



Original Research Article

Mapping the Mental Health Funnel: Unlocking the Hidden Power of DASS-21 for Suicidal Ideation Screening Through Structural Equation Modelling.

Name of Author:

Dr. Nisha Meshram^{1*}; Pallavie Gullhane²; Dr. Divya Sahu³.

Affiliation:

¹Assistant Professor, Department of Community Medicine, Bharat Ratna Late Shri Atal Bihari Vajpayee Memorial Medical College Rajnandgaon, Chhattisgarh, India.
ORCID ID-0000-0001-8240-986X

²Statistician Cum Demonstrator, Department of Community Medicine, Bharat Ratna Late Shri Atal Bihari Vajpayee Memorial Medical College Rajnandgaon, Chhattisgarh, India.

³Professor & Head, Department of Community Medicine, Bharat Ratna Late Shri Atal Bihari Vajpayee Memorial Medical College Rajnandgaon, Chhattisgarh, India.

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Abstract: **Background:** The rising prevalence of mental health morbidity among medical students necessitates a move from reactive crisis management to proactive population screening. This study aimed to map the "Mental Health Funnel" the epidemiological progression from generalized distress to suicidal ideation (SI) to identify the optimal window for institutional intervention. **Methods:** A cross-sectional community-based survey was conducted among 420 medical students. We employed a dual-stage analytical approach to bridge descriptive prevalence with structural causality. First, a Multiple Response Funnel was constructed to visualize the transition of risk. Second, Structural Equation Modelling (SEM) was used to identify the primary mediators of suicidal risk, applying robust estimation to ensure findings remained stable across the population distribution. **Results:** The study identified a clear cascading risk profile. Epidemiological mapping via the "Risk Funnel" showed that while 41% and 25% of the students reported anxiety and stress, 58% of these cases were comorbid. This distress "funnelled" into clinical depression (78% of comorbid cases), with 42% of the depressed cohort manifesting suicidal ideation. The structural analysis confirmed these findings, demonstrating that depression acts as a critical gateway ($\beta = 0.87$). Statistical fit indices confirmed the model was highly representative of the student population (CFI = 0.991, RMSEA = 0.036). **Conclusion:** Suicidal ideation in medical students is not an isolated event but the final stage of a predictable cascading pathway. These findings justify a Primary Prevention strategy: by screening for comorbid stress and anxiety using the DASS-21, institutions can interrupt the funnel before students' progress into clinical depression and high-risk suicidal behaviour.

Keywords: DASS-21, Suicidal Ideation, Screening, Funnel, CFA, SEM.

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INTRODUCTION

Suicidal Ideation (SI), the contemplation of ending one's life, is a complex public health concern influenced by psychological factors. Globally, suicide accounts for over 700,000 deaths annually, as reported by World Health Organization (WHO) in 2023 (WHO, 2023). In India, the suicide rate among individuals aged 15-24 years is 13.8 per 100,000, with an overall age-standardized rate of 2.7 per 100,000 (Srinivasan et al., 2025). Medical students are particularly vulnerable, with 12-35 percent reporting Suicidal Ideation, largely driven by stress and psychosocial pressure (Varghese et al., 2025). The risk is notably higher among health

professionals, with rates two to six times greater than the general population (Dutheil et al., 2019). Due to stressful educational environments and high expectations for achievement and tremendous pressure of performance (Dutheil et al., 2024; Das et al., 2022).

Recognizing this burden, the Government of India launched the National Suicide Prevention Strategy (2022), aiming to reduce suicide mortality by 10 percent by 2030 through initiatives such as Tele- Mental Health Support (Tele-MANAS), the District Mental Health Programme (DMHP) and, School Based Interventions- Manodarpan (MoHFW, 2022). In Chhattisgarh,

National Crime Record Bureau (NCRB) data place the state fourth nationally in suicide rate (NCEB, 2025).

