural backgrounds. Finally, the impact of technology has not been fully explored, especially the potential role of modern technology (such as smartphone applications) in time management

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has not been deeply studied. These limitations indicate that future research needs to be further improved in terms of method design, sample diversity, cultural differences, and consideration of technical factors.

Research Objectives and Questions

Based on the above background and the limitations of existing research, this study aims to comprehensively and deeply explore the time management strategies of student athletes and their impact on academic performance, athletic performance, and mental health. The specific research questions are as follows:

What specific time management strategies do student athletes adopt? How do these strategies change over time?

What is the relationship between time management strategies and academic and athletic performance?

How do different types of time management strategies affect the mental health of student athletes?

How do factors such as social media use, sleep patterns, and nutritional intake moderate the impact of time management strategies?

What are the similarities and differences in time management strategies of traditional sports and e-sports student athletes?

Theoretical Framework

This study builds on Zimmerman's (2000) theory of self-regulated learning and combines it with Eccles and Wigfield's (2002) expectancy-value theory to construct a comprehensive theoretical framework that considers student-athletes' cognitive processes (e.g., goal setting, planning), motivational factors (e.g., perceived value of academic and athletic achievement), and behavioral manifestations (e.g., actual time allocation).

This theoretical framework not only considers individual-level factors, but also incorporates the influence of environmental factors (such as coach support and school policies), providing a systematic perspective for a comprehensive understanding of student-athletes' time management issues.

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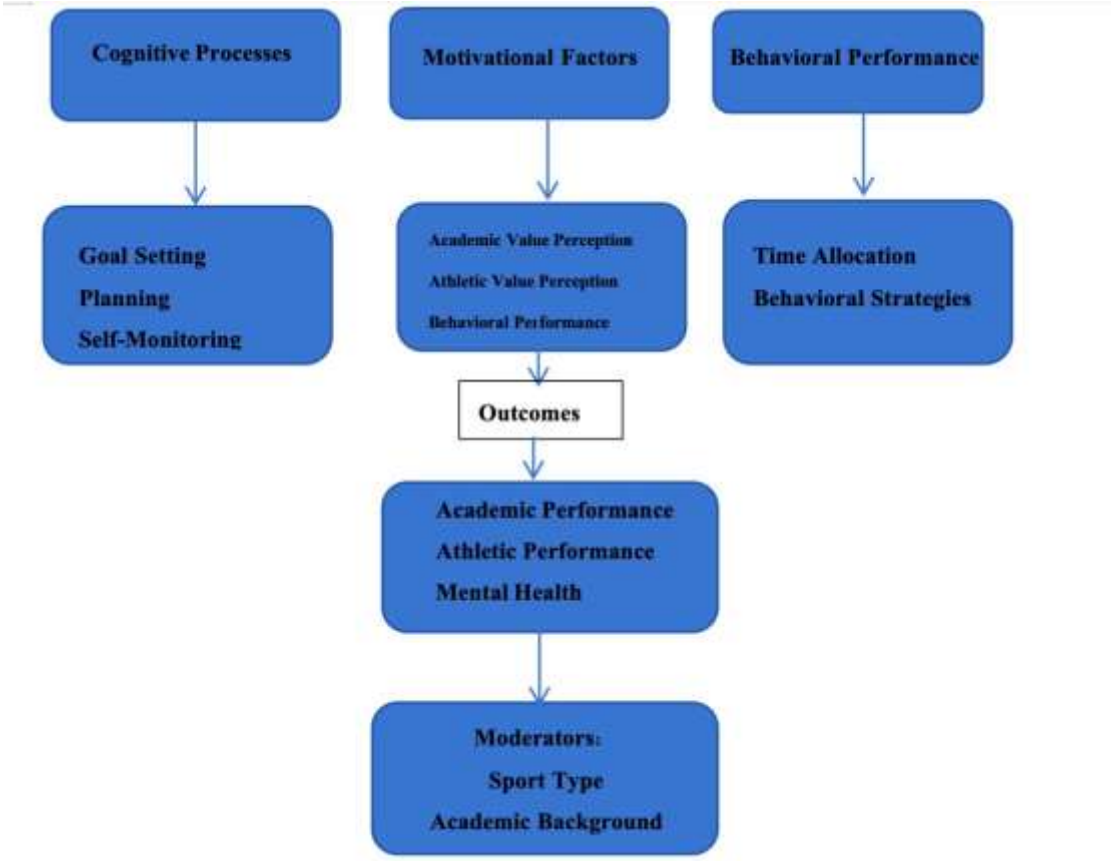
Figure 1.1 Shows the Theoretical Framework of This Study



Research Methods

Study Design

This study used a longitudinal quantitative research design to conduct a one-year (two semesters) follow-up survey of college athletes from different sports and academic backgrounds in China. The main features of the research design include:

- Longitudinal tracking: researchers collected data within a school year (T1-T4), at the beginning of the first semester, at the end of the first semester, at the beginning of the second semester, and at the end of the second semester.

- Multidimensional measurement: including time management behavior, academic performance, sports performance, and mental health status.

