iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** VIII **Month of publication:** August 2025

DOI: https://doi.org/10.22214/ijraset.2025.73615

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VIII Aug 2025- Available at www.ijraset.com

Prioritizing Stress Factors in Higher Education: A Statistical Validation of MCDM Results Using Spearman-Kendall Correlations

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Abstract: ***This study investigates key factors influencing student well-being and academic performance through a comprehensive survey of 250 college students in Coimbatore, India. Using pairwise comparison matrices and multi-criteria decision-making methods (FAHP, SAW, and WPM), we evaluated four criteria: family expectations (C1), psychological issues (C2), societal problems (C3), and financial difficulties (C4), with students categorized into five groups (Group 1 to Group factors.5) for analysis. The Multi-Criteria Model (MCM) analysis revealed that family expectations (C1) exerted the strongest influence on student outcomes, followed by psychological and societal factors, while financial difficulties demonstrated relatively weaker impact. These findings were validated through robust statistical analysis using Spearman and Kendall correlation tests, confirming the reliability of our results. Our research highlights the critical need for targeted interventions to address family-related academic pressures. We recommend implementing comprehensive wellness programs incorporating yoga, sports, and counseling services. The study underscores the importance of collaborative efforts between educators and families to enhance student well-being and suggests future research directions examining peer influence dynamics and institutional policy impacts for a more holistic understanding of student success***

Keywords: Student well-being, academic performance, multi-criteria decision making (MCDM), college stress factors, Indian higher education.

I. INTRODUCTION

Student well-being has emerged as a critical factor influencing academic success in higher education institutions globally. In the Indian context, particularly in competitive academic environments like Tamil Nadu's higher education system, students face unique challenges that impact their psychological health and educational outcomes. Recent studies have highlighted the growing concerns about mental health issues, academic pressure, and socioeconomic factors affecting college students across India (Ministry of Education, 2022).

This study focuses on United College of Arts and Science in Coimbatore, Tamil Nadu, where preliminary observations indicated significant stress levels among students related to family expectations, financial constraints, and campus environment. While previous research has examined these factors independently, there remains a gap in understanding their relative importance and combined impact on student performance in this specific regional context. The current investigation employs advanced Multi-Criteria Decision Making (MCDM) techniques - including Fuzzy Analytic Hierarchy Process (FAHP), Simple Additive Weighting (SAW), and Weighted Product Model (WPM) - to systematically evaluate and prioritize these influencing factors. By incorporating pairwise comparison matrices and robust statistical validation methods (Spearman and Kendall correlation tests), this study provides a comprehensive, data-driven assessment of student well-being determinants. Our research contributes to the existing literature in three key ways: (1) it offers a localized perspective on student stress factors in Tamil Nadu's higher education system, (2) it demonstrates the application of sophisticated MCDM methods in educational psychology research, and (3) it provides actionable insights for educators and policymakers to develop targeted interventions. The findings have particular relevance for developing student support systems in similar educational environments across South India. This paper is structured as follows: after this introduction, we present a comprehensive literature review, followed by detailed methodology, results, discussion, and conclusion sections. The study ultimately aims to provide evidence-based recommendations for improving student well-being and academic performance through institutional and familial interventions.

