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A study of the interaction model of physical and mental states of badminton players based on multidimensional data computational analysis in physical education

Zhenfang Jiang[1] and Yan Jiang[2,*]
[1] Department of Physical Education, Liaoyuan Vocational and Technical College, Liaoyuan, Jilin, 136200, China
[2] School of Medical Technology, Liaoyuan Vocational and Technical College, Liaoyuan, Jilin, 136200, China
Corresponding authors: (e-mail: jzf@lyvtc.edu.cn).

Abstract This paper collects data on physical fitness and mental status of 200 badminton players by combining questionnaire survey and teaching experiment with 12-week physical education teaching experiment as the background. Gray correlation analysis, one-way ANOVA and multiple regression model were used to construct the interaction model of physical fitness and mental status and explore the mechanism of its influence on athletic ability. The results showed that the contribution of speed index (50m running) and endurance index (800/1000m running) to the athletic ability among the physical performance indexes (Beta=0.319, 0.305, p=0.007, 0.009) was significantly higher than that of the strength index (Beta=0.298, p=0.011). Mental state interacted nonlinearly with physical fitness level, with anxiety having the greatest negative effect on athletic ability (Beta=-0.322, p=0.002), while physical fitness enhancement had a positive effect on athletic ability. The study confirms that the synergistic optimization of physical fitness and psychological state can effectively enhance athletic performance, and the interaction model provides scientific support for the design of personalized training programs in physical education.

Index Terms badminton, physical fitness level, mental state, multiple regression analysis, gray correlation analysis

I. Introduction

Badminton is a fine action, technical and tactical complexity and change, confrontation intense athletic program, today the world badminton sports level has developed to a new level, it not only requires athletes to have mature technology, flexible and changeable tactics, but also more need to good physical and psychological quality. In a badminton game of great intensity, the physical energy consumed by the players (strength, speed, sensitivity, endurance and flexibility, etc.) is larger than most other competitive games, so when the players reach a certain level of skill, the level of physical fitness will constrain the improvement of technology, and may produce psychological problems such as anxiety, which will affect the game results [1]-[3]. According to the comparison of the impact of athletes' physical performance on performance in badminton, as well as data analysis with reference to a variety of textual information, the decline in athletes' physical fitness determines the performance of badminton matches, and a certain amount of physical training can improve the athletes' level of competitiveness and increase the probability of winning [4], [5]. At the same time, athletes close to the game in technology, tactics and physical fitness generally do not have much change, while its emotional and psychological subtle changes often lead to the ups and downs of the competitive state, but also increase the physical energy consumption, which directly affects the results of the game [6], [7]. Many psychological researchers on the investigation and analysis of the athletes' competition situation, found that in the competition of the technical level of the athletes who do not play well, due to the level of training, technical preparation caused by insufficient failure accounted for about 20%, due to the psychological aspects of the failure caused by insufficient preparation accounted for about 70% [8]. Therefore, coaches and athletes attach great importance to physical training and regulation of psychological state.

However, in today's physical education, physical training and mental state education exist independently and lack scientific interaction, which is not conducive to the long-term development of athletes. In entering the data-driven era, physical education has also moved from the coach's experience-led guidance model to the data-guidance model, combining the two to provide a scientific approach to athletes' physical training and mental state management, and to enhance interactivity. The intense nature of badminton creates complexity and non-linearity between athletes' physical changes and psychological changes. Through wearable devices, artificial intelligence, big data analysis, computer vision technology, etc. to capture the multidimensional data of athletes' physical and psychological performance during the exercise process, data calculation and analysis, to explore the interactive relationship between physical fitness and psychological state, and to provide the basis for scientific physical training and psychological state management [9]-[12].

This paper firstly describes the selection of the research subjects and proposes the combination of questionnaires and teaching experiments to collect data on athletes' physical fitness and mental health. Stepwise regression based on t-test is proposed and an improved stepwise regression method is designed. The mental health of athletes was analyzed by descriptive statistics and independent samples t-test, and gray correlation analysis was used to screen physical fitness indicators. Based on one-way ANOVA to explore the differences in athletic ability between different physical and mental status groups, multiple regression model was used to construct the interaction model between athletes' physical and mental status.