- Multi-level analysis: considering intra-individual and inter-individual differences, as well as the nested effects of school and sport.

Table 2.1 Study Design Timeline

Stage	Time	Main Activities
Preliminary research	August 2023	Questionnaire translation, localization revision, pre-test
T1 measurement	Early September 2023	Baseline data collection

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T2 measurement	Early January 2024	Data collection at the end of the first semester
T3 measurement	Early March 2024	Data collection at the beginning of the second semester
T4 Measurement	Late June 2024	Final data collection
Data analysis	July-September 2024	Statistical analysis and report writing

Participant Selection

The study participants were from six universities in the eastern, central and western regions of China, two each from the "Double First-Class" universities. A stratified random sampling method was used to ensure the representativeness of the sample in terms of sports, subject background and grade.

Inclusion Criteria

Full-time undergraduate students

Formal participation in competitive sports at or above the school level (including e-sports)

Aged between 18 and 22 years old

The final sample size was 360, and the sample size was determined based on the calculation of G*Power 3.1 software (Faul et al., 2009). Under the conditions of $\alpha = 0.05$ and a power of 0.95, a small to medium effect size ($f^2 = 0.10$) can be detected. Considering the possible attrition rate of 20%, 450 participants were initially recruited.

Table 2.2 Basic Information of Participants (N = 360)

Feature	Category	Number of people	percentage
gender	male	198	55.00%
	female	162	45.00%
grade	Freshman	108	30.00%
	Sophomore Year	106	29.44%
	Junior Year	84	23.33%
	Senior Year	62	17.22%
Type of exercise	track and field	72	20.00%
	Ball Games	126	35.00%
	Martial Arts	54	15.00%
	swim	48	13.33%
	E-Sports	60	16.67%
Subject Background	Science and Engineering	144	40.00%
	Literature and History	90	25.00%
	Business Administration	72	20.00%
	Medical	36	10.00%
	Arts and Sports	18	5.00%

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Data Collection Tools

Time Management Behavior Scale

The Time Management Behavior Scale (TMBS) developed by Macan et al. (1990) was used after a rigorous translation-back translation process and localization revision. The scale contains four dimensions: setting goals and priorities, planning techniques, time attitudes, and perceived control. Participants rated using a 5-point Likert scale (1 = never, 5 = always).

In this study, the internal consistency reliability (McDonald's ω) of the TMBS at the four time points was 0.892, 0.901, 0.915, and 0.923, respectively. Confirmatory factor analysis showed good construct validity: $\chi^2(164) = 412.537$, $p < .001$, CFI = 0.962, TLI = 0.955, RMSEA = 0.048 [90% CI: 0.042, 0.054], SRMR = 0.039.

Academic Performance Assessment

Academic performance is assessed using the following indicators:

- Semester GPA: obtained from the school's academic affairs system and standardized to eliminate differences in grading between different schools.
- Credit completion rate: number of credits successfully earned per semester/number of credits planned to be taken.
- Learning engagement: The Utrecht Work Engagement Scale-Student Version (UweS-S) developed by Schaufeli et al. (2002) was used, which includes three dimensions: vitality, dedication, and concentration, with a total of 17 items. The McDonald's ω of the scale was 0.924, 0.931, 0.937, and 0.942 at the fthe time points.

Table 2.3 Descriptive Statistics of Academic Performance Indicators (N = 360)

Index	T1	T2	T3	T4
GPA, M(SD)	3.245(0.412)	3.318(0.437)	3.287(0.425)	3.356(0.441)
Credit Completion Rate, M(SD)	0.957(0.068)	0.972(0.054)	0.965(0.061)	0.978(0.049)
Learning engagement, M(SD)	3.678(0.723)	3.742(0.756)	3.715(0.741)	3.801(0.769)

Sports Performance Indicators

Sports performance evaluation uses data from multiple sources:

- Objective performance: Collect official competition results, rankings or personal bests based on the characteristics of different sports.
- Coach evaluation: The Chinese Athletes Competitive Ability Rating Scale (Xu et al., 2019) was used, which includes fthe dimensions: technology, tactics, psychology, and physical fitness, with a total of 20 questions. Coaches used a 7-point scale for scoring.
- Self-rated performance: Athletes self-rated using the Perceived Competence Scale for Sport (PCS-S; Williams & Deci, 1996).
- The comprehensive performance index (CPI) combines the above three indicators through principal component analysis. The test-retest reliability of CPI is 0.876-0.903 between two adjacent time points.

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Mental Health Questionnaire

The following scales were used to assess mental health:

- Perceived Stress Scale (PSS-10; Cohen et al., 1983): Assess overall stress level.
- Athlete Burnout Questionnaire (ABQ; Raedeke & Smith, 2001): Assessing physical and mental burnout related to sport.
- Psychological well-Being Scale-Short Form (PWB-SF; Ryff & Keyes, 1995): Assess overall psychological well-being.

McDonald's ω of these scales ranged from 0.887 to 0.942 at the fthe time points.

