

# Correlation Analysis of Middle School Students' Happiness and Sports in the Context of Big Data

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## ABSTRACT

Data mining has been applied to a large extent in various information application fields this year. In this paper, it is applied to the students' physical exercise for partial optimization and compared with some traditional algorithms for improvement. Different analysis results are obtained under different potential information analysis backgrounds, which improves the accuracy and results of clustering analysis. This study used the physical activity rating scale and the subjective well-being scale to assess the status, subjective well-being level, and interaction mechanism of middle school students in Sichuan Province participating in physical exercise. The physical activity of students is insufficient, and the physical activity of girls is seriously insufficient; the overall level is above average, and the average score of boys in the two dimensions of life satisfaction and emotional balance is higher than that of girls; the relationship between each dimension of physical exercise and life satisfaction and emotional balance is shown.

## KEYWORDS

Impact Research, Middle School Students, Physical Exercise, Subjective Well-Being

## INTRODUCTION

Today, almost all productive human activity is inseparable from computers and the internet. People use computers more widely and more conveniently, which makes data grow exponentially (Shiri, 2015). This data has huge commercial value, and the irregular storage of big data will increase the storage cost (Wang et al., 2015). The ability to analyze big data cannot keep up with this growth, so while the amount of data is large, the amount of information is still insufficient (Pisarenko, 2017). Analyzing and mining valuable information from big data will create the value. Data mining is a computer science, but it also includes many other disciplines (Pisarenko, 2017). For example,

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for pattern recognition, visual performance analysis includes statistics and machine models. Data information provides valuable references for decision makers' analysis.

The research of data integration began in the 1970s, and the scope and difficulty of data integration increased from the initial homogeneous data source integration to the heterogeneous data source, followed by semantic-based data integration (Suhane et al., 2016). The existence of heterogeneity in data integration includes four aspects: heterogeneity at the system level, heterogeneity at the syntactic level, heterogeneity at the structural level, and heterogeneity at the semantic level. System-level heterogeneity refers to the heterogeneity of underlying hosts and operating systems; syntax-level heterogeneity refers to the heterogeneity of data representation types and formats. Heterogeneity at the semantic level refers to differences in word meanings in certain domains caused by communication barriers (Fathi & Derakhshan, 2019). Traditional methods cannot yet sufficiently solve the problem of semantic heterogeneity. Currently, ontologies are used to address semantic heterogeneity.

Subjective aspects of human activity such as well-being offer significant potential for information gleaned from big data. Since the beginning of the 21st century, with the improvement of Chinese people's material conditions and living standards, people have begun to pay attention to spiritual pursuits. Xi Jinping argued at the 18th Congress of the CPC Central Committee that "people's happiness" is a necessary condition for realizing the Chinese dream (Li & Ma, 2018). Subjective well-being can be measured by many indicators; for example, if the aspects of one's life that are most satisfying are sufficient, one can be evaluated as happy, and vice versa. Self-affirmation is another key indicator of subjective well-being.

Due to increasingly fierce social competition and heavy academic pressure, levels of subjective well-being among middle school students in China are declining. Physical health monitoring shows that students' physical fitness and health level have been in a state of continuous decline in the past 20 years (Cohn et al., 2009). Lung capacity, speed, explosive power, and endurance have further declined. The detection rate of obesity and poor eyesight has increased. The proportion of middle school students remains high among the general population. Middle school is a critical period for developing physical health and mental well-being. However, at this stage, students often bear heavy learning tasks and pressures, and their inner feelings and subjective well-being are often ignored (Starovoytova & Namango, 2016). How to attain the goal of quality education is a significant question since young people represent the future of the nation, and subjective well-being is an area of great concern (Schrier, 2008). This research responds to questions concerning how to improve school life satisfaction and happiness of middle school students. It builds on research that proposes providing practical and theoretical support for the development of school sports to cultivate middle school students' happiness and promote their physical and mental health (Huang & Liu, 2021).