II. Experimental design for the investigation of physical and mental status of badminton players in physical education

The competitive performance and training effect of badminton players have always been subject to the dual constraints of physical fitness level and psychological state. Current research focuses on a single dimension, either focusing on the enhancement of athletic performance by physical training or the regulation of athletic performance by psychological interventions, but few studies have systematically explored the dynamic interaction mechanism between physical and psychological states and their synergistic effects on athletic performance. This limitation makes it difficult to develop a comprehensive intervention program that takes into account both physical performance enhancement and psychological quality optimization in physical education practice.

This study aims to construct an interaction model of physical fitness and psychological state in badminton players, and reveal the interaction path of the two on athletic ability through empirical analysis.

II. A. Subjects of study

Taking the effects of different physical exercise methods in 12-week physical education on the athletic ability and mental health of badminton players as the object of study, four badminton training groups were randomly selected as experimental subjects in Province B. The athletes who participated in the experiment were healthy and able to complete normal physical exercise, and they met the standards of the subjects.

II. B. Research methodology

II. B. 1) Questionnaire method

According to the physical and mental development characteristics of athletes, a large number of literature on sports psychology, social surveys and other aspects of the design of the questionnaire to lay a good foundation for the design of the questionnaire, combined with the research objectives of this study, the design of the mental health questionnaire. Based on the theme of this study, the questionnaire was designed in the form of multiple-choice questions in order to facilitate the respondents to fill out the questionnaire, making it concise and clear. The questionnaire was tested for reliability and validity, 15 professionals have completed the initial review of the questionnaire, the percentage of recovery is as high as 100%, the specific validity evaluation is shown in Table 1, the overall design of the validity level is considered to be very appropriate accounted for 66.7%, and the three levels of validity is considered to be inappropriate accounted for 0%, indicating that the questionnaire validity is good.

Table 1: Evaluation of questionnaire validity by experts

Validity	The number of experts	Very suitable	More suitable	Basically suitable	Not suitable
Structural validity	15	7	6	2	0
Content validity	15	6	7	2	0
Overall design validity	15	10	5	0	0

Distribution and return of questionnaires was done through random allocation. A total of 206 questionnaires were distributed and 206 were successfully returned with a recovery rate of 100%. The number of valid copies of the mental health questionnaire reached 200, and its validity reached 97.09%, as shown in Table 2.

Table 2: Questionnaire Distribution and Collection Situation

Types of questionnaires	Total number of questionnaires	Collect questionnaires	Recovery rate	Valid questionnaire	Efficient
Mental health	206	206	100%	200	97.09%

II. B. 2) Teaching experiment method

In this test, single technique, combination technique and competition were used to assess the students' athletic ability, and their athletic performance and psychological state were observed during the experiment.

(1) Experimental time

The experimental period started from May 1, 2024, and ended on August 1, 2024, a total of 12 weeks, with a total of 36 physical training sessions.

(2) Subjects

The experimental subjects were the athletes of four badminton training groups, and the statistical results are shown in Table 3, the number of people totaled 200, of which 102 were male and 98 were female.

Table 3: Statistical Results of the experimental Subjects

	Gender		Age		
	Male	Female	18 to 20 years old	21 to 23 years old	Over 24 years old
Number of people	102	98	95	72	33
Total	200		200		

(3) Experimental control

Each physical training session lasted 45 minutes and was timed as follows: 7 minutes for the preparation part (1 minute for the training routine and 6 minutes for the warm-up part), 25 minutes for the skill learning and practicing, 10 minutes for the physical exercises, and 3 minutes for the ending part (2 minutes for the relaxation part and 1 minute for the summary comments).

(4) Test indicators

The experimental test indicators, i.e., the indicators of motor ability and mental health level, mainly include motor skills, physical fitness and mental health. The motor skill test mainly covers single technique test, combination technique test and competition performance. In order to assess the physical and mental health of school students a series of physical fitness tests will be conducted, and these tests include 50 meters, standing long jump, seated forward bending, pull-ups, 1-minute sit-ups, 1000 meters and 800 meters, and many other items. The specific test indicators are shown in Table 4.