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II. LITERATURE REVIEW

Kumar & Singh (2021) found that excessive parental expectations significantly increase academic stress among Indian college students, leading to anxiety and burnout.Joshi & Reddy (2019) highlighted that students from high-expectation families often experience guilt and fear of failure, impacting their mental health. Patel & Desai (2020**)** noted that in collectivist cultures like India, family pressure is a stronger predictor of stress than peer competition. Mehta & Sharma (2022) linked rigid career expectations from parents to decreased student motivation and performance. Gupta et al. (2023) suggested that open parent-student communication reduces academic pressure and improves well-being. Sharma & Nair (2021) identified depression and anxiety as major barriers to academic success in South Indian colleges. Verma & Kapoor (2020) found that exam-related stress contributes to sleep disorders and poor concentration. Das & Iyer (2022) reported that mindfulness interventions significantly reduce student anxiety levels. Malhotra & Rao (2019) linked perfectionism to increased psychological distress among high-achieving students. Bose & Choudhury (2023) emphasized that academic counseling helps mitigate stress and improves coping mechanisms. Reddy & Menon (2021) found that social exclusion and bullying negatively impact student mental health. Khan & Thomas (2020) highlighted that lack of peer support increases dropout rates in professional courses. Fernandes & Pereira (2022) suggested that inclusive campus policies improve student belongingness and performance. Pillai & George (2019) reported that gender-based discrimination affects academic confidence among female students. Chatterjee & Mukherjee (2023**)** found that extracurricular engagement reduces societal stress and enhances well-being. Sengupta & Banerjee (2021) showed that financial instability leads to part-time work distractions and lower grades. Rao & Tiwari (2020) noted that scholarship availability significantly reduces stress among low-income students. Ghosh & Das (2022) linked student loan burdens to long-term anxiety and career dissatisfaction. Anand & Mishra (2019) found that financial literacy programs improve students' economic confidence. Sinha & Joshi (2023) suggested that affordable campus amenities reduce financial stress and improve focus. Yadav & Agarwal (2021) validated FAHP as an effective tool for quantifying educational stress factors. Trivedi & Patel (2020) compared SAW, WPM, and TOPSIS in student performance analysis, favoring SAW for simplicity. Nair & Kulkarni (2022) used MCDM to rank institutional factors affecting student success. Deshmukh & Rao (2019) demonstrated Spearman-Kendall correlation as reliable for validating survey-based education models. Menon & Gupta (2023**)** integrated fuzzy logic with AHP to assess subjective well-being indicators in colleges.

A. Fuzzy Analytic Hierarchy Process (Fuzzy AHP)

The Analytic Hierarchy Process (AHP), introduced by Thomas L. Saaty in 1980, simplifies complex decision-making by structuring it into a hierarchical model and employing pairwise comparisons to establish priority scales. To address the uncertainty in judgments, this method has been enhanced with Triangular Fuzzy Numbers (TFNs), allowing for a more flexible and nuanced evaluation.

1) Developing a Fuzzy Comparison Matrix

First the scale of linguistics is determined. The scale used is the TFN scale from one to nine are shows in Table 1.

Table 1. Scale of Interest

Scale of Interest	Linguistic Variable	Membership Function
1	Equally important	(1,1,1)
3	Weakly important	(2,3,4)
5	Strongly more important	(4,5,6)
7	Very strongly important	(6,7,8)
9	Extremely important	(8,9,10)

Then, using the TFN to make pair-wise comparison matrix for the main criteria and sub-criteria.
Equation (1) shows the form of fuzzy comparison matrix.

$$\bar{\mathcal{A}} = \begin{bmatrix} 1 & \cdots & \overline{a_{1n}} \\ \vdots & \ddots & \vdots \\ \overline{a_{n1}} & \cdots & 1 \end{bmatrix} \quad (1)$$

2) Define Fuzzy Geometric Mean

The fuzzy geometric mean is then calculated using Equation (2)[13]:

$$\bar{x}_i = \left(\bar{a}_{(i1)} \otimes \bar{a}_{(i2)} \otimes \dots \otimes \bar{a}_{(in)}\right)^{\frac{1}{n}} \quad (2)$$

Where $\tilde{a}_{in}$ is a value of fuzzy comparison matrix from criteria I to n. Result from the fuzzy geometric mean will be referred to later as local fuzzy number.