To promote the psychological development of middle school students and to improve and enrich their exercise, psychological theories that test subjective well-being are necessary (Golombek\* & Johnson, 2004). In practice, some theoretical problems have not been solved, such as the measurement of subjective well-being, measuring the individual and group psychological state of students (Zhou & Liu, 2021). Research on the relationship between happiness and perceived stress and self-efficacy, as well as the role of school education in students' psychological development and other issues, need to be further resolved. At present, there are many challenges related to the psychological development of middle school students, such as: the relationship between individual development and social needs and the requirements of school education goals (Hu, 2022).

This study conducted a questionnaire survey and individual interviews with 1,848 middle school students in five cities in Sichuan Province. The purpose was to understand the current situation of participating middle school students and to study the physical and mental health development of adolescents.

## MATERIALS AND METHODS

There are many data mining research institutions, especially in universities such as MIT, Carnegie Mellon University, Stanford University, and more (Salama & Abdelbar, 2017). Much current research centers on swarm intelligence, including the ant colony algorithm. In the 1990s, scholars first proposed the ant colony optimization algorithm (Wang, 2022). Artificial ants are used to simulate the cooperative activities and information exchange phenomena of real ants in the natural world, and the research is applied to NP-hard problems, leading to strong results (Fernandes et al., 2013). For example, the ant colony optimization algorithm has been successfully used to solve the traveling salesman problem (TSP), network routing problems, and other combinatorial optimization problems (Wang et al., 2021). At present, the theoretical and applied research of ant colony algorithm is mainly concentrated in European countries, such as Belgium, Italy, the United Kingdom, France, and Germany. Japan and the United States are catching up. The first and second International Symposium on Ant Optimization was held at the University of Brussels, Belgium in 1998 and 2000, respectively. The research on DMKD in China started late, and the development status and application of related technologies are currently weaker than those outside of China. The bulk of this research comes from universities. Relevant research project support includes the 863 plan and the 95 plan. Representative activity is an important aspect of the research in this process of investigation. At present, many universities are engaged in the theoretical knowledge and application research of data mining, such as Peking University, Fudan University, Nanjing University, and Sichuan University.

### Ant Colony Clustering Algorithm

Clustering based on swarm intelligence originated from the observation of the daily behavior of ant colonies. The shortest action path was determined by observing the action path of the ant colony under different environmental conditions. Scientists also found that ants classified different actions. The principle of proximity is often adopted for heavy tasks (Ghotra, 2017). Later, researchers carried out classification studies on this behavior. According to the classification of different ant colony data models, the above application scenarios are analyzed. Different recognition classifications have different recognition functions. In the two-dimensional plane, ants have random spatial moving paths. If the virtual ant model is randomly assigned to the appropriate application scenario, one can continue to load the random plane data when encountering the appropriate data analysis. When the threshold of random movement is higher than the process of data itself, the random movement of ants and the data set carried are in a highly similar threshold range. It is possible to repeat this process and analyze and unload the redundant data to get similar clustering analysis. This paper picks up the randomly moving data content and analyzes the two-dimensional plane of clustering analysis to obtain results.

### Probability Transfer Function

Different data picking probabilities and different probability sets can be calculated using the average similarity of data. The data object principle is the loss calculation of probability. The higher the probability of picking, the higher the calculation result of function probability. According to the picking probability calculation principle, the analysis result of similarity probability can be obtained. The motion path of a random ant is defined as the formula for an object without load:

$$P_p = 1 - \text{Sigmoid}\left(f(0_i)\right) \quad (1)$$

$$P_d = \text{Sigmoid}\left(f(0_i)\right) \quad (2)$$

Table 1. The statistical characteristics of the questionnaire survey

Variable	Variable Meaning	Number	Proportion
Gender	Man	1104	0.59
	Woman	744	0.40
Grade	Middle School Freshman	672	0.36
	Middle School Sophomore	982	0.53
	Middle School Senior	192	0.10