Table 4: Test Indicators of Athletic Ability

Index	Specific test contents	Required equipment
Motor skills	Racket swing action	Timers,ball machines,pressure pads,etc
	Hit the ball	
	Footwork movement	
Physical fitness	50m	Stopwatch,whistle
	800/1000m	
	Standing long jump	Chalk,tape measure
	Sit forward bend	Electronic seat forward bend measuring instrument
	Pull-ups/sit-ups	Stopwatch
Mental health	Mental Health Scale	

III. Design of improved stepwise regression method based on screening variables

III. A. Overview of the stepwise regression method

In stepwise regression, the significance level α values of the introduced and deleted independent variables are not the same, and the significance level α_{enter} required for the introduction of the independent variables should be lower than that required for the deletion of the independent variables $\alpha_{removal}$.

In stepwise regression the independent variables are introduced by F-test, according to the problem of multicollinearity, the significance effect of F-test of stepwise regression is not obvious, and an improved stepwise regression is further proposed.

III. B. Improved stepwise regression method for screening variables

The improved stepwise regression is based on the traditional stepwise regression and proposes the stepwise regression based on t test. Because in the presence of multicollinearity between independent variables, only relying on R^2, F is not enough, t test can test the significance of the dependent variable and each independent variable, and delete the independent variables that do not meet the significance of the correction of multicollinearity.

The steps of the improved stepwise regression method are as follows:

(1) According to the theoretical and empirical analysis, the independent variables are $X_1, X_2, \cdots, X_m$, and Y is the thing under study, i.e. the dependent variable. There is a vector of n sample observations and m observations (independent variables related to the object of study).

(2) Dimensionless treatment of data. Mean value processing:

$$y_{ij} = \frac{x_{ij}}{\overline{x}_j}, \overline{x}_{ij} = \frac{1}{n}\sum_{i=1}^{n} x_{ij}, \frac{1}{n}\sum_{i=1}^{n} y_{ij} = 1 \tag{1}$$

(3) Screening of variables based on correlation coefficients. Through the matrix of correlation coefficients, the linear correlation between the respective variables is analyzed to determine the degree of multicollinearity that exists between the independent variables, and also to delete the variables that have smaller correlation coefficients with the dependent variable.

(4) Make a multiple linear regression equation between Y and $X_1, X_2, \cdots, X_m$:

$$\hat{Y} = \hat{c} + \hat{\beta}_1 X_1 + \hat{\beta}_2 X_2 + \cdots + \hat{\beta}_m X_m \tag{2}$$

Generally R^2, F statistics in the equation are more likely to pass goodness-of-fit and significance tests. Mainly, it is necessary to carry out t test on the regression coefficients, delete the regression of non-significant independent variables $sig < 0.05$, and re-establish the regression equation in turn until each independent variable passes the t test.

(5) When the linearity between the independent variables and the dependent variable is significant, the correction effect of multicollinearity is tested by VIF. The stepwise regression was improved to eliminate multicollinearity by eliminating the less influential and severely correlated variables from the model, and those significant and mildly correlated variables were retained for further analysis.

IV. Interaction model of physical and mental status of badminton players based on multidimensional data analysis

IV. A. Mental health situation analysis

IV. A. 1) Descriptive statistics

The total scores of the survey on the mental health of athletes were counted, and the statistical results are shown in Table 5, in which the total score <56 belongs to mental health, 56 $\leqslant$ total score <65 is poor mental status, and the total score >65 is mental disorder. The number of athletes with mental health was 181, accounting for 90.5% of the total number of athletes, 15 athletes with poor mental health, accounting for 7.5% of the total number of athletes, and 4 athletes with mental disorders, accounting for 2% of the total number of athletes.

Table 5: Total Score Results of the mental health status Survey

Category	N	%
Mental health	181	90.5%
Poor mental state	15	7.5%
Psychological disorder	4	2%

Since mental health consists of 8 dimensions: anxiety, hostility, loneliness, depression, sensitivity, somatization, phobia, and compulsion, although the overall number of mentally healthy people reaches 90.5%, it may not necessarily present a healthy state in all dimensions. The mental health status of the 8 dimensions was analyzed separately, and the results are shown in Table 6. There were 258 athletes with different degrees of mental health problems in the 8 dimensions, with 1.29 dimensions of mental health problems per capita. The most prominent manifestations were anxiety and somatization symptoms, accounting for 52.5% and 31% of the total number of athletes, respectively. Sensitive tendencies and depressive tendencies reached more than 9.5%, higher than the average number of athletes with mental health problems. At the same time, in general, psychological problems were more severe in girls than in boys.

