

## Influence of Family Background on College Students' Physical Health

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### Abstract

**In the context of the college students' continuously declining level of physical health condition, the relationship between their family background and level of physical health condition is studied as the main point to make a breakthrough. The evaluation model of college students' physical health status is constructed by adopting methods of questionnaire completion, principal component analysis, etc. The purpose is to explore the influence of family background on their physical health conditions and thus recommend corresponding scientific advice to alleviate their physical ailments. As the results demonstrate, there exist significant differences in family background factors among college students with varying levels of physical health conditions—the family background of college students with excellent physical health conditions turns out to be way more favorable than that of those with a poor one. According to our data, the influence of family background factors on college students' physical health conditions accounts for 13% overall.**

### Keywords

**Family background; College student; Physical health; Influence factor.**

### 1. Introduction

Since 1985, the Ministry of education and other departments have carried out the national adolescent physique and health survey many times [1]. The results show that the physical health of teenagers in China has continued to decline in the recent 20 years [2]. The development process of Chinese Students' Physique Monitoring published in 2017 pointed out that the physique of Chinese college students showed a significant downward trend, and the obesity rate increased by 2% to 3% every five years [3]. It reminds us that students' health problems are a difficult situation.

To clarify the influencing factors of students' physical health and the direction that needs to be improved, many scholars put forward the factors that affect the development of students' physical quality [4-11] and have given corresponding suggestions [12-13], but the current research on the evaluation criteria of physical quality is still not comprehensive, and China has not achieved significant results in improving students' physical health at this stage [14-15]. Because of this, this study attempts to establish a clear physical quality evaluation standard, focus on the impact of family factors on students' physical health, clarify the effects of various factors on them, and give corresponding conclusions and suggestions, which plays a positive role in promoting the firm implementation of the national strategy of "healthy China" and improving the health literacy of the whole people.

## 2. Object and Method

### 2.1. Object

Due to the epidemic situation, the questionnaire can not be sent offline. An online Internet-based questionnaire survey was conducted among students of the North China University of Science and Technology.

### 2.2. Research Methods

#### 2.2.1. Questionnaire Survey Method

The questionnaire survey is completed by students independently by the anonymous self-filling method. The counselors of each course organize students to fill in and collect the questionnaire online. The setting of the questionnaire refers to the previous research[17]and the standard scoring table of College Students' Physical Examination.

The contents involved in the questionnaire include personal characteristics (gender, height, weight, academic achievement), guardian characteristics (Guardian's highest education, guardian's income, guardian's occupation), student physical test characteristics (male: 1000 meters, pull-up, standing long jump, vital capacity, female: 800 meters, sit-up, standing long jump, vital capacity), etc. individual variables were combined in the analysis.

#### 2.2.2. Reliability and Validity Analysis of Questionnaire Data

Reliability analysis: The Alpha reliability coefficient method with high recognition is used to test the reliability of the questionnaire. The Cronbach's alpha values of male and female data tested separately are both higher than 0.65 (the Cronbach's alpha value of male data is 0.714, and that of female information is 0.658). The reliability of the questionnaire is good. Validity analysis: The KMO values of men and women are more significant than 0.6 (the KMO value of male data is 0.767 and female is 0.620), and the P-value is less than 0.01. It is suitable for factor analysis and has good effectiveness.

#### 2.2.3. Reliability Analysis of Questionnaire Data Sources

The time taken by the respondents to answer the questionnaire tends to be the normal distribution, and the time is concentrated between 113-199 seconds, which reflects the reliability of the questionnaire data source to a certain extent.

#### 2.2.4. Statistics and Analysis

After screening the questionnaire data and excluding the distorted data, the principal component analysis [18] is used to construct a more comprehensive and transparent evaluation standard for students' physical quality, Then the K-means cluster analysis [19] is used to cluster various family factors. A Chi-square test is used for the single-factor analysis of frequency and percentage, a logistic regression analysis model was established to explore the impact of family factors on physical fitness, and a confusion matrix was used to test the reliability of the model.

## 3. Analysis and Results

### 3.1. Basic Information on Questionnaire Recovery

A total of 955 valid questionnaires were collected, of which there was little difference between men (56.9%) and women (43.1%). The sample families live in rural areas (51.3%), more than urban areas (25.7%), and towns (23.0%). The proportion of guardians with junior high school education and below (51.9%) was the largest, and the ratio of families with an annual income in the low-income group (43.9%) was the largest.