$$Sigmoid(x) = \frac{1 - e^{-cx}}{1 + e^{-cx}} \quad (3)$$

The saturation degree of the sigmoid function curve is related to the clustering analysis results of the data analysis object. The faster the convergence speed of the clustering analysis of parameters, the higher the convergence degree of the algorithm. In the clustering process analysis, the outliers cannot be similar to the content of the data itself, since it may lead to poor performance of the population set. When picking and classifying data objects, the average similarity needs to consider different parameter value results. When different data objects are stable in the results of the ant algorithm, the carried data values will be reduced (Sahoo, 2017). Therefore, when calculating the average similarity, overlapping analysis of data is required to simulate the position of ant population. According to different ant population density, different occurrence positions can be determined. The distribution of ants can be predicted and estimated using models.

### Comprehensive Quality of Middle School Students' Evaluation

The comprehensive quality of students includes physical quality, ideological quality, basic knowledge quality, and professional quality. Clustering the comprehensive evaluation of students' performance provides a macro understanding of students' overall learning level (Fathi & Derakhshan, 2019). This allows for targeted evaluation, coaching, guidance, management, supervision, and more for students. Therefore, cluster analysis can objectively analyze the performance characteristics of students and, when the information behind the results is mined, provide teaching and administrative support (Chen, 2022).

Using the stratified and random sampling method, 2126 middle school students from five cities in Sichuan Province were selected as the research objects to conduct a questionnaire survey. The questionnaire data was converted into standard Z scores, and Python was used for analysis and processing. The statistical characteristics of the samples are in Table 1:

Exercise volume score=intensity ×time×frequency. Each aspect is divided into five grades, with one to five points, respectively. The scale has been widely used and has good reliability and validity. There are 35 items in the questionnaire, which are divided into five dimensions. The higher the score of positive emotion or negative emotion dimension, the more the emotion is experienced; the higher the score of the other three dimensions, the more satisfied with life the participant is (Lun & Meng, 2018).

The physical activity of boys and girls of each grade is counted, and a T-check is used to judge the physical activity of male and female students and the minimum standard of sports entrance in Sichuan Province. Figure 1 shows the physical activity characteristics of boys and girls of the same grade and the statistical characteristics of physical activity of middle school students of each grade. Table 2 shows the following three points: (1) the physical activity of high school students continued to decline and reached the lowest point in the third grade of high school; (2) the physical activity of