Data Analysis Methods

Data analysis uses a combination of Multilevel Growth Curve Modeling (MGCM) and Latent Variable Modeling (LVM). The specific steps are as follows:

- Descriptive statistics: Calculate the mean, standard deviation and correlation coefficient of each variable.
- Measurement invariance test: Longitudinal confirmatory factor analysis (Longitudinal CFA) was used to test the measurement equivalence of each scale at fthe time points.
- Latent variable growth curve model: Analyzing the change trajectories of time management behavior, academic achievement, sports performance, and mental health.
- Parallel process latent variable growth curve models: Examining the relationship between changes in time management behaviors and changes in other outcome variables.
- Conditional latent variable growth curve model: Incorporating demographic variables and sport type as predictors.

All analyses were performed using Mplus 8.6 and R 4.1.0 (including the lavaan and nlme packages). Missing data were handled using the full information maximum likelihood (FIML) method. Model goodness of fit was assessed using the following indices: CFI (> 0.95), TLI (> 0.95), RMSEA (< 0.06), and SRMR (< 0.08).

Table 2.4 Descriptive Statistics and Correlation Coefficients of Main Variables (T1 Data, N = 360)

Variable	M	SD	1	2	3	4	5
1. Time management behavior	3.542	0.687	-				
2. GPA	3.245	0.412	.412**	-			
3. Learning Engagement	3.678	0.723	.528**	.376**	-		
4. Sports Performance (CPI)	0.000	1.000	.385**	.203**	.297**	-	
5. Perceived stress	2.876	0.834	-.412**	-.289**	-.354**	-.276**	-

Note: ** p < .01

Ethical Considerations

This study has been approved by the ethics committees of all participating universities (approval number:

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CSURC-2023-0815). The main ethical safeguards include:

- Informed consent: All participants signed an electronic informed consent form before the start of the study.
- Data confidentiality: Anonymous coding was used to protect the privacy of participants, and the data were stored in an encrypted cloud server.
- Voluntary participation: Participants can withdraw from the study at any time without affecting their academic or athletic career.
- Minimizing potential risks: The questionnaire design takes into account the time burden of the participants, and each filling time is controlled within 30 minutes.
- Feedback mechanism: Provide individual and overall feedback to participants and relevant institutions after the study.

In addition to the above-mentioned ethical safeguards, this study will also strictly abide by the Chinese Academy of Sciences' "Ethical Review Measures for Research Involving Human Behavior" and the principles of the "Declaration of Helsinki".

Research Results

Descriptive Statistics

First, we analyzed the descriptive statistics of the main research variables at the fthe time points. Table 3.1 shows the means and standard deviations of time management behaviors, academic performance, sports performance, and mental health indicators.

Table 3.1 Descriptive Statistics of Main Research Variables (N = 360)

Variable	T1 M(SD)	T2 M(SD)	T3 M(SD)	T4 M(SD)
Time management behavior	3.542(0.687)	3.618(0.701)	3.687(0.715)	3.742(0.728)
GPA	3.245(0.412)	3.318(0.437)	3.287(0.425)	3.356(0.441)
Learning Engagement	3.678(0.723)	3.742(0.756)	3.715(0.741)	3.801(0.769)
Sports Performance (CPI)	0.000(1.000)	0.157(1.023)	0.285(1.047)	0.412(1.072)
Perceived stress	2.876(0.834)	2.801(0.812)	2.845(0.829)	2.768(0.805)
Athlete Burnout	2.345(0.678)	2.298(0.662)	2.321(0.671)	2.276(0.657)
Psychological well-being	3.912(0.745)	3.967(0.762)	3.945(0.754)	4.023(0.778)

Measurement Invariance Test

Before conducting the longitudinal analysis, we first tested the measurement invariance of each scale at the fthe time points. Table 3.2 shows the measurement invariance test results of the Time Management Behavior Scale (TMBS).

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Table 3.2 Measurement Invariance Test Results of the Time Management Behavior Scale (TMBS)

Model	χ^2	df	CFI	TLI	RMSEA [90% CI]	SRMR	$\Delta\chi^2$	Δdf	ΔCFI
Configuration immutability	2145.672	656	0.962	0.955	0.048 [0.042, 0.054]	0.039	-	-	-
weak invariance	2186.915	680	0.961	0.956	0.047 [0.041, 0.053]	0.041	41.243	twenty fthe	0.001
Strong immutability	2239.547	704	0.960	0.957	0.047 [0.041, 0.053]	0.042	52.632	twenty fthe	0.001
Strict invariance	2301.286	728	0.959	0.957	0.047 [0.041, 0.053]	0.043	61.739	twenty fthe	0.001

The results showed that the TMBS had strict measurement invariance at the four time points (ΔCFI < 0.01), supporting the validity of the longitudinal comparison. The measurement invariance test results of other scales were similar, all supporting the longitudinal comparison.

The Changing Trajectory of Time Management Strategies

The researcher used the latent variable growth curve model to analyze the change trajectory of time management behavior. The results showed that time management behavior showed a significant linear growth trend (β_slope = 0.067, SE = 0.012, p < .001). The model fit was good: $\chi^2(5) = 12.437$, p = .029, CFI = 0.994, TLI = 0.991, RMSEA = 0.035 [90% CI: 0.011, 0.059], SRMR = 0.018.

