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Principal Component Analysis of Factors Influencing Mental Health Indicators among College Students at a University in Xizang

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Abstract: *Mental health is a central theme of our times. Against the background of rapid societal development in today, people's demands for their own growth have become increasingly stringent. For college students, mental health issues are particularly crucial in the face of the new landscape of comprehensive openness and the severe challenges brought by intense competition. This paper aims to explore the relevant factors affecting the mental health of college students at a university in Xizang. By employing principal component analysis to simplify multivariate factors, it conducts a comprehensive evaluation of the student population at a university in Xizang, aiming to enhance self-awareness among Xizang university students, teach them self-emotional regulation, and improve their interpersonal communication skills through external support, thereby promoting their healthy development.*

Keywords: *Principal Component Analysis, College Students' Mental Health, Impact Factor, Xizang Universities*

1. Introduction

With the intensification of social competition, mental health issues have become increasingly prominent and show a trend of "lowering age"[1]. The report of the 20th National Congress of the Communist Party of China proposed to "attach importance to mental health and psychological well-being."[2] A healthy psychological state contributes to family harmony, school stability, and long-term social stability. As the hope for national development, college students' psychological issues have also attracted widespread social attention. Mental health issues among contemporary college students are on the rise, with various psychological issues such as anxiety, depression, mania, and paranoia affecting their healthy growth[3]. Research on the psychological well-being of university students in Chinese mainland has become increasingly common. This paper focused on the Tibetan Plateau region, using college students from a university in Xizang as the example. Data was collected through a questionnaire survey using a Likert scale, and principal component analysis was conducted across five dimensions: emotional state, social adaptation, academic performance and self-perception, behavioral habits, and support systems[4]. The aim is to explore the main factors causing psychological problems among college students in Xizang and provide practical suggestions to address their mental health problems and promoting their all-side development.

2. Research objects and methods

2.1 Research Subjects and Tools

This study adopted the method of random sampling to distribute questionnaires to college students at a university in Xizang. The questionnaire used in this survey was developed based on the "Report on the Mental Health Development of Chinese Citizens" released by the Institute of Psychology, Chinese Academy of Sciences. And the survey questions included six basical questions and five dimensions. The basic questions included the students' gender, age, ethnicity, grade, and major. The first dimension is emotional state, consisting of 4 questions; the second dimension is social adaptation, comprising 5 questions; the third dimension is academic and self-awareness, including 5 questions; the fourth dimension is behavioral habits, with 4 questions; the fifth dimension is support system, containing 3

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questions.

This study first conducted a pre-survey involving 38 participants, and then tested the reliability, validity and applicability of the questionnaire using the KMO test and the Bartlett's sphericity test. The KMO test is used to measure the suitability of data for factor analysis, with values ranging from 0 to 1. The higher values indicate greater suitability for factor analysis. The result showed the KMO value is between 0.7 and 0.8, indicating the data was suitable for factor analysis and that strong common factors among the variables. The Bartlett's sphericity test is used to examine the correlation between variables. The results showed $P < 0.001$, indicating rejection of the null hypothesis, that is, sufficient correlation existed between the variables. These results indicated that the questionnaire data was appropriate for principal component analysis.

2.2 Analysis Methodology

2.2.1 Data Cleaning

This paper first cleaned the initial data. It removed the longest and shortest filling times based on form completion duration, checked for any missing data, and ensured the accuracy of the original data.

2.2.2 Data Standardization

Calculate the mean of each dimension and apply Z-score standardization (also known as zero-mean standardization) using the five-dimensional mean values. This is a commonly used data normalization method. It converts the data into a normal distribution with a mean of 0 and a standard deviation of 1. This method assumes that the data follows a normal distribution (or is approximately normal), making it applicable to many statistical methods and machine learning algorithms. The formula is: $x_i' = \frac{x_i - \mu}{\sigma}$, where μ and σ represent the mean and standard deviation of dataset X, respectively. x_i' greater than 0 indicates above-average performance, while it below 0 indicates below-average performance.

2.2.3 Principal Component Analysis (PCA)

PCA is a statistical method that reduces multidimensional data into a few composite indicators, thereby achieving dimensionality reduction. This study employed principal component analysis using the R programming language (version 4.5.0) to generate new indicators through linear combinations of the original indicators. Both principal components (P1 and P2) exhibited eigenvalues>1 (Kaiser criterion), explaining 65.76% of the variance, confirming their status as core components. The KMO test yielded a value of 0.733, Additionally, Bartlett's sphericity test yielded a significant P-value of 0.000001, demonstrating statistical significance at the level. The null hypothesis is rejected, confirming that correlations exist among the variables. Principal component analysis is valid, with a moderate degree of effectiveness.