Figure 1. Statistics of physical activity of boys and girls in high school

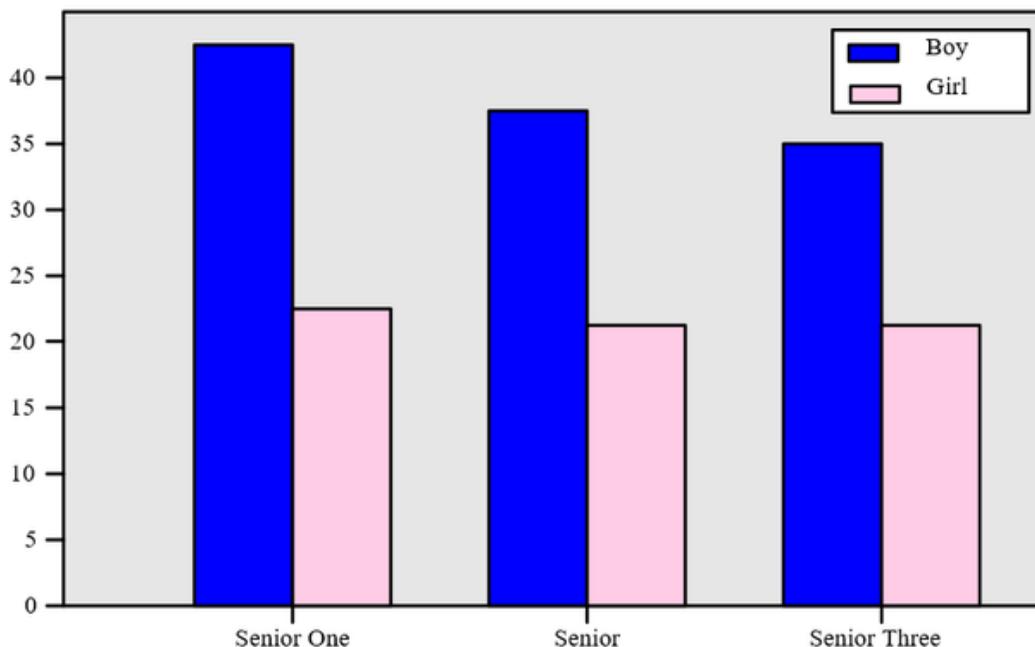


Table 2. Statistical characteristics of high school students' physical activity

Measure Variables	M	SD	P
High school boys	42.94	21.15	0.00
A first-year high school girl	22.61	20.61	0.00
Sophomore boy	37.75	24.80	0.01
A sophomore in high school	21.50	17.08	0.00
A junior in high school	35.90	16.25	0.68
A senior in high school	14.78	17.62	0.00

boys was generally higher than that of girls, and the difference was extremely significant ( $P < 0.01$ ); (3) The minimum standard of sports activity among the general population in Sichuan Province has an extremely significant difference to that of the student population. The physical activity of boys in the second year of high school is lower than the minimum standard of sports activity among the general population in Sichuan Province, and the difference is significant ( $P < 0.01$ ); The amount of exercise was lower than the minimum standard of sports among the population in Sichuan Province, and the difference was extremely significant ( $P < 0.01$ );

## THE INFLUENCE OF SPORTS ON STUDENTS' EMOTION

This paper analyzes the classified training level of middle school students in different groups. The differences of subjective well-being were studied, which measures the amount of physical exercise by exercise intensity, exercise frequency, and time of exercise. Scores  $\leq 1$  point were determined as

the non-exercise group, and scores > 1 point were determined as the exercise group. The subjective well-being levels of the two groups of high school students were investigated (Chang et al., 2019). To improve the accuracy and reliability of the research results, this paper examines the impact of the subjective performance of these two groups and analyzes the related well-being. The study examined the demographics of the subjects, such as grade, gender, school location, and school category. The relationship between the sample and the subjective well-being of the tested students was analyzed by multivariate analysis of variance.

When examining whether high school students who consciously participate in physical exercise have differences in subjective well-being, it is necessary to control gender variables. With gender as the covariate of one-way multivariate analysis of variance, the results show that consciously doing physical exercise has a significant impact on subjective well-being. Table 3 outlines the between-group test of multivariate analysis of variance, in addition to learning satisfaction ( $P > 0.05$ ) and physical satisfaction ( $P < 0.05$ ).

Observe the boxplots of the two groups on the emotional dimension of subjective well-being. From the median and interval comparison, learning satisfaction, positive affect, negative affect, life satisfaction, and physical satisfaction were higher among students who exercised than those who did

Table 3. Multivariate analysis of covariance between groups for subjective well-being with gender as a covariate

Measurable Variables	df	SS	MS	F	sig
Positive emotions	1.0	570.32	10.49	15.36	0.00
Negative emotions	1.0	203.94	6.18	5.43	0.00
Life satisfaction	1.0	221.53	4.89	9.73	0.00
Learning satisfaction	1.0	130.06	4.98	3.59	0.05
Physical satisfaction	1.0	3.08	2.58	8.45	0.00