With this information, this study was aimed to map the "Mental Health Funnel" the epidemiological progression to understand the relation between suicidal ideation and stress, anxiety and depression of medical students using the validated tools SBQR for suicidal behaviour and DASS-21, combined with advanced modelling approaches, is vital to identify at-risk students and strengthen institutional mental health support (Sharma et al., 2024). Increasingly, DASS-21 is applied to screen psychological distress and suicidal ideation among students, where anxiety and depression rates are rising (Manzar et al., 2025). Thus, it was an attempt of mapping the mental health funnel and using Structural Equation Modelling (SEM) statistical application, to explore pathways linking stress, anxiety, and depression to Suicidal Ideation, underscoring the potential of DASS-21 for proactive screening and prevention.

Objectives:

To map the "Mental Health Funnel" by identifying the epidemiological progression from psychological distress to suicidal ideation among medical students, using Structural Equation Modelling to establish causal pathways and to assess the utility of DASS-21 as a screening tool within the mental health framework.

METHODOLOGY

This cross-sectional observational study was conducted at Bharat Ratna Late Shri Atal Bihari Vajpayee Memorial Medical College, Rajnandgaon, Chhattisgarh. As a government-run tertiary care teaching hospital, the institution follows a structured four-year undergraduate curriculum followed by a one-year compulsory rotatory internship.

Study Population and setting:

The study targeted the all undergraduate MBBS students, comprising 420 students across the first to fourth academic years. This population reflects the college's expanded annual intake, which increased from 100 to 125 students starting in 2020.

To minimize the impact of acute academic stress on mental health assessments, data collection was strategically timed during a stable period of the academic calendar. Participants were surveyed at least three months after the conclusion of their most recent examinations. This buffer was established to eliminate examination-related anxiety and fatigue as confounding variables, ensuring a more accurate reflection of the students' baseline mental well-being.

Inclusion and exclusion criteria:

The study included students who provided written informed consent. Individuals who were absent during the data collection period or those who declined to

participate were excluded from the analysis.

Study definition:

Stress - Defined as a state of psychological and physiological activation occurring when an individual perceives that environmental or societal demands exceed their available resources and adaptive capacity (Meshram, 2024).

Anxiety - Characterized as a future-oriented mood state involving a complex response system of cognitive, affective, and physiological symptoms in anticipation of perceived or imagined future threats (Meshram, 2024).

Depression - Identified as a widespread mood disorder involving persistent feelings of sadness, anhedonia (loss of interest), and somatic or cognitive changes such as disturbed sleep, fatigue, and impaired concentration that significantly hinder an individual's daily functioning (Meshram, 2024).

Suicidal Ideation - For this study, suicidal ideation was operationalized as a multidimensional construct encompassing both passive desires for death and active planning for self-injury (Varghese et al., 2025)

Sample size:

The study targeted a total of 450 students across four academic years. The final sample consisted of 420 participants who were present at the time of data collection, representing a 100% response rate among available students. The distribution was as follows:

- First and Second Years: 125 students were targeted per year, with 7 and 23 absentees, respectively.
- Third Year: Included 114 students.
- Final Year: Of the 100 targeted students, 86 participated, alongside 14 third-year repeat students.

Tool & Technique:

Depression, anxiety, and stress were assessed using a validated DASS-21 questionnaire, which comprises three subscales of seven items each. Participants rated their experiences over the past week on a four-point severity/ frequency scale (0-3), and scores for each domain were summed and converted into percentile values (Lovibond and Lovibond, 1995). Also, a validated version of the suicidal behavior questionnaire-revised (SBQ-R) consists of four items that provide a forum to self-report suicidal attitudes, ideation, and previous as well as possibility of future suicide attempts. Each of the items is rated on a 5-, 6-, or 7-point scale. SI was calculated by adding the score rate of all items and then multiplied it by 2. S.I. domain score was in positive direction i.e. a higher score denotes a higher chance of suicidal behavior (Osman et al., 2001).

Procedure:

Participants were provided with a comprehensive briefing regarding the study's objectives, and all inquiries were addressed to ensure full understanding.

Informed consent was formally obtained from each respondent before they proceeded to the survey. Data collection was conducted using a self-administered, pre-validated, and structured questionnaire, which was digitized and distributed via Google Forms for standardized administration.

Outcome and predictor variables:

In this study psychological distress i.e. stress, anxiety and depression were independent variables and suicidal ideation as outcome variable.