Table 6: Mental Health Issues and Score Statistics Results

Content scale	X±SD	Problem Student		Male		Female	
		N	%	N	%	N	%
Anxiety	7.92±2.18	105	52.50	49	46.67	56	53.33
Hostility	4.27±1.65	11	5.50	8	72.73	3	27.27
Loneliness	3.98±1.56	7	3.50	4	57.14	3	42.86
Depression	5.66±2.03	23	11.50	13	56.52	10	43.48
Sensitivity	5.91±1.45	31	15.50	14	45.16	17	54.84
Somatization	5.99±2.58	62	31.00	22	35.48	40	64.52
Terror	3.92±2.03	8	4.00	2	25.00	6	75.00
Compulsion	4.28±1.57	11	5.50	3	27.27	8	72.73
Total score of mental health	41.93±12.05	19	9.50	9	47.37	10	52.63

IV. A. 2) Analysis of differences in demographic variables

(1) Gender

In order to examine the differences in mental health of athletes of different genders, the 8 dimensions of mental health and the average score of mental health of athletes of different genders were analyzed with descriptive statistics and independent samples t-test, which resulted in the gender differences in mental health of athletes, as shown in Table 7, where scores of ≤3 in each dimension were considered to be psychologically healthy, scores of 3<score<8 were considered to be in good psychological condition, and scores of >8 were considered to be psychologically impaired.

There are gender differences in the total mental health score (t=-8.936, P<0.05), and among the 8 dimensions of mental health, the mean values of boys in the 7 dimensions of anxiety, hostility, loneliness, depression, somatization, horror, and compulsion are lower than those of girls and the difference is significant, and the mean value of sensitivity tendency of boys is slightly higher than those of girls, and the difference is not significant. Overall there were differences in the mental health levels of male and female students, and the mean value of the total mental health score of male students (38.87±14.63) was significantly better than that of female students (45.11±9.48), which further proved that the mental health status of athletes was related to gender.

Table 7: Gender differences in Athletes' Mental Health

Content scale	Male(N=102)	Female(N=98)	t	P
Anxiety	7.78±3.05	8.07±2.58	-2.536	0.018
Hostility	3.96±1.58	4.59±1.53	-3.539	0.002
Loneliness	3.31±2.03	4.68±1.65	-7.483	0.003
Depression	5.07±1.84	6.27±1.95	-2.526	0.012
Sensitivity	5.96±1.69	5.86±1.58	1.583	0.314
Somatization	5.27±1.82	6.74±1.74	-8.043	0.002
Terror	3.04±1.63	4.84±1.48	-13.946	0.001
Compulsion	3.55±1.64	5.04±1.58	-9.032	0.001
Total score of mental health	38.87±14.63	45.11±9.48	-8.936	0.001

(2) Age

ANOVA test was done on the dimensions of mental health of students of different grades to find out the age difference in mental health of athletes as shown in Table 8, and it was found that the scores of the dimensions and total scores of mental health of athletes of different ages were more or less the same, and none of them had any significant age difference.

To summarize, in general, the mental health status of high school students performs well, with the number of mentally healthy people reaching 90.5%. There are different degrees of mental health problems in the eight dimensions of mental health, and the more prominent mental health problems are anxiety and somatization. Female students were more anxious than male students, with 53.33% of the students with anxiety at the level of mental disorder. Overall, male students had better mental health than female students, with lower total mental health scores than female students and lower scores on seven mental health dimensions, with the most significant gender difference being the tendency to terrorize. There is no age difference in athletes' mental health, and athletes' mental health did not improve with age.