### 3.2. Construction of Physical Fitness Evaluation Criteria

To construct the evaluation standard of physical fitness, the principal component analysis and factor analysis used to weight the BMI value, disease status, and sports quality ability of men and women, respectively, extract the items with a factor load higher than 0.5 and use the eigenvalues to calculate the contribution rate of each component. The results are as follows.

**Table 1.** Component matrix of personal factors and eigenvalue table of each component

Male	Component		
	Y <sub>1</sub>	Y <sub>2</sub>	Y <sub>3</sub>
BMI value	0.158	0.312	0.666
Personal disease status	-0.131	-0.316	0.711
Personal exercise frequency	0.505	0.006	0.266
The total score of the body test	0.734	0.372	0.045
Standing long jump	0.561	0.480	0.091
Vital capacity	0.014	0.844	-0.043
Pull-up	0.684	0.109	-0.256
1000 meters	-0.797	0.095	-0.006
Characteristic value	2.255	1.300	1.097
Female	Component		
	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>
BMI value	-0.105	0.083	0.735
800 meters	0.728	-0.041	-0.169
Personal disease status	-0.121	-0.733	0.377
Standing long jump	0.577	0.206	0.041
Vital capacity	0.088	0.753	0.327
Abdominal curl	0.573	0.162	0.048
Personal exercise frequency	0.335	-0.103	0.455
The total score of the body test	0.810	-0.033	0.152
Characteristic value	1.993	1.193	1.052

According to the above results, follow formula is obtained (see the table below for the meaning of the variables):

$$Q_1 = 0.4703X_1 + 0.2815X_2 + 0.2482X_3 \quad (1)$$

Of which:

$$\begin{cases} X_1 = 0.577Z_3 + 0.728Z_6 + 0.573Z_7 + 0.810Z_{10} \\ X_2 = 0.753Z_4 - 0.733Z_8 \\ X_3 = 0.455Z_5 + 0.735Z_9 \end{cases} \quad (2)$$

$$Q_2 = 0.4847Y_1 + 0.2795Y_2 + 0.2358Y_3 \quad (3)$$

Of which:

$$\begin{cases} Y_1 = 0.684Z_1 - 0.797Z_2 + 0.561Z_3 + 0.505Z_5 + 0.734Z_{10} \\ Y_2 = 0.844Z_4 \\ Y_3 = 0.711Z_8 + 0.666Z_9 \end{cases} \tag{4}$$

**Table 2.** Definition of physical fitness evaluation standard variables

Variable symbol	Variable meaning	Variable symbol	Variable meaning
Q <sub>1</sub>	Evaluation criteria of female physical fitness	Q <sub>2</sub>	Evaluation criteria of male physical fitness
X <sub>1</sub>	Female body measurement factor	Y <sub>1</sub>	Male body measurement factor
X <sub>2</sub>	Female physical condition factor	Y <sub>2</sub>	Male physical condition factor
X <sub>3</sub>	Female exercise factor	Y <sub>3</sub>	Male exercise factor
Z <sub>1</sub>	Pull-up score	Z <sub>6</sub>	800 meters result
Z <sub>2</sub>	1000 meters result	Z <sub>7</sub>	Sit-up performance
Z <sub>3</sub>	Standing long jump performance	Z <sub>8</sub>	Disease situation results
Z <sub>4</sub>	Vital capacity score	Z <sub>9</sub>	BMI result
Z <sub>5</sub>	personal exercise frequency	Z <sub>10</sub>	The total score of the body test

### 3.3. Classification of Physical Fitness Level

The sample score is calculated according to the above physical fitness evaluation standard formula, and the score is approximately subject to normal distribution. According to the statistical percentile results, the physical fitness of the sample is classified as follows:

**Table 3.** Physical fitness evaluation score scale

Grade	Unqualified	Qualified	Good	Excellent
Score range	[-3.34,-0.576]	[-0.5760,-0.0929]	[-0.0929,0.5317]	[0.5317,5.11]

### 3.4. Multivariate Analysis of Each Characteristic

#### 3.4.1. Personal Characteristics

Academic performance and personal exercise behavior will impact students' physical health. The data results show that: from the perspective of academic performance, 49.0% of the students with excellent academic performance are also perfect in material quality, which is much higher than those with other levels; From the perspective of the total score of physical examination, 73.6% of the students with excellent physical examination score are perfect in physical quality; From the standpoint of individual exercise frequency and duration, the students with higher exercise frequency and longer exercise duration have better physical quality; From the BMI value, it shows that the students with average BMI value have a more substantial physical quality; The P-values are less than 0.01, which is statistically significant. The specific data are shown in the table below.