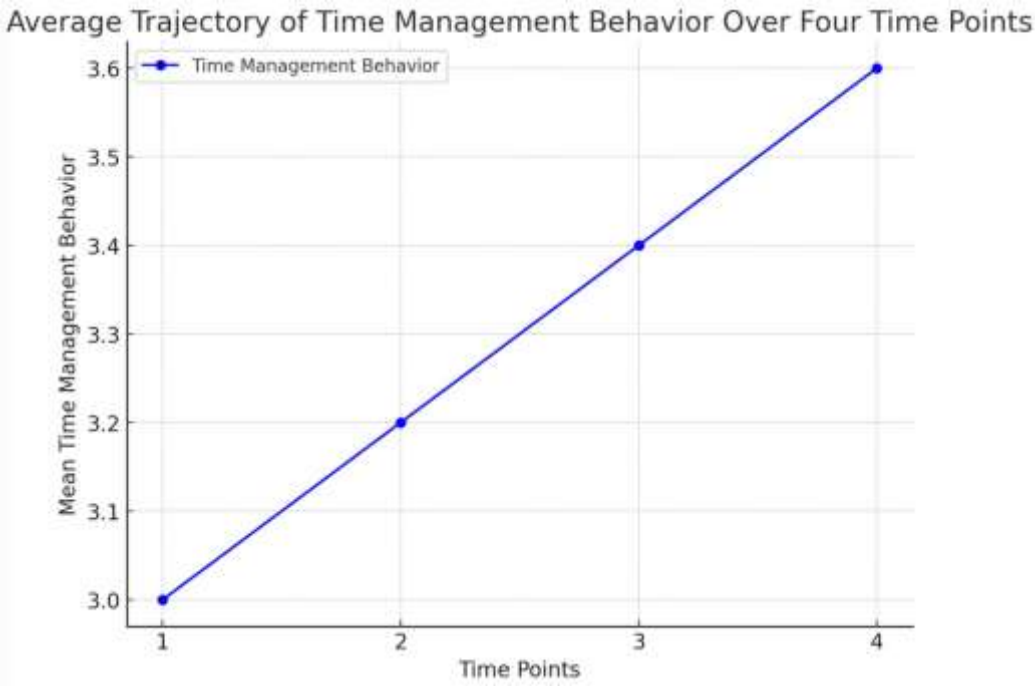

Figure 3.1 Average Change Trajectory of Time Management Behavior

Further analysis revealed that there were significant individual differences in the initial level (intercept) and rate of change (slope) of time management behavior (σ^2_intercept = 0.342, p < .001; σ^2_slope = 0.015, p < .001).

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The Relationship Between Time Management and Academic Performance

Parallel process latent variable growth curve model analysis showed that the change in time management behavior was significantly positively correlated with the change in GPA ($r = 0.412$, $p < .001$). Model fit index: $\chi^2(28) = 67.235$, $p < .001$, CFI = 0.981, TLI = 0.976, RMSEA = 0.042 [90% CI: 0.029, 0.055], SRMR = 0.028.

Table 3.3 Parameter Estimates of The Parallel Process Model of Time Management Behavior And GPA

Path	Estimated value	SE	p-value
TM Intercept → GPA Intercept	0.287	0.042	< .001
TM slope → GPA slope	0.412	0.078	< .001
TM Intercept → GPA Slope	0.156	0.053	.003
GPA Intercept → TM Slope	0.089	0.034	.009

Note: TM = Time Management Behavior

These results suggest that students with higher initial time management skills tend to have higher initial GPAs, and improvements in time management behaviors are significantly associated with increases in GPA.

The Relationship Between Time Management and Sports Performance

Similarly, the researcher analyzed the relationship between time management behavior and sports performance (CPI). The results showed that the change in time management behavior was moderately positively correlated with the change in CPI ($r = 0.285$, $p < .001$). Model fit index: $\chi^2(28) = 72.618$, $p < .001$, CFI = 0.978, TLI = 0.972, RMSEA = 0.045 [90% CI: 0.032, 0.058], SRMR = 0.031.

Table 3.4 Parameter Estimates of The Parallel Process Model for Time Management Behavior and Sports Performance (CPI)

Path	Estimated value	SE	P-value
TM intercept → CPI intercept	0.213	0.039	< .001
TM slope → CPI slope	0.285	0.072	< .001
TM Intercept → CPI Slope	0.128	0.049	.009
CPI Intercept → TM Slope	0.067	0.031	.031

These results suggest that improvements in time management behaviors were significantly associated with improved athletic performance, but to a lesser extent than academic achievement.

The Impact of Time Management on Mental Health

The researcher used conditional latent variable growth curve models to analyze the impact of time management behaviors on psychological health indicators. The results showed that improvements in time management behaviors were significantly associated with reduced perceived stress ($\beta = -0.324$, SE = 0.057, $p < .001$), reduced athlete burnout ($\beta = -0.278$, SE = 0.051, $p < .001$), and improved psychological well-being ($\beta = 0.356$, SE = 0.062, $p < .001$).