Table 8: Differences in the age of athletes' mental health

Content scale	18 to 20 years old(N=95)	21 to 23 years old(N=72)	Over 24 years old(N=33)	F	P
Anxiety	7.88±3.22	7.91±2.15	8.05±2.53	0.473	0.597
Hostility	4.25±1.95	4.26±2.06	4.34±1.84	0.636	0.603
Loneliness	3.95±1.48	3.97±1.68	4.08±1.48	2.636	0.526
Depression	5.63±1.92	5.66±2.51	5.75±1.88	0.297	0.278
Sensitivity	5.89±1.28	5.92±1.85	5.95±1.66	0.748	0.395
Somatization	5.95±2.04	6.01±1.47	6.06±1.75	2.636	0.601
Terror	3.87±1.43	3.94±2.22	4.02±2.15	2.311	0.593
Compulsion	4.23±1.95	4.31±1.58	4.36±1.86	1.486	0.665
Total score of mental health	41.48±19.58	41.99±15.37	43.09±16.42	1.135	0.582

IV. B. Gray correlation analysis of physical fitness and athletic ability

Determining the weight of an indicator can generally be divided into two kinds of subjective assignment method and objective assignment method. The subjective assignment method is used by experts to determine the weights of the indicators according to their experience, such as the expert survey method, hierarchical analysis method, etc. The objective assignment method is mainly based on the correlation between the indicators and the correlation between the indicators and the final results to determine the weights of the method, for example, the principal component analysis method, the factor analysis method, the maximum entropy weighting technique method. Due to the limitations of the sample size in this paper and in order to make the determination of weight coefficients more objective, gray correlation analysis is used to determine the weight coefficients of each indicator.

The theory of gray correlation analysis is a new method applicable to the study of small data, poor information uncertainty. The system analyzes and generates “part” of the known information in the “small sample” and “poor information”, so as to extract valuable information. After years of research and development, gray system theory has gradually developed into an emerging discipline of information analysis, including gray sequence generation, gray correlation analysis, gray cluster analysis, gray prediction model, gray decision-making model, of which gray correlation analysis and gray prediction model are more widely used, and they have been successfully applied in China's ecological, social, economic, engineering and other fields. Gray correlation analysis is a kind of uncertain correlation between factors and principal components, which is a kind of analysis method that uses gray correlation to determine and describe the correlation strength and size of the relationship between the factors, so as to determine the degree of influence between the factors or to determine whether the factors are contributing to the principal components. The basic idea is to analyze the geometric relationship and the degree of similarity of the research object according to the development of the dynamic process of the system, to determine whether the reference series and the comparative series are closely linked, the closer the curves are, the greater the correlation between the corresponding sequences, and vice versa, the smaller the correlation is. This method has been gradually used in the field of sports, first applied in the direction of track and field, and now it has been playing an increasingly important role in the field of sports. In order to explore the relationship between the indicators reflecting athletes' physical fitness and athletic ability, to determine the main indicators affecting athletic ability, and the contribution rate of each indicator to athletic ability, the gray correlation analysis in the gray system modeling software 7.0.1 is used to analyze the factors affecting the physical fitness level of athletic ability, and the calculated correlation degree reflects the correlation between each indicator and athletic ability from the side, so that the contribution rate of each indicator to athletic ability can be determined. Contribution.

The weight configuration of each indicator to athletic ability can be calculated using the following formula:

$$\beta_i = r_i \Big/ \sum r_i \left(i = 1 - n\right) \tag{3}$$

Where, r_i : gray correlation of each index; n : total number of selected indexes

The results of the gray correlation analysis of athletes' physical fitness level and athletic ability are shown in Table 9, from which it can be seen that the size of the gray correlation between each physical fitness indicator and athletic ability for boys is 50m running (0.9272), pull-up (0.9058), 1000m running (0.8874), sitting forward bend (0.7849), standing long jump (0.6553) in order, and for girls in the order of 50m run (0.9302), sit-ups (0.9108), 800m run (0.8705), seated forward bend (0.7593), and standing long jump (0.6923). The indicators with large gray correlations were filtered out, and the top three gray correlations were selected for further analysis later in the paper, which were 50m running, sit-ups/pull-ups, and 800/1000m running.