Figure 2. Comparison of learning satisfaction with exercise and without exercise

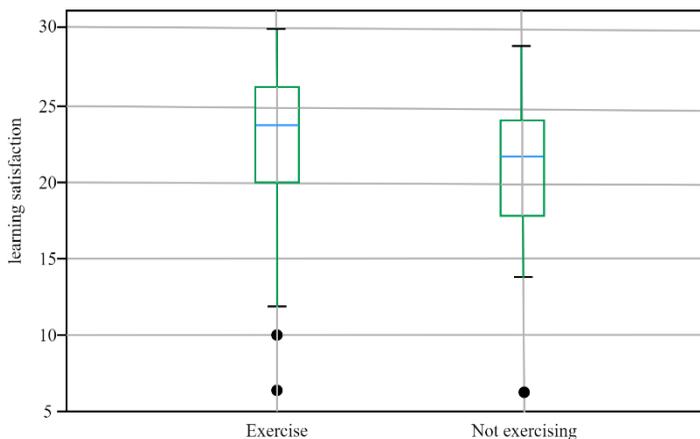


Figure 3. Comparison of positive emotional satisfaction with exercise and without exercise

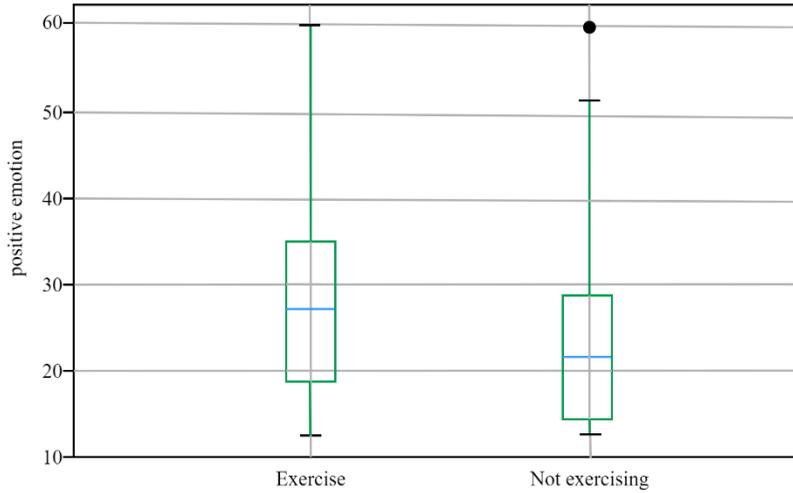
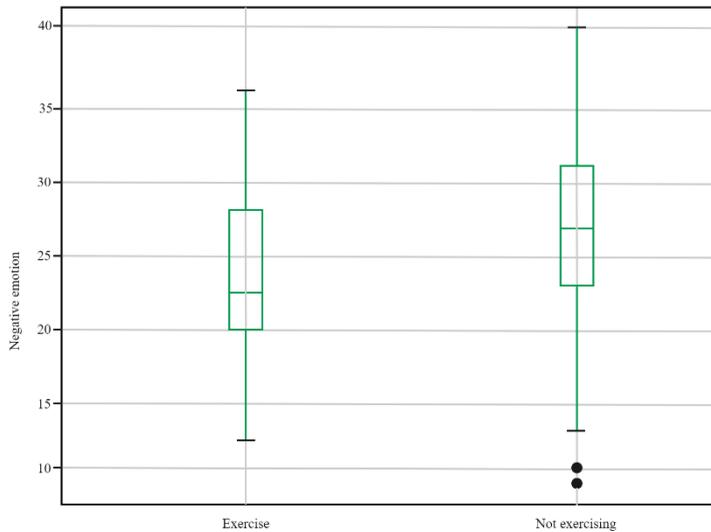


Figure 4. Comparison of negative emotions between exercising and not exercising



not exercise, suggesting that physical exercise can improve students' level of well-being. According to the five level classification introduced in the previous section, the last five categories are classified into one category, and the previous full data stratification has been corrected based on the clustering results. The proportion of excellent grades increased from 2.6% to 6.2%, and the proportion of good grades increased from 14.4% to 18.2%. The mid-range share increased from 19% to 27.4%. The pass rate dropped from 41% to 25.2%, and the fail rate remained the same. The line chart of the clustering results is shown in Figure 7:

According to the result of broken line, the statistical results before students' grade distribution slightly corrected is basically normal distribution trend. There are fewer people on both sides and most

Figure 5. Comparison of physical satisfaction with exercise and without exercise

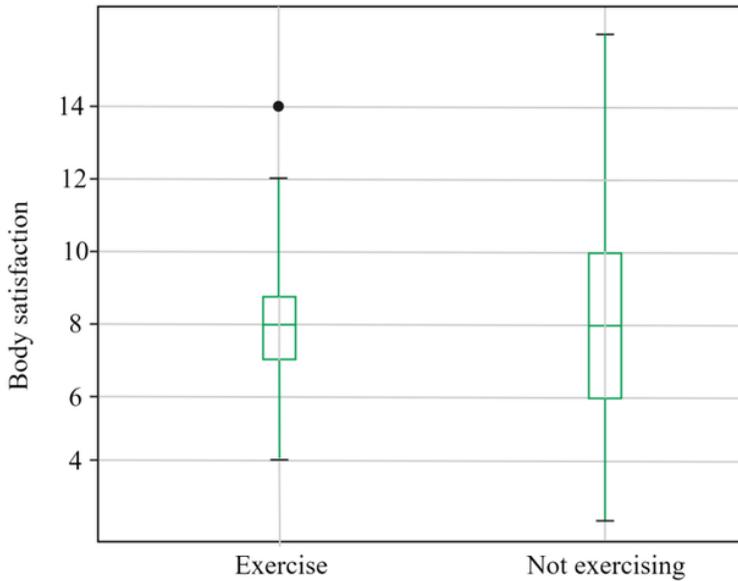
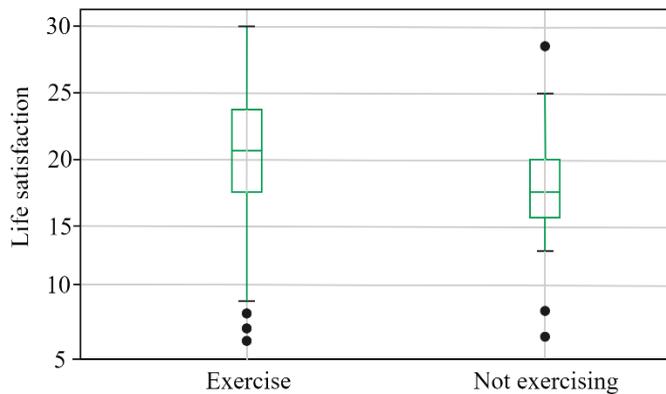


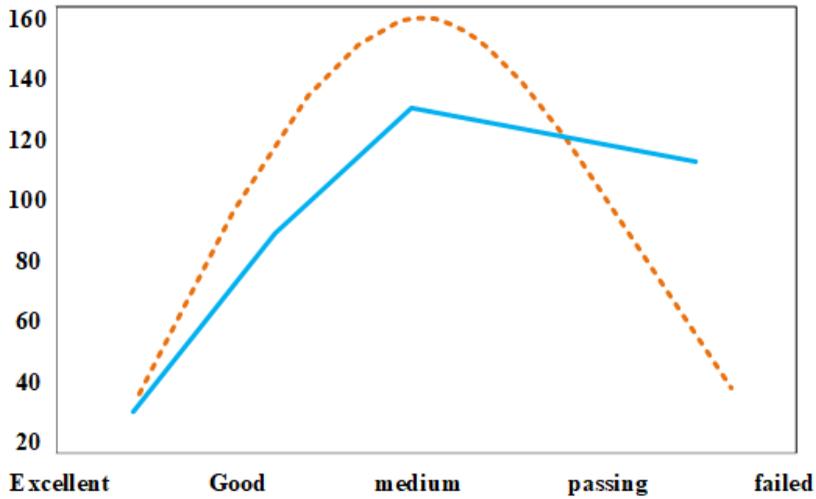
Figure 6. Comparison of life satisfaction with exercise and without exercise



in the middle. Such a clustering model is in line with the actual situation. In teaching management, it is important to evaluate students' performance objectively, rationally, and scientifically. According to the conventions of educational statistics, students' abilities are subject to normal distribution. If the difficulty of the test questions is too high, the overall statistical analysis of students' examination results will show a backward trend.