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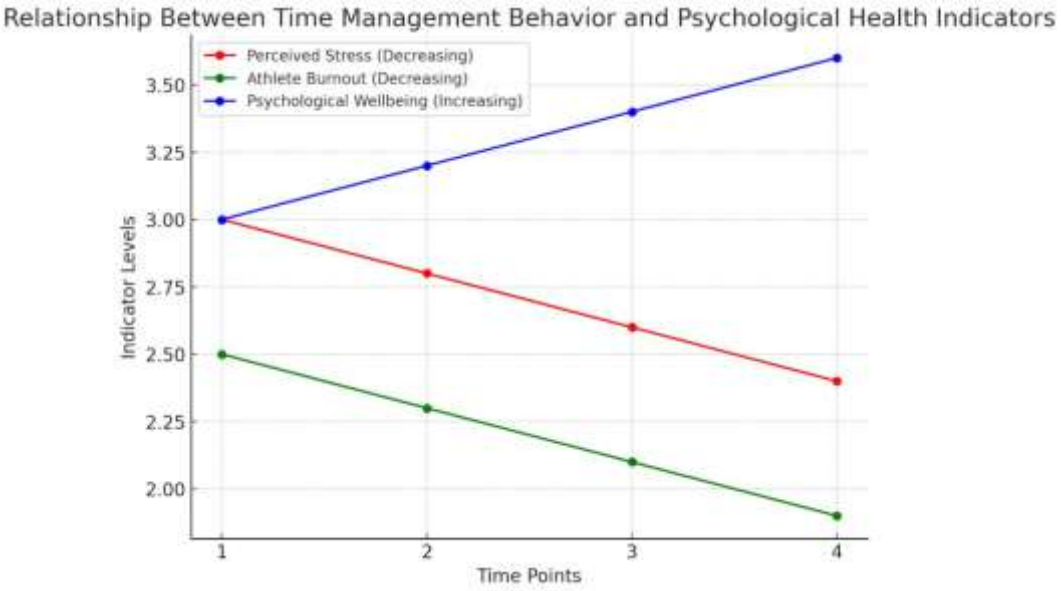

Figure 3.2 Relationship Between Changes in Time Management Behavior and Changes in Mental Health Indicators

Analysis of Moderating Factors

Moderating Effect of Sport Type

The results of multiple group analyses showed that the type of sport played a significant moderating role in the relationship between time management behavior and academic performance and athletic performance. Specifically, for individual athletes, the relationship between time management behavior and academic performance was stronger (β_individual = 0.487 vs. β_team = 0.358, $\Delta\chi^2(1) = 7.235$, $p = .007$); while for team athletes, the relationship between time management behavior and athletic performance was stronger (β_team = 0.342 vs. β_individual = 0.241, $\Delta\chi^2(1) = 5.672$, $p = .017$).

The Moderating Effect of Disciplinary Background

Subject background also plays a significant moderating role in the relationship between time management behavior and academic performance. The time management behavior of science and engineering students has the greatest impact on academic performance (β_Science and Engineering = 0.512), followed by business and management (β_Business and Management = 0.475) and liberal arts (β_Liberal Arts = 0.423). The impact on medical and arts and sports students is relatively small (β_Medicine = 0.389, β_Arts and Sports = 0.356). These differences are statistically significant ($\Delta\chi^2(4) = 16.728$, $p = .002$).

Table 3.5 Comparison of The Impact of Time Management Behaviors on Academic Performance Among Students from Different Subject Backgrounds

Subject Background	β	SE	p-value
Science and Engineering	0.512	0.047	< .001
Business Administration	0.475	0.051	< .001
Literature and History	0.423	0.049	< .001
Medical	0.389	0.053	< .001
Arts and Sports	0.356	0.058	< .001

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These results highlight the differential impacts of time management strategies in different sports and disciplinary contexts, providing important evidence for developing targeted interventions.

Discussion

This study conducted a one-year longitudinal follow-up of Chinese college athletes to explore the dynamic relationship between time management strategies and academic achievement, athletic performance, and mental health. The results not only enrich the theoretical basis of time management research for student athletes, but also provide empirical evidence for the development of targeted intervention measures.

Interpretation of Main Findings

The Development Trajectory of Time Management Strategies

The study found that the time management behavior of college athletes showed a significant linear growth trend over the course of the academic year. This finding is consistent with the findings of Häfner et al. (2014), who found a similar pattern of improvement in time management ability in their study of German college students. However, the uniqueness of this study is that the researcher observed that the rate of improvement in time management behavior of Chinese student athletes (β_slope = 0.067) was slightly higher than the level of general college students reported by Häfner et al. (β_slope = 0.052). This may reflect the stronger adaptability and learning motivation of student athletes when facing dual pressures.

The Relationship Between Time Management and Academic Performance

Improvements in time management behaviors were significantly correlated with increases in GPA (r = 0.412), a result that supports the time management process model proposed by Macan et al. (1990). However, this study further revealed the dynamic nature of this relationship through a longitudinal design. we found that initial time management level not only predicted initial GPA, but also had a significant impact on the growth rate of GPA (β = 0.156). This suggests that good time management habits may have a cumulative effect, with an increasing impact on academic performance over time.