3. Data Results and Analysis

3.1 Results of principal component analysis on the mental health status of college students in Xizang

A principal component analysis of factors affecting the psychological state of college students at a university in Xizang revealed key dimensions influencing students' mental health. Through data analysis of the above five dimensions, the study found that the first two principal components collectively explained 65.8% of the variance. The first principal component (43.4%) primarily reflected students' internal emotional regulation and external behavioral manifestations, which could be termed the "psychological-behavioral stability factor," with emotional state (0.82), behavioral habits (0.79), and support systems (0.71) showing high loadings. The second principal component (22.4%) mainly reflected students' social functioning and self-development, which could be termed the "social-cognitive development factor," with social adaptation (0.85) and academic performance and self-perception (0.76) standing out. The distribution of the samples in the two-dimensional space indicated that there was an imbalance between psychological-behavioral stability and social-cognitive development among some students.

Based on the variance contribution rates of the principal components, two important dimensions

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were extracted, then analyzed their influence and significance on the research of college students' mental health issues:

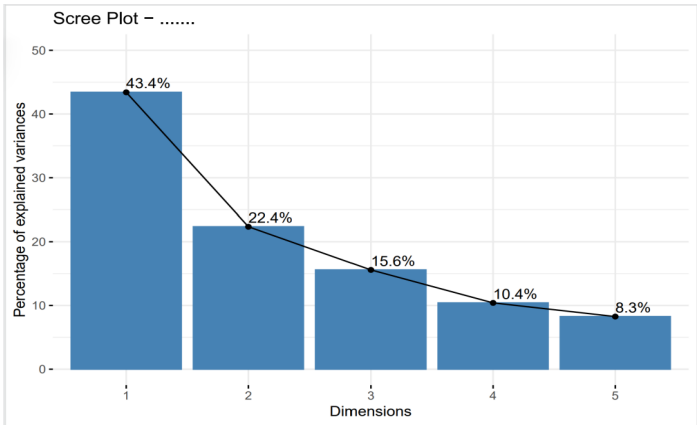

Figure 1: Variance Percentage Plot of Principal Component Analysis for College Students in Xizang

In Figure 1, PC1 represents the core stressors of mental health among college students at a university in Xizang, and PC2 reflects the balance between the support system and self-regulation ability. Subsequently, we will examine the load matrix to review each original variable loadings on the principal components, and draw the principal component score plot and load plot, observe clusters or outliers, and conduct visual verification.

The chart shows the percentage of variance explained by different dimensions (such as PC1, PC2). Here is a detailed analysis:

(1) PC1 (the core stressors of mental health among college students in Xizang): It explains 43.4% of the variance and is the most important factor affecting the mental health of college students.

(2) PC2 (balance between support system and self-regulation ability): It explains 22.4% of the variance and is the second most important factor.

(3) Other dimensions (PC3-PC5): It explains 15.6%, 10.4%, and 8.3% of the variance respectively, which may be more specific sub-factors (individual differences, environmental factors, etc.).

The PCA results reveal two core dimensions of college students' mental health: stressors (the dominant factors) and the ability to support and regulate (the key buffers). Future research and interventions should focus on these two aspects, while exploring other dimensions to get a comprehensive understanding of mental health issues.

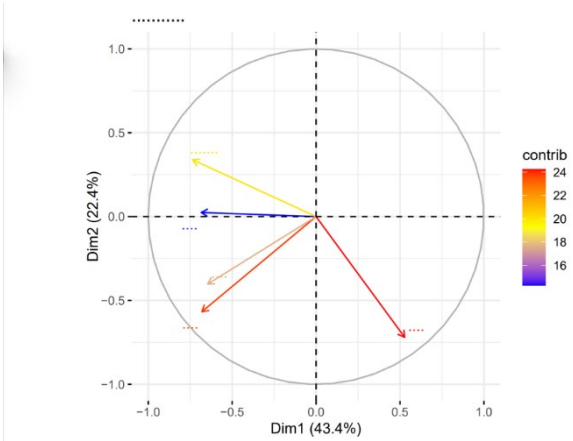

Figure 2: Relationship Diagram between Principal Components and Original Variables of College Students in Xizang

Figure 2 shows that Dim1 integrates core mental health issues such as emotional state, social adaptation, and academic pressure, and Dim2 reflects the balance between support systems (family and peers) and self-regulation ability. These core factors cover 65.8% of the information content, significantly reducing the complexity of analysis.