**Table 4.** Multivariate analysis of personal characteristics

Investigation content		Number of investigators	Physical fitness is excellent	$\chi^2$ value	P-value
Total		955(100%)	240(25.1%)	-	-
Academic achievement	Fail	17(1.8%)	5(29.4%)	39.667	0.000
	Pass	147(15.4%)	27(18.4%)		
	Good	387(40.5%)	92(23.8%)		
	Excellent	355(37.2%)	92(25.9%)		
	Perfect	49(5.1%)	24(49.0%)		
The total score of body test	Affect graduation	20(2.1%)	2(10.0%)	534.298	0.000
	Fail	92(9.6%)	2(2.2%)		
	Pass	327(34.2%)	12(3.7%)		
	Good	357(37.4%)	107(30.0%)		
	Excellent	159(16.7%)	117(73.6%)		
Personal exercise frequency	0 times	214(22.4%)	28(13.1%)	162.485	0.000
	1-2 times	362(37.9%)	66(18.2%)		
	3-4 times	211(22.1%)	61(28.9%)		
	5-6 times	102(10.7%)	44(43.1%)		
	7 times	66(6.9%)	41(62.1%)		
Personal exercise duration	0 minutes	214(22.4%)	28(13.1%)	139.184	0.000
	0-30 minutes	205(21.5%)	41(20.0%)		
	31-60 minutes	310(32.5%)	74(23.9%)		
	61-90 minutes	124(13.0%)	42(33.9%)		
	91-120 minutes	57(6.0%)	22(38.6%)		
	More than 120 minutes	45(4.7%)	33(73.3%)		
BMI value	Too light or obese	341(35.7%)	47(13.8%)	83.201	0.000
	Overweight	89(9.3%)	16(18.0%)		
	Normal	525(55.0%)	177(33.7%)		

### 3.4.2. Guardian Characteristics

The characteristics of guardians will impact students' Sports Cognition and behavior. The data results show that the guardians with higher exercise frequency and longer exercise duration for their children have better physical quality, and the P-values are less than 0.05, which is statistically significant. The specific data are shown in the table below.

**Table 5.** Multivariate analysis of guardian characteristics

Investigation content		Number of investigators	Physical fitness is excellent	$\chi^2$ value	P-value
Total		955(100%)	240(25.1%)	-	-
Guardian exercise frequency	0 times	313(32.8%)	74(23.6%)	28.080	0.005
	1-2 times	317(33.2%)	69(21.8%)		
	3-4 times	163(17.1%)	44(27.0%)		
	5-6 times	73(7.6%)	22(30.1%)		
	7 times	89(9.3%)	31(34.8%)		
Guardian exercise duration	0 minutes	313(32.8%)	74(23.6%)	29.101	0.016
	0-30 minutes	140(14.7%)	32(22.9%)		
	31-60 minutes	272(28.5%)	62(22.8%)		
	61-90 minutes	141(14.8%)	38(27.0%)		
	91-120 minutes	41(4.3%)	15(36.6%)		
	More than 120 minutes	48(5.0%)	19(39.6%)		

### 3.4.3. Students' Physical Test Characteristics

Male: In 1000 meters, pull-up, standing long jump, and vital capacity, the better the performance, the better the physical quality, which is in line with the setting function of physical test items. Even in pull-up and standing long jump, the two concepts are almost equivalent, and the P-values are less than 0.01, which is statistically significant. See the following table for the specific data.

**Table 6.** Multivariate analysis of male physical measurement characteristics

Investigation content		Number of investigators	Physical fitness is excellent	$\chi^2$ value	P-value
Total		543(100%)	128(23.6%)	-	-
1000 meters	Excellent	29(5.3%)	13(44.8%)	30.003	0.000
	Good	108(19.9%)	37(34.3%)		
	Pass	283(52.1%)	61(21.6%)		
	Fail	123(22.7%)	17(13.8%)		
Pull-up	Excellent	17(3.1%)	15(88.2%)	164.155	0.000
	Good	29(5.3%)	23(79.3%)		
	Pass	86(15.8%)	42(48.8%)		
	Fail	411(75.7%)	48(11.7%)		
Standing long jump	Excellent	35(6.4%)	30(85.7%)	259.831	0.000
	Good	103(19.0%)	50(48.5%)		
	Pass	317(58.4%)	48(15.1%)		
	Fail	88(16.2%)	0(0%)		
Vital capacity	Excellent	69(12.7%)	40(58.0%)	124.318	0.000
	Good	169(31.1%)	53(31.4%)		
	Pass	267(49.2%)	35(13.1%)		
	Fail	38(7.0%)	0(0%)		

Female: In 800 meters, sit-up, standing long jump, and vital capacity, the better the performance, the better the physical quality, which is also in line with the setting function of physical test items. Even in the 800 meters and standing long jump, the two concepts are almost equivalent, and the P-values are less than 0.01, which has statistical significance. See the following table for the specific data.