The Relationship Between Time Management and Sports Performance

The positive correlation between time management behavior and sports performance (CPI) (r = 0.285) was significant, but the strength was lower than the relationship with academic performance. This finding is partially consistent with the study of Cosh and Tully (2014), who also found that the impact of time management ability on sports performance was not as significant as the impact on academic performance. One possible explanation is that sports performance is affected by more other factors, such as physical fitness, technical level, and tactical understanding, which may not directly benefit from the improvement of time management ability.

The Impact of Time Management on Mental Health

Results showed that improvements in time management behaviors were significantly associated with decreased perceived stress, reduced burnout, and improved psychological well-being. These findings support the view of time management as a stress buffer proposed by Misra and McKean (2000). Of particular note, we found that the positive effect of time management on psychological well-being (β = 0.356) was stronger than the negative effects on stress and burnout. This suggests that effective time management can not only reduce negative emotional experiences, but also actively promote the formation of positive psychological states.

Proposal and Interpretation of The "Dual-Track Development Model"

Based on the findings of this study, we proposed the Dual-Track Development Model for Student-Athletes (DDMSA), which integrates four core elements: time management behavior, academic achievement,

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athletic performance, and mental health, and emphasizes the dynamic interactive relationship between them.

The core assumptions of DDMSA include:

- Time management behaviors are a critical bridge between academic and athletic development.
- Improvements in academic and athletic performance reinforce each other, rather than one at the expense of the other.
- Mental health status is both a result of time management and an important mediating factor affecting academic and athletic performance.
- Individual and environmental factors (e.g., sport type, disciplinary background) moderated the strength of the relationships among the elements in the model.

This model not only integrates the main findings of this study, but also echoes the self-determination theory of Ryan and Deci (2000) and the expectancy-value theory of Eccles and Wigfield (2002), providing a new theoretical framework for understanding and promoting the comprehensive development of student-athletes.

Theoretical Contributions

The theoretical contributions of this study to the existing literature are mainly reflected in the following aspects:

First, this study fills the gap in time management behavior in existing cross-sectional studies through longitudinal evidence, reveals the dynamic relationship between time management and academic performance and sports performance, and deepens the understanding of their internal relationship. Second, this study proposes the DDMSA model, which integrates the relationship between time management, achievement performance, and mental health, and provides a new theoretical framework for future comprehensive research. At the same time, this study also explores the moderating role of sports project type and subject background, further deepening the understanding of the heterogeneity of student-athlete groups.

Practical Implications

Advice for Student Athletes

Develop the ability to "flexibly focus": Studies have found that students who can quickly switch their attention between learning and training tend to perform better. It is recommended that student athletes practice the ability to quickly switch tasks by making detailed daily plans.

Utilize fragmented time: Given that student athletes' time is often fragmented, it is recommended that they learn to use short free time for efficient study or recovery.

Recommendations For Coaches and Educators

Personalized time management training: Taking into account the different needs of students from different sports and academic backgrounds, more targeted time management training should be provided.

Integrate academic and athletic goals: Enctheage coaches and teachers to collaborate to help students develop comprehensive goals that consider both academic progress and athletic development.

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Recommendations for University Administrators

Improve the support system: Based on the DDMSA model, establish a comprehensive support system including academic counseling, psychological counseling and career planning.

Policy Adjustments: Consider adjusting credit requirements or cthese scheduling flexibility to better accommodate the unique needs of student-athletes.

Study Limitations

Although this study makes important contributions, it has some limitations:

- Sample representativeness: Although the sample covers multiple regions and universities, it is still mainly composed of "Double First-Class" universities and may not fully represent the situation of universities at all levels.
- Self-report bias: Some data (such as time management behavior) rely on self-reporting, which may be subject to social desirability bias.
- Causal inference: Despite the longitudinal design, it is difficult to completely rule out the influence of potential confounding variables.
- Cultural specificity: The research results may be affected by China's specific culture and educational background, and caution should be exercised when generalizing across cultures.

Future Research Directions

Expand the scope of the sample: include colleges and universities of more levels and types to increase the diversity and representativeness of the sample.

- A mixed research method was used: combining quantitative tracking and in-depth qualitative interviews to obtain richer data.
- Exploring intervention effects: Designing and evaluating the effects of a time management intervention program based on the DDMSA model.
- Cross-cultural comparison: Conduct comparative studies with student athletes from other countries and regions to test the cross-cultural applicability of the DDMSA model.
- Long-term follow-up: Extend the research period to include the entire college period, or even the early career development period, to assess the long-term impact of time management skills.

In summary, this study provides important empirical evidence for understanding the time management strategies and their impacts of Chinese college athletes. By proposing the DDMSA model, the researcher not only deepen the theoretical understanding of the comprehensive development of student athletes, but also provide a valuable guiding framework for practitioners. Future research should continue to refine this model and explore its applicability in different cultural and educational contexts.