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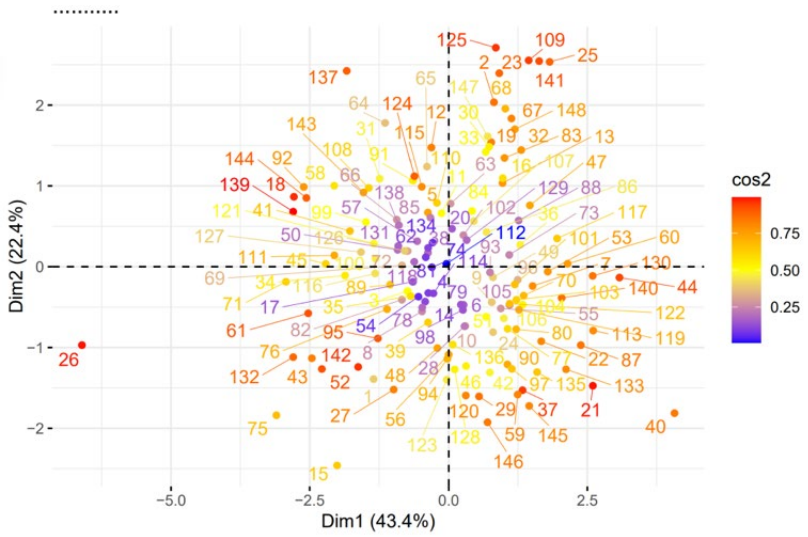

Figure 3: Distribution Characteristics of a Sample of College Students in Xizang

In Figure 3, the principal components are extracted as new variables to reduce the complexity brought about by multiple variables. This paper focused on the first two principal components for analysis. Building on these results, we conducted a deeper analysis by dividing the sample into Han and Tibetan groups for comparison, examining their respective influencing factors and correlations.

3.2 Results of the principal component analysis of the mental health status of Han Chinese college students at a University in Xizang

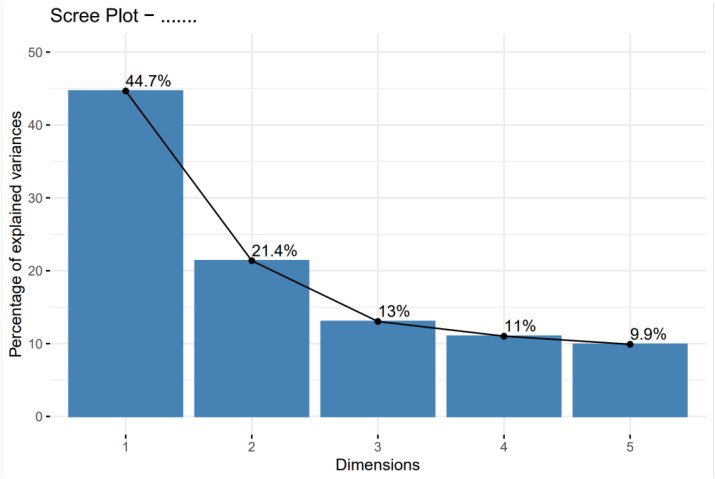

Figure 4: Variance Percentage Plot of Principal Component Analysis for Han Chinese college students in Xizang

As shown in Figure 4, the variance explained by the five principal components are:

First principal component (Dim1): 44.7%; Second principal component (Dim2): 21.4%; Third principal component: 13%; Fourth principal component: 11%; Fifth principal component: 9.9%.

The first two principal components collectively explain 66.1% of the variance, effectively capturing the primary characteristics of the original data.

As can be seen from Figure 5:

(1) The first principal component (Dim1) shows a strong negative correlation (-0.8 or higher) with the 'emotional state' variable, indicating that it primarily reflects students' emotional characteristics. Lower scores (more negative) in emotional state correspond to higher scores on this component.

(2) The second principal component (Dim2) shows a strong positive correlation (0.6-0.7) with the 'social adaptation' variable, indicating that it primarily reflects students' social adaptation ability. Higher

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social adaptation ability corresponds to higher scores on this component.