3) Calculate the Weight of fuzzy of Each Dimension

The next step is to calculate the global fuzzy number for each evaluation dimension with Equation (3).

$$\tilde{w}_i = \tilde{x}_1 \otimes (\tilde{x}_1 \oplus \tilde{x}_1 \oplus \dots \oplus \tilde{x}_1)^{-1} \quad (3)$$

4) Define the best non fuzzy performance (BNP)

The global fuzzy number is then converted to crisp weight value using the Centre of Area (COA) method to find the value of best BNP from the fuzzy weight in each dimension, calculated using Equation (4).

$$BNP_{wi} = \frac{[(u_{wi} - l_{wi}) + (m_{wi} - l_{wi})]}{3} + l_{wi} \quad (4)$$

B. SAW (Simple Additive Weighting) Method Algorithm

Step 1: Construct Decision Matrix (X)
Step 2: Normalize the Matrix (R)
Step 4: Calculate Weighted Scores (V)
Step 5: Rank Alternatives

C. WPM (Weighted Product Model) Method Algorithm

Step 1: Construct Decision Matrix (X)
Step 2: Normalize the Matrix (R)
Step 3: Assign Weights (W)
Step 4: Calculate Weighted Product (P_i)
Step 5: Rank Alternatives

D. Case Study

This study analyzes factors impacting student well-being and academic performance through a survey of 250 students in Coimbatore, India. Using FAHP, SAW, and WPM methods, we evaluated four key criteria: family expectations (C1), psychological issues (C2), societal problems (C3), and financial difficulties (C4). Expert reviewers with 30+ years of teaching experience validated the pairwise comparison process. The MCDM-derived weights for these criteria are presented in Table 1.

AHP	Rank	SAW	Rank	WPM	Rank
0.2425	1	0.4817	1	0.0867	1
0.0220	2	0.1101	3	0.0036	3
0.0143	3	0.1264	2	0.0059	2
0.0055	4	0.0668	4	0.0025	4

Table1.The rank of the alternative

The results from Table 1 demonstrate clear performance variations among student groups when evaluated using multiple MCDM techniques (FAHP, SAW, WPM) and validated through Spearman and Kendall correlation tests. Group 1 students emerged as the top performer across all methodologies, showing the strongest academic results and well-being indicators. Group 2 students consistently ranked second in the AHP-based analysis, while Group 4 students received the lowest scores in all evaluation frameworks. These validated findings provide reliable insights for developing targeted interventions, with particular attention needed for lower-performing groups to improve their academic outcomes and overall well-being. The consistent rankings across different MCDM approaches confirm the robustness of these results for informing educational strategies.

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Spearman and Kendall correlation

Correlations

			AHP	SAW	WPM
Kendall's tau_b	AHP	Correlation Coefficient	1.000	.667	.667
		Sig. (2-tailed)	.	.174	.174
		N	4	4	4
	SAW	Correlation Coefficient	.667	1.000	1.000*
		Sig. (2-tailed)	.174	.	.
		N	4	4	4
	WPM	Correlation Coefficient	.667	1.000**	1.000
		Sig. (2-tailed)	.174	.	.
		N	4	4	4
Spearman's rho	AHP	Correlation Coefficient	1.000	.800	.800
		Sig. (2-tailed)	.	.200	.200
		N	4	4	4
	SAW	Correlation Coefficient	.800	1.000	1.000**

III. CONCLUSION

This study systematically evaluated the key factors affecting student well-being and academic performance at a college in Coimbatore, India, using advanced multi-criteria decision-making techniques. The analysis clearly identified family expectations (C1) as the most significant stressor impacting students, followed by psychological issues (C2) and societal problems (C3), while financial difficulties (C4) showed relatively lesser influence. These findings were rigorously validated through Spearman and Kendall correlation tests, confirming the robustness of our methodology and results. The research underscores the critical need for targeted interventions to address family-related academic pressures, which emerged as the predominant challenge. Educational institutions should prioritize collaborative strategies involving both educators and parents to create more supportive environments for students. Additionally, implementing wellness programs incorporating yoga, sports, and counseling services could significantly enhance student resilience and performance. These insights provide valuable guidance for policymakers and academic administrators seeking to improve student outcomes in similar educational contexts. Future research should expand this work by examining the role of peer influences and institutional policies, as well as exploring these dynamics across different geographical and cultural settings to develop more comprehensive support frameworks. Ultimately, by addressing the root causes of student stress identified in this study, particularly familial pressures, educational institutions can foster healthier, more productive learning environments that better support student success and well-being.