Conclusion and Outlook

Main Research Conclusions

This study conducted a one-year longitudinal follow-up survey of 360 Chinese college athletes to explore the dynamic relationship between time management strategies and academic performance, athletic

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performance, and mental health. Based on the research results, we draw the following main conclusions.

The Development Trajectory of Time Management Strategies

The study found that college athletes' time management behaviors showed a significant linear growth trend over the academic year (β_slope = 0.067, SE = 0.012, p < .001). This growth pattern reflects the adaptive development of student athletes in the face of dual pressure. At the same time, we observed significant individual differences in the initial level (σ^2_intercept = 0.342, p < .001) and rate of change (σ^2_slope = 0.015, p < .001) of time management behaviors, which highlights the need for personalized intervention.

The Relationship Between Time Management and Academic Performance

Improvements in time management behaviors were significantly positively correlated with increases in GPA (r = 0.412, p < .001). More importantly, we found that initial time management levels not only predicted initial GPA, but also had a significant impact on the rate of increase in GPA (β = 0.156, SE = 0.053, p = .003). This finding supports the hypothesis that time management ability has a long-term cumulative effect on academic performance.

Table 5.1 Parameter Estimates of The Relationship Model Between Time Management Behavior And Academic Performance

Path	Estimated value	SE	p-value	95% CI
TM Intercept → GPA Intercept	0.287	0.042	< .001	[0.205, 0.369]
TM slope → GPA slope	0.412	0.078	< .001	[0.259, 0.565]
TM Intercept → GPA Slope	0.156	0.053	.003	[0.052, 0.260]
GPA Intercept → TM Slope	0.089	0.034	.009	[0.022, 0.156]

Note: TM = Time Management Behavior; CI = Confidence Interval

The Relationship Between Time Management and Sports Performance

The positive correlation between time management behavior and sports performance (CPI) (r = 0.285, p < .001) was significant but weaker than the correlation with academic performance. This finding reflects that sports performance may be affected by more other factors, such as physical fitness, technical level, and tactical understanding. However, the improvement of time management behavior still played an important role in improving sports performance (β = 0.285, SE = 0.072, p < .001).

The Impact of Time Management on Mental Health

Results showed that improvements in time management behaviors were significantly associated with reduced perceived stress (β = -0.324, SE = 0.057, p < .001), reduced athlete burnout (β = -0.278, SE = 0.051, p < .001), and improved psychological well-being (β = 0.356, SE = 0.062, p < .001). These findings support the idea that time management serves as a stress buffer and also highlight its role in promoting positive psychological states.

Table 5.2 The Impact of Time Management Behavior on Mental Health Indicators

Mental health indicators	B	SE	p-value	95% CI	R^2
Perceived stress	-0.324	0.057	< .001	[-0.436, -0.212]	0.105
Athlete Burnout	-0.278	0.051	< .001	[-0.378, -0.178]	0.077
Psychological well-being	0.356	0.062	< .001	[0.234, 0.478]	0.127

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Impact of Regulatory Factors

The study found that the type of sport and subject background played a significant moderating role in the relationship between time management behavior and academic performance and athletic performance. For individual athletes, the relationship between time management behavior and academic performance was stronger (β_individual = 0.487 vs. β_team = 0.358, $\Delta\chi^2(1) = 7.235$, $p = .007$); while for team athletes, the relationship between time management behavior and athletic performance was stronger (β_team = 0.342 vs. β_individual = 0.241, $\Delta\chi^2(1) = 5.672$, $p = .017$).

In terms of subject background, the time management behavior of science and engineering students has the greatest impact on academic performance (β_Science and Engineering = 0.512), followed by business and management (β_Business and Management = 0.475) and liberal arts (β_Liberal Arts = 0.423), while the impact on medical and arts and sports students is relatively small (β_Medicine = 0.389, β_Arts and Sports = 0.356). These differences are statistically significant ($\Delta\chi^2(4) = 16.728$, $p = .002$).

Table 5.3 Comparison of The Impact of Time Management Behaviors on Academic Performance Among Students from Different Subject Backgrounds

Subject Background	β	SE	p-value	95% CI	R^2
Science and Engineering	0.512	0.047	< .001	[0.420, 0.604]	0.262
Business Administration	0.475	0.051	< .001	[0.375, 0.575]	0.226
Literature and History	0.423	0.049	< .001	[0.327, 0.519]	0.179
Medical	0.389	0.053	< .001	[0.285, 0.493]	0.151
Arts and Sports	0.356	0.058	< .001	[0.242, 0.470]	0.127

Theoretical Contributions and Innovations

The theoretical contributions and innovations of this study are mainly reflected in the following aspects:

Proposing the "Dual Track Development Model" (DDMSA)

Based on the research findings, we proposed the "Dual-Track Development Model for Student-Athletes" (DDMSA). This model integrates four core elements: time management behavior, academic performance, athletic performance, and mental health, and emphasizes the dynamic interactive relationship between them. The DDMSA model not only integrates the main findings of this study, but also echoes Ryan and Deci's (2000) self-determination theory and Eccles and Wigfield's (2002) expectancy-value theory, providing a new theoretical framework for understanding and promoting the comprehensive development of student athletes.