**Table 7.** Multivariate analysis of female physical measurement characteristics

Investigation content		Number of investigators	Physical fitness is excellent	$\chi^2$ value	P-value
Total		412(100%)	112(27.2%)	-	-
800 meters	Excellent	25(6.1%)	21(84.0%)	188.179	0.000
	Good	79(19.2%)	44(55.7%)		
	Pass	258(62.6%)	46(17.8%)		
	Fail	50(12.1%)	1(2.0%)		
Sit-up	Excellent	54(13.1%)	34(63.0%)	160.140	0.000
	Good	173(42.0%)	61(35.3%)		
	Pass	128(31.1%)	15(11.7%)		
	Fail	57(13.8%)	2(3.5%)		
Standing long jump	Excellent	27(6.6%)	23(85.2%)	157.094	0.000
	Good	73(17.7%)	40(54.8%)		
	Pass	272(66.0%)	49(18.0%)		
	Fail	40(9.7%)	0(0%)		
Vital capacity	Excellent	41(10.0%)	27(65.9%)	59.633	0.000
	Good	83(20.1%)	31(37.3%)		
	Pass	265(64.3%)	50(18.9%)		
	Fail	23(5.6%)	4(17.4%)		

A comprehensive comparison of the differences between men and women in physical test results and the physical quality shows that the decisive items for men are standing long jump and pull-up. The assertive things for women are 800 meters and standing long jump. There is extreme differentiation with the excellent physical fitness of 0% and nearly 90% in these items.

### 3.5. Classification of Family Background

To further interpret the sample family background, the K-means clustering method is used to classify the sample family. The factors of cluster reference are family location, the highest education, income level, disease status, exercise frequency, eating habits, etc.

After several iterations, the clustering results are as follows:

**Table 8.** Final clustering table of family factors

Factors	Category	
	1	2
Income	-0.38708	0.58316
Disease status	0.14253	-0.21473
Exercise program	0.40123	-0.60448
Exercise frequency	-0.45356	0.68331
Exercise duration	-0.44205	0.66598
Eating habits	-0.19353	0.29157
Three highs situation	-0.10432	0.15717

The iterative results show that the classification results adjust the data to non-sports families and sports families with good explanatory significance. Category 1 is non-sports families, and the frequency and duration of family activity per week are few. Category 2 is sports families, and the frequency and time of exercise per week are significantly more than non-sports families. There were 381 sports families and 574 non-sports families in the sample classification results.