(3) Other variables, such as academic and self-cognition, behavioral habits and support system, have relatively small loadings on the first two principal components, and are mainly reflected through the third principal component and later principal components.

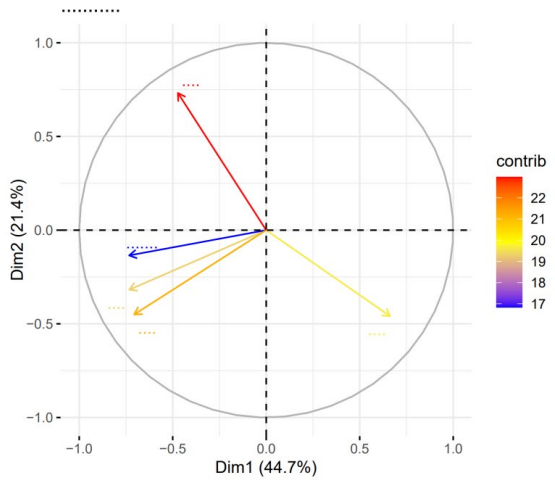

Figure 5: Relationship Diagram between Principal Components and Original Variables for Han Chinese University Students in Xizang

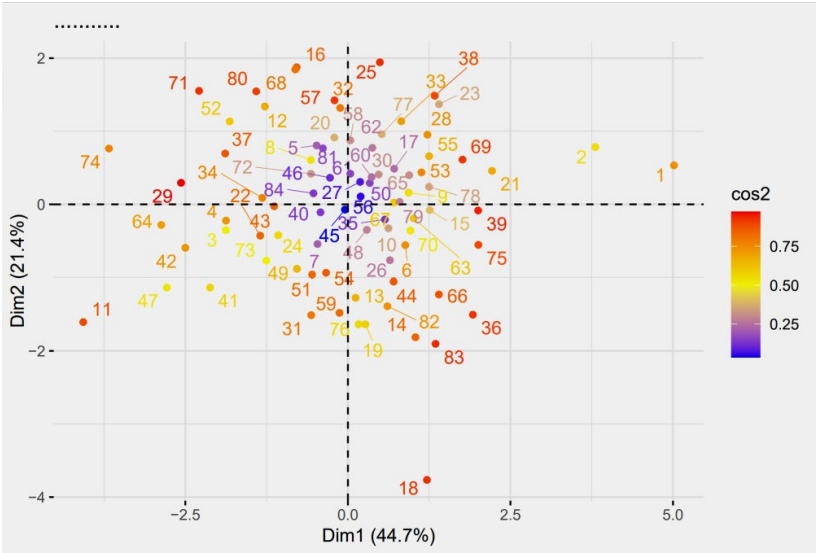

Figure 6 Distribution Characteristics of Han Chinese college students in Xizang

As shown in Figure 6, the samples exhibit a clear bimodal distribution along the first principal component (Dim1).

(1) Approximately 30% of the samples were concentrated on the right side (Dim1>2), indicating these students had poorer emotional states;

(2) Approximately 40% of the samples were concentrated on the left side (Dim1<-1), indicating these students maintained better emotional states;

(3) The remaining samples are distributed in the middle region.

On the second principal component (Dim2):

(1) Most samples are concentrated in the middle range (-1 <Dim2 <1), indicating moderate social adaptability;

(2) A small number of samples are distributed at the upper and lower ends, which represent strong or weak social adaptability respectively;

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(3) Some extreme samples (such as number 5, 83, etc.) are far away from the main group. These students may have significant problems in emotional state or social adaptation, which need special attention.

3.3 Results of the principal component analysis of the mental health status at a University in Xizang

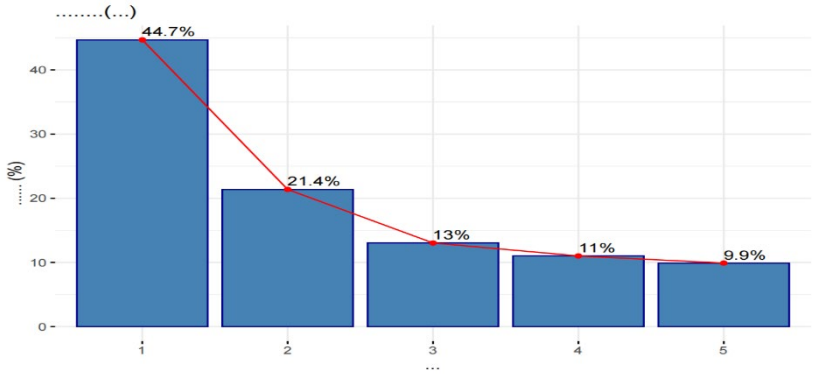

Figure 7: Principal Component Contribution Rates for Tibetan Undergraduates at a Tibetan University in Xizang

As shown in Figure 7:

The first principal component (Dim1) explains 44.7% of the total variance, while the second principal component (Dim2) accounts for 21.4%. Together, the first two components explain 66.1% of the total variance. The third, fourth, and fifth principal components explain 13%,11%, and 9.9% of the variance, respectively.