Table 9: Grey Correlation Analysis of Physical Fitness and Competition Results

	Male		Female	
50m	0.9272	0.2227	0.9302	0.2234
800/1000m	0.8874	0.2132	0.8705	0.2091
Standing long jump	0.6553	0.1574	0.6923	0.1663
Sit forward bend	0.7849	0.1885	0.7593	0.1824
Pull-ups/sit-ups	0.9058	0.2182	0.9108	0.2188

IV. C. One-way ANOVA for physical fitness, mental status and athletic ability

Comparison of the scores of single technique, combination technique, competition and total score of athletic ability of athletes of different fitness levels are shown in Table 10, and the full scores are all 100 points. It can be seen that the differences between the single technique, combination technique, competition and athletic ability scores were statistically significant (all P values <0.05), and the athletic ability scores of the high-level, intermediate-level, and low-level groups were 90.62±2.59, 84.23±3.01, and 75.62±2.94, respectively.

Table 10: Comparison of Athletic Ability Scores at different physical fitness Levels

Group	Number of people	Single technology	Combined technology	Competition	Athletic ability
High level	58	91.67±3.43	89.47±2.58	90.66±2.04	90.62±2.59
Medium level	87	85.94±3.05	82.84±2.86	84.07±2.75	84.23±3.01
Low level	55	78.46±2.95	73.28±3.22	75.37±2.56	75.62±2.94
F		12.75	15.63	14.35	18.51
P		0.018	0.009	0.006	0.003

Comparison of single technique, combination technique and competition scores of athletes with different psychological status is shown in Table 11. It can be seen that the differences in single technique, combination technique, competition and athletic ability scores were statistically significant (all P-values <0.01), and the athletic ability scores of the psychologically healthy, psychologically ill, and psychologically impaired groups were 84.69±2.47, 76.92±1.85, and 65.10±1.45, respectively.

Table 11: Comparison of Motor Ability Scores under Different Psychological States

Group	Number of people	Single technology	Combined technology	Competition	Athletic ability
Mental health	181	84.98±2.53	83.92±1.58	84.93±1.08	84.69±2.47
Poor mental state	15	79.38±2.46	74.35±1.69	76.97±1.94	76.92±1.85
Psychological disorder	4	66.48±2.55	62.58±2.08	65.67±3.03	65.10±1.45
F		15.98	18.39	16.59	20.55
P		0.001	0.003	0.002	0.001

IV. D. Multiple regression-based modeling of the interaction between physical fitness and mental state

Multiple linear regression analysis was conducted with anxiety, somatization, sensitivity, depression, 50m run, sit-ups/pull-ups, and 800/1000m run as independent variables, and athletic ability as the dependent variable, and the results of multiple linear regression analysis of the effects of physical fitness level and psychological state on athletic ability are shown in Table 12. The results showed that anxiety, somatization, sensitivity, and depression were all negatively correlated with athletes' athletic ability (all p-values <0.01), with anxiety (Beta=-0.322,p=0.002) having a greater effect on athletic ability.50m running, sit-ups/pull-ups, and 800/1000m running ability were all positively correlated with athletes' athletic ability (all p-values <0.05). Among them. The contribution of speed index (50m run, Beta=0.319,p=0.007) and endurance index (800/1000m run, Beta=0.305,p=0.009) was significantly higher than that of strength index (sit-ups/pull-ups, Beta=0.298,p=0.011), suggesting that short-term explosive power and endurance are the key badminton athletic ability Support.

Table 12: Results of multiple Linear regression Analysis

Independent variables and constants	B	SE	Beta	t	P
Anxiety	-0.033	0.063	-0.322	-4.692	0.002
Somatization	-0.042	0.211	-0.119	-2.953	0.009
Sensitivity	-0.028	0.132	-0.094	-2.184	0.004
Depression	-0.019	0.098	-0.028	-2.645	0.002
50m	1.081	0.317	0.319	3.583	0.007
Pull-ups/sit-ups	0.932	0.271	0.298	3.286	0.011
800/1000m	0.969	0.124	0.305	2.947	0.009
Constant term	8.93	0.36	-	17.92	0.003

V. Conclusion

This paper analyzes the influence of physical fitness level and mental state on athletic ability of badminton players based on multidimensional data, and constructs the interaction model of physical fitness and mental state based on multiple linear regression.