The use of a fixed percentage score and the scale of the test results will inevitably result in a backward tilt of the distribution of test scores, resulting in irrational evaluation results. If exam questions are easy, it is of course a good result for students to improve the exam results, but it is not reasonable to evaluate the students' grades. If the average student's overall level is used as a reference to achieve clustering, the rating will show a normal distribution trend. This method of evaluation is based on students' reference to each other, and the difference of ability between students will be

Figure 7. Clustering result line graph



reflected. Therefore, it is reasonable and objective to abandon the fixed conversion standard and evaluate the grade of students by using dynamic student achievement clustering.

### Analysis of the Influence of Exercise Duration and Exercise Level

The time of each exercise and the duration of exercise are important factors that affect the psychological benefits of physical exercise. Physical exercise is almost always aerobic. Therefore, when examining the type of physical exercise, only exercise intensity, exercise duration, and exercise frequency are used as independent variables. According to the scores measured by the Physical Activity Rating Scale, which measures the amount of physical exercise, exercise types are divided into 3 groups. Scores  $\leq 19$  are divided into small exercise volume groups: scores between 20 and 42 are moderate exercise volume groups: Scores  $\geq 43$  denote a large exercise volume group. To ensure the content of different students' subjective well-being, this paper conducts a multi-dimensional difference analysis between different populations' well-being. The difference analysis results between different motion data volumes are adjusted. The analysis and comparison with the tested differences show that gender is a significant factor affecting the happiness of high school students.

Therefore, a univariate multivariate analysis of variance was conducted using positive emotions, negative emotions, life satisfaction, satisfaction, and satisfaction as dependent variables, and gender as covariate.

Table 4. Covariates for one-way MANOVA

Average Exercise/Well-Being	Small Amount of Exercise	Moderate Amount of Exercise	Large Amount of Exercise
Positive emotions	22.57	25.48	26.21
Negative emotions	23.67	27.85	27.62
Life satisfaction	18.47	21.50	22.23
Learning satisfaction	24.22	24.57	20.10
Physical satisfaction	10.15	10.38	7.08

In the process of studying different sports training, it was found that there was no significant difference in the level of learning satisfaction. Therefore, positive emotion, negative emotion, life satisfaction and physical satisfaction were used in this study's analysis.

### Exercise Intensity, Exercise Time, Exercise Frequency Multivariate Analysis of Variance With Gender as the Dependent Variable

The results (Table 5) show that: (1) For the multivariate model, the main effect of exercise intensity on high school students' subjective well-being, positive affect, and life satisfaction test is significant ( $P < 0.05$ ), while the main effect on negative affect and body satisfaction is not significant ( $P > 0.05$ ); (2) The main effect of exercise time on the positive affect and life satisfaction of high school students' subjective well-being is extremely significant ( $P < 0.01$ ), but the main effect on negative affect and life satisfaction is not significant ( $P > 0.05$ ); (3) The main effect of exercise frequency on positive emotion and body satisfaction is significant ( $P < 0.05$ ), while the main effect on negative emotion and body satisfaction is not significant.