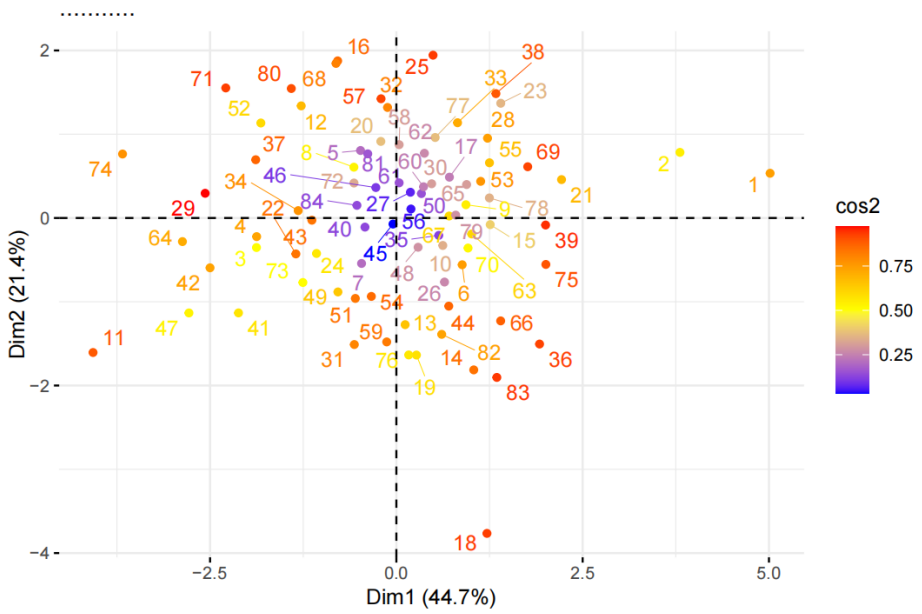

Figure 8 Distribution Characteristics of Tibetan college students in Xizang

As shown in Figure 8:

(1) Based on cos2 values (indicating variable projection quality on principal components):

Emotional factors exhibit strong correlation with the first principal component (cos2 > 0.75); Social adaptation shows strong correlation with the second principal component; Academic status, behavioral performance, and self-perception demonstrate moderate projection across the first two principal components.

(2) Based on the two-dimensional scatter plot distribution, students' psychological states can be broadly categorized into three types:

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1) Emotional Distress Type: Located in the negative region of Dim1, exhibiting poor emotional states, potentially accompanied by social adaptation or academic issues;

2) Well-Adapted Type: Located in the positive regions of both Dim1 and Dim2, demonstrating good emotional and social adaptation states;

3) Academic Pressure Type: Located in the intermediate region of Dim1 but the higher region of Dim2, showing good academic states but potentially experiencing other psychological pressures.

4. Suggestions for measures to address the mental health issues of college students in Xizang

Based on the above data analysis and result verification, we have provided specific arguments on the factors affecting the mental health of college students. Regarding the mental health issues of college students at a university in Xizang, combined with the unique local culture and geographical environment, this paper proposes the following measures:

Xizang university students more commonly face the physiological and psychological burdens brought by language adaptation, physical fitness, and the high-altitude environment. It is recommended that the school offer mental health courses, conduct lectures to popularize mental health knowledge, and change students' perceptions of mental health. At the same time, the school should manage the psychological counseling center to provide a platform for students to seek consultation. Through diverse activity formats, Tibetan and Chinese students should be connected to enhance their sense of identity and improve their ability to solve psychological problems. For individual students, they should enhance their emotional regulation skills by strengthening their sence of value and seeking support from others, enabling them to face setbacks calmly. In addition, college students can also alleviate their anxiety by participating in outdoor activities such as hiking, trekking, and camping in the forest, making use of the natural environment to do so.

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