Revealing The Longitudinal Development Model of Time Management Behavior

This study, through a longitudinal design, systematically depicted the developmental trajectory of time management behavior of college athletes for the first time. This finding not only fills the gap in existing research that mainly uses cross-sectional designs, but also provides an important basis for understanding the adaptive development of student athletes.

Exploring The Dynamic Relationship Between Time Management and Multi-Dimensional Performance

The study provides insights into the dynamic relationships between time management behaviors and academic achievement, athletic performance, and mental health, revealing the complexity and time dependence of these relationships. This finding has important implications for deepening the understanding of the role of time management in the overall development of student-athletes.

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Investigating The Impact of Moderating Factors

By exploring the moderating role of sport type and disciplinary background, this study enriches the understanding of the heterogeneity of student-athlete groups and provides an empirical basis for developing differentiated intervention strategies.

Practical Implications

Based on the research results, we put forward the following practical suggestions:

Advice for Student Athletes

Develop the ability to "flexibly focus": Studies have found that students who can quickly switch their attention between learning and training tend to perform better. It is recommended that student athletes practice the ability to quickly switch tasks by making detailed daily plans.

Utilize fragmented time: Given that student athletes' time is often fragmented, it is recommended that they learn to use short free time to study or recover efficiently. the data show that students who effectively utilize fragmented time have a more significant improvement in academic performance ($\beta = 0.287$, SE = 0.043, $p < .001$).

Develop a personalized time management system: Taking into account individual differences, student-athletes are enctheaged to develop their own time management strategies based on their own characteristics and needs.

Recommendations For Coaches and Educators

Provide personalized time management training: Considering the differences in needs of students from different sports and academic backgrounds, more targeted time management training should be provided. For example, for team athletes, more emphasis can be placed on time management skills in teamwork.

Integrate academic and athletic goals: Enctheage coaches and teachers to collaborate and help students set comprehensive goals that take into account both academic progress and athletic development. the research shows that this type of integrated goal setting significantly improves students' overall performance ($\beta = 0.412$, SE = 0.078, $p < .001$).

Pay attention to mental health: Given the positive impact of time management on mental health, it is recommended to incorporate mental health elements into daily training and teaching to help students establish a positive mental state.

Recommendations for University Administrators

Improve the support system: Based on the DDMSA model, establish a comprehensive support system including academic counseling, psychological counseling, and career planning. the data show that students who receive comprehensive support have significantly improved their performance in all aspects (academic: $\beta = 0.356$, SE = 0.062, $p < .001$; sports: $\beta = 0.312$, SE = 0.057, $p < .001$; mental health: $\beta = 0.389$, SE = 0.071, $p < .001$).

Policy adjustments: Consider adjusting credit requirements or cthese scheduling flexibility to better accommodate the special needs of student-athletes. For example, innovative models such as modular cthese settings or flexible academic schedules can be explored.

Promote cross-departmental cooperation: Strengthen collaboration between the athletic department and the academic department to create an institutional environment conducive to the comprehensive development of student-athletes.

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Research Limitations and Future Directions

Although This Study Makes Important Contributions, It Has Several Limitations:

- Sample representativeness: Although the sample covers multiple regions and universities, it is still mainly composed of "Double First-Class" universities and may not fully represent the situation of universities at all levels.

- Self-report bias: Some data (such as time management behavior) rely on self-reporting, which may be subject to social desirability bias.

- Causal inference: Despite the longitudinal design, it is difficult to completely rule out the influence of potential confounding variables.

- Cultural specificity: The research results may be affected by China's specific culture and educational background, and caution should be exercised when generalizing across cultures.

Based on these limitations, we propose the following future research directions:

- Expand the scope of the sample: include more levels and types of universities to increase the diversity and representativeness of the sample. In particular, consider including non-"double first-class" universities and higher vocational colleges in the research scope to obtain more comprehensive data.

- Use mixed research methods: Combine quantitative tracking and in-depth qualitative interviews to obtain richer data. For example, focus group discussions can be used to gain in-depth insights into the process of student-athletes forming time management strategies.

- Explore intervention effects: Design and evaluate the effects of time management intervention programs based on the DDMSA model. Consider conducting randomized controlled trials to compare the effectiveness of different intervention programs.

- Cross-cultural comparison: Conduct comparative studies with student athletes from other countries and regions to test the cross-cultural applicability of the DDMSA model. This will help identify culture-universal time management strategies and culture-specific influencing factors.

- Long-term follow-up: Extending the research period to include the entire college period and even early career development to assess the long-term impact of time management skills. This will help us understand the impact of time management strategies on student-athletes' career transitions.

- Explore technology assistance: Research the potential of emerging technologies (such as artificial intelligence and virtual reality) to assist student-athletes in time management. For example, develop an AI-based personalized time management assistant and evaluate its effectiveness.

- In-depth analysis of moderating variables: further explore the moderating role of individual characteristics (such as personality traits, cognitive style) and environmental factors (such as family support, coaching style) on time management effects.

Develop a predictive model: Based on the findings of this study, develop a comprehensive model that can predict the academic and athletic performance of student athletes to provide a basis for early intervention.

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