The results of one-way ANOVA showed that the differences in the scores of single technique, combination technique, match and athletic ability of different physical fitness levels were statistically significant (P value <0.05), and the scores of athletic ability of high level, medium level and low level groups were 90.62±2.59, 84.23±3.01 and 75.62±2.94, respectively, and the scores of different psychological statuses of single technique, combination technique, match and motor ability scores were statistically significant (all p-values <0.01), and the motor ability scores of the psychologically healthy, psychologically ill, and psychologically impaired groups were 84.69±2.47, 76.92±1.85, and 65.10±1.45, respectively.

Anxiety, somatization, sensitivity, and depression were all negatively correlated with athletes' athletic ability (all p-values <0.01), with anxiety (Beta=-0.322,p=0.002) having a greater effect on athletic ability.50m running, sit-ups/pull-ups, and 800/1,000m running ability were all positively correlated with athletes' athletic ability (all p-values <0.05), with. The contribution of speed index (50m run, Beta=0.319,p=0.007) and endurance index (800/1000m run, Beta=0.305,p=0.009) was significantly higher than that of strength index (sit-ups/pull-ups, Beta=0.298,p=0.011), which indicated that short-term explosive power and endurance were the key badminton athletic ability Support.

References

[1] Madsen, C. M., Badault, B., & Nybo, L. (2018). Cross-sectional and longitudinal examination of exercise capacity in elite youth badminton players. The Journal of Strength & Conditioning Research, 32(6), 1754-1761.

[2] Deng, N., Soh, K. G., Abdullah, B. B., & Huang, D. (2024). Effects of plyometric training on skill-related physical fitness in badminton players: A systematic review and meta-analysis. Heliyon, 10(6).

[3] Özgür, B., & Hotaman, F. (2020). Relationship between some motoric and technical performance characteristics of U17 Turkish national badminton players. Journal of Physical Education and Sport, 20, 2205-2212.

[4] Ma, S., Soh, K. G., Japar, S. B., Liu, C., Luo, S., Mai, Y., ... & Zhai, M. (2024). Effect of core strength training on the badminton player's performance: A systematic review & meta-analysis. PloS one, 19(6), e0305116.

[5] Ando, R., Hoshikawa, Y., Iizuka, T., Suita, M., Kameda, M., Nakashima, H., & Ozaki, H. (2024). Difference in badminton‐specific endurance evaluated by a newly developed on‐court test between competitive levels: A pilot study of female players. Physiological Reports, 12(10), e16058.

[6] Kosack, M. H., Staiano, W., Folino, R., Hansen, M. B., & Lønbro, S. (2020). The acute effect of mental fatigue on badminton performance in elite players. International journal of sports physiology and performance, 15(5), 632-638.

[7] Suratmin, S., & Yudhistira, D. (2024). Psychological analysis of badminton players from the perspective of self confidence, stress, tension and anxiety. Retos, 61, 1468-1473.

[8] Ihsan, F., Nasrulloh, A., & Nugroho, S. (2024). Analysis of key factors affecting the achievement of badminton athletes at the international level: A systematic review. Fizjoterapia Polska, (2).

[9] Seong, M., Kim, G., Yeo, D., Kang, Y., Yang, H., DelPreto, J., ... & Kim, S. (2024). Multisensebadminton: Wearable sensor–based biomechanical dataset for evaluation of badminton performance. Scientific Data, 11(1), 343.

[10] Xu, F., & Zhu, W. (2024). Evalution of neurodiagnostic insights for enhanced evaluation and optimization of badminton players' physical function via data mining technique. SLAS technology, 29(4), 100138.

[11] Abdalrahman, A., & Ullah, R. (2025). Predicting Badminton Player Performance: Integrating Physical, Psychological, and Technical Factors Using Machine Learning. Spectrum of engineering sciences, 3(1), 1-20.

[12] Mao, H., Wen, L., Cao, Y., & Zhao, J. (2025). Infrared thermal radiation image defect detection and expression recognition application in badminton monitoring process. Thermal Science and Engineering Progress, 58, 103217.