## DISCUSSION AND SUGGESTION

The survey results show that middle school students in Sichuan Province generally have insufficient physical activity ( $29.78 \pm 21.91$ ); the physical activity of girls in particular is seriously insufficient ( $25.11 \pm 20.97$ ,  $n = 820$ ), which is consistent with the actual situation we learned from our visit. This result reflects the fact that these current middle school students are not conscious of actively participating in physical exercise and lack the habit of exercise. The heavy academic burden makes

Table 5. Main effects of negative mood and body satisfaction

Source of Variation	Measure Variables	df	SS	MS	F	sig
Exercise intensity	Positive emotions	4	1357.86	339.46	3.36	0.01
	Negative emotions	4	269.53	67.38	1.81	0.12
	Life satisfaction	4	279.91	69.97	3.13	0.01
	Physical satisfaction	4	19.03	4.75	0.68	0.60
Exercise time	Positive emotions	4	1015.56	253.89	8.50	0.00001
	Negative emotions	4	146.92	36.73	0.98	0.41
	Life satisfaction	4	26.09	6.52	10.74	0.00001
	Physical satisfaction	4	17.82	4.45	0.64	0.63
Exercise frequency	Positive emotions	3	251.70	83.90	3.83	0.008
	Negative emotions	3	211.30	70.43	2.89	0.04
	Life satisfaction	3	181.78	60.59	2.71	0.04
	Physical satisfaction	3	8.29	2.76	5.39	0.02

middle school students have no time to participate in moderate physical exercise. Students study hard at the expense of their health, which seriously affects their physical and mental health. On the other hand, the results also suggest that there are serious problems in middle school physical education. Under the pressure of exam-oriented education, physical education classes and sports activities are marginalized and regarded as a lower priority by school leaders, teachers, and students, which prevents it from serving its important function. The imminence of the college entrance examination makes the amount of exercise in the second and third years of high school lower than that of the first year of high school.

The research results show that the overall level of subjective well-being of middle school students in Sichuan Province is above average. Further research found that the average score of boys in the two dimensions of life satisfaction and emotional balance is higher than that of girls, and the difference is very significant. There are many reasons for the gender difference. For example, there are more abstract thinking elements in the middle school curriculum, which are easier for boys to learn than girls. In addition, boys participate more in sports and have stronger physique and better health than girls. This is also one of the reasons why boys' subjective well-being is higher than that of girls.

There are different degrees of correlation between various dimensions of physical exercise, life satisfaction, and emotional balance. Regression analysis showed that exercise time and frequency had a good predictive effect on life satisfaction, and exercise time also had a good predictive effect on emotional balance. Hence, if an individual participates in exercise at a higher frequency and for a longer time, the more subjective well-being they will feel.

## CONCLUSION

The aim of this paper was to evaluate students' well-being through dynamic data clustering. The feasibility of the method is proved by data analysis and experiments. Through this dynamic clustering method, the physical activity of middle school students was found to be, generally, seriously insufficient. The education authorities, schools, teachers, and parents should fully realize the seriousness of this problem and make effective measures as soon as possible to bring middle school students, especially girls, who are in a period of rapid physical and mental development, to the sports field and encourage students to participate in various forms of physical exercise. The healthy growth of a generation of middle school students will impact the future of China.

The overall level of subjective well-being of the study participants is above average, revealing that the mental health level of middle school students is acceptable. Teachers and parents should not only focus on the achievements of students but also care about their physical development and mental health. Schools can implement quality education by integrating intellectual education, physical education, and mental health education to encourage young people to develop comprehensively.

On the basis of the improved algorithm, data testing experiments are carried out. The ant colony clustering algorithm was applied to the analysis of students' well-being, thus illustrating the significance of clustering analysis. On the one hand, the rationality of the algorithm is verified by actual data statistics. On the other hand, according to the clustering results, the division of students' well-being evaluation is obtained, and the result distribution shows a normal distribution trend compared with the fixed transformation method. In line with the actual application, it shows the rationality of cluster analysis.

This paper has studied the correlation analysis between middle school students' happiness and sports in the context of big data, but there are still limitations. The students' sports time is limited, and the external factors creating the time limit have not been considered. The further work in the future is as follows: analyze the external factors that affect students' exercise time and find the correlation between multiple data sets.

## **DATA AVAILABILITY**

The figures and tables used to support the findings of this study are included in the article.

## **CONFLICTS OF INTEREST**

The authors declare that they have no conflicts of interest.

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