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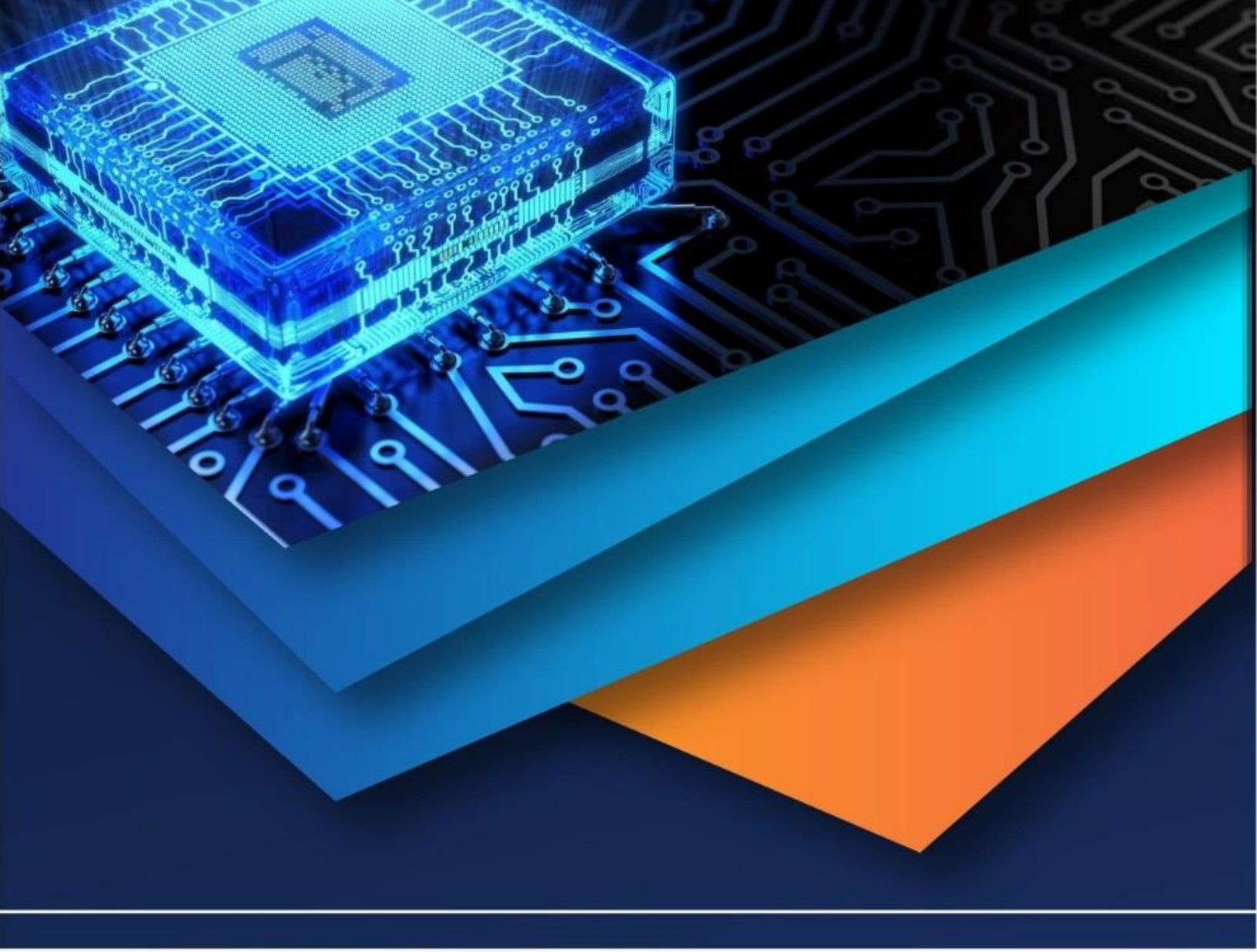
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*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).



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