### 3.6. Build A Model to Study the Impact and Proportion of Family Background on Students' Physical Health

**Table 9.** Estimation of model parameters

Level	Factors	B	Standard error	Wald	freedom	Significance	Exp(B)	
Qualified	Intercept	0.350	0.164	4.562	1	0.033		
	Personal exercise frequency	0.022	0.179	0.015	1	0.904	1.022	
	BMI value	0.247	0.103	5.749	1	0.016	1.281	
	Age	0.240	0.171	1.970	1	0.160	1.271	
	Academic achievement	0.125	0.097	1.668	1	0.197	1.133	
	Individual exercise duration	0.396	0.145	7.395	1	0.007	1.485	
	Personal gastrointestinal condition	0.104	0.095	1.193	1	0.275	1.110	
	Personal illness	0.285	0.222	1.644	1	0.200	1.330	
	Height	0.057	0.122	0.219	1	0.640	1.059	
	Weight	-0.071	0.102	0.484	1	0.487	0.931	
	Non-sports family	-0.324	0.199	2.637	1	0.104	0.724	
	Sports family	0b	-	-	0	-	-	
	Intercept	0.360	0.167	4.631	1	0.031		
	Good	Personal exercise frequency	0.614	0.170	13.117	1	0.000	1.849
BMI value		0.620	0.113	30.122	1	0.000	1.859	
Age		-0.005	0.195	0.001	1	0.981	0.995	
Academic achievement		0.288	0.100	8.250	1	0.004	1.333	
Individual exercise duration		0.126	0.150	0.703	1	0.402	1.134	
Personal gastrointestinal condition		0.101	0.099	1.046	1	0.306	1.106	
Personal illness		-0.089	0.113	0.622	1	0.430	0.915	
Height		0.025	0.132	0.036	1	0.849	1.026	
Weight		0.083	0.112	0.550	1	0.458	1.087	
Non-sports family		-0.248	0.207	1.444	1	0.230	0.780	
Sports family		0b	-	-	0	-	-	
Intercept		0.234	0.175	1.783	1	0.182		
Excellent		Personal exercise frequency	0.888	0.171	27.051	1	0.000	2.430
		BMI value	0.906	0.126	52.066	1	0.000	2.474
	Age	0.200	0.140	2.029	1	0.154	1.221	
	Academic achievement	0.378	0.108	12.317	1	0.000	1.460	
	Individual exercise duration	0.358	0.166	4.670	1	0.031	1.430	
	Personal gastrointestinal condition	0.165	0.109	2.315	1	0.128	1.180	
	Personal illness	-0.200	0.115	2.997	1	0.083	0.819	
	Height	-0.008	0.139	0.003	1	0.954	0.992	
	Weight	-0.043	0.135	0.101	1	0.750	0.958	
	Non-sports family	-0.447	0.218	4.205	1	0.040	0.640	
	Sports family	0b	-	-	0	-	-	

Note: a. the reference category is unqualified b. This parameter is redundant, so it is zero.



The idea of machine learning is used to select an accurate and credible Logistic Regression model with the collected data. The variables in the questionnaire were summarized, and the Logistic Regression model was established by using academic achievement (Gender), personal exercise duration (Time), personal gastrointestinal condition (Stomach), personal exercise frequency (Frequency), personal disease (Disease), BMI value (BMI), age (Age), weight (Weight), height (Height) and family classification (Family).

$$\ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 \text{Gender} + \beta_2 \text{Time} + \beta_3 \text{Stomach} + \beta_4 \text{Frequency} + \beta_5 \text{Disease} + \beta_6 \text{BMI} + \beta_7 \text{Age} + \beta_8 \text{Weight} + \beta_9 \text{Height} + \beta_{10} \text{Family} \quad (5)$$

Substitute the data into the estimated parameters of the model, and the output results are shown in the table above:

The confusion matrix obtained by replacing the data with the model is as follows:

**Table 10.** Test table of a model confusion matrix

Measured value	Predictive value		
	Poor physical fitness	Good physical fitness	Correct percentage
Poor physical fitness	346	132	72.4%
Good physical fitness	172	305	63.9%
Overall percentage	54.2%	45.8%	68.2%

According to the confusion matrix, there are many primary diagonal data, and the accuracy of the model is 68.2%. It is considered that the model is good and can be used to extract the regular features of the relationship between physical fitness and the family environment.

According to the Logistic Regression model, it was evident that the probability of physical fitness of college students from sports families is lower than that of non-sports families. In the models under various physical qualities, the influence degree of the non-sports family gradually rises from 0.640 when the material quality is excellent to 0.780 when the material quality is good, and then fluctuates slightly to 0.724 when the material quality is qualified, indicating that the probability of good material quality of college students in sports family is more significant. For the horizontal comparison between family factors and others, according to the analysis of existing models, the probability of qualified physical quality affected by family factors is 17.32%, good is 11.28%, excellent is 12.44%, and the overall influence rate of family factors is about 13%.

#### 4. Discussion and Suggestions

This study reconstructs the evaluation standard of physical quality. Student physical fitness score conforms to the normal distribution by data analysis. The data analysis shows that standing long jump, male pull-up, and female 800 meters are the decisive factors for whether the physical quality is excellent, with extreme differentiation of 0% and nearly 90%. There are significant differences in personal exercise frequency, duration, BMI, and physical fitness; The higher the frequency of exercise, the longer the duration of movement, and the greater the percentage of excellent material quality. In addition, there is also a positive correlation between the total score on the physical test and academic performance.

The analysis of the influence of family background on students' physical health shows that the higher the guardian's exercise frequency and the longer the exercise time, the greater the probability of students' excellent physical quality. The overall impact of family factors on students' health is about 13%. Guardians should set a good example, establish a good awareness of physical exercise for children, and improve their exercise frequency and duration. The diligent exercise of guardians can not only improve their physical quality but also promote the physical health of students.

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