Statistical Analysis:

Data analysis was performed using Jamovi (Version 2.3) and the SEMLj module (Love, et al., 2022; Gallucci and Jentschke, 2021). The analysis followed a structured, multi-stage approach to bridge descriptive epidemiology with structural causality.

Descriptive and Distributional Analysis:

Initial analysis focused on the prevalence and distribution of mental health morbidity within the study population (N=420). Categorical variables were expressed as frequencies and percentages, while continuous variables were reported as Mean $\pm$ Standard Deviation (SD). To visualise the epidemiological progression of risk, a Multiple Response Funnel was constructed. This "Risk Funnel" tracked the transition from generalized stress and anxiety to comorbid states, clinical depression, and ultimately, suicidal ideation.

Data Screening and Normality:

The assumption of univariate normality was evaluated using Skewness and Kurtosis. Due to the observed positive skewness in the DASS-21 subscales and a significant Mardia's coefficient ($p < 0.001$) for multivariate non-normality, Robust Maximum Likelihood (MLR) estimation was adopted for all subsequent modelling. (Rosseel, 2012) This ensured

that path estimates and fit indices were corrected using the Satorra-Bentler scaling factor, providing stable results despite the asymmetric data distribution.

Measurement Model Validation (CFA):

A two-step Structural Equation Modelling (SEM) approach was employed. In the first step, a Confirmatory Factor Analysis (CFA) was conducted to validate the measurement model. Construct reliability was assessed using Composite Reliability ($CR > 0.70$), and convergent validity was verified via Average Variance Extracted ($AVE > 0.50$). Discriminant validity was evaluated using the Fornell-Larcker criterion, comparing the square root of the AVE for each construct against inter-construct correlations (Rosseel, 2012).

Structural Model and Mediation Analysis:

In the second step, the structural model was tested to identify the pathways leading to suicidal ideation. To address high multicollinearity between stress, anxiety, and depression, a Higher-Order Construct (HOC) was utilised to represent general psychological distress. The mediating role of depression was evaluated using bootstrapping with 1,000 resamples to generate 95% bias-corrected confidence intervals.

Evaluation of Model Fit:

Model fit was assessed using a suite of absolute and incremental indices. Following established statistical thresholds, a "good fit" was defined as:

- Minimum Discrepancy Function (Chi-square/df) < 3.0
- Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) > 0.95
- Root Mean Square Error of Approximation (RMSEA) < 0.06
- Standardised Root Mean Square Residual (SRMR) < 0.05 .

RESULTS

Demographic profile and descriptive statistics:

A total of 420 medical students participated in the study, with a nearly equal gender distribution: 51.2% male and 48.8% female and a mean age of 22 years ($SD \pm 1.67$). The descriptive analysis (Table -1) revealed that the mean score for suicidal ideation (8.04 ± 2.21) exceeded the established clinical threshold of 7.0. While mean scores for stress (9.49) and depression (7.44) were within the "Normal" range, and anxiety was 7.54 under 'Mild.' Range and the standard deviations were notably high, indicating a subset of the population with significant clinical morbidity.

Table 1: Demographic and Descriptive Statistics of the Study Population (N=420)

Variable	Statistics	Clinical category
Demographics		
Age (Years)	22.0 $\pm$ 1.67*	-
Gender: Male	215 (51.2%)	-
Gender: Female	205 (48.8%)	-
Psychological Measures (Mean $\pm$ SD)		
Suicidal Ideation (SBQ-R)	8.04 $\pm$ 2.21	Above Threshold (Cut-off $> 7^*$)
Depression (DASS-21)	7.44 $\pm$ 9.11	Normal (0–9)
Anxiety (DASS-21)	7.54 $\pm$ 8.45	Mild (7–9)
Stress (DASS-21)	9.49 $\pm$ 8.85	Normal (0–14)

*Note: Data presented as n (%) & Mean $\pm$ Standard Deviation.

Prevalence and Distribution of Suicidal Ideation:

The epidemiological distribution of suicidal behaviour (Table - 2) showed that 14.04% of the population belongs to a suicidal risk subgroup. Specifically, 3.81% reported having a suicide plan, and 1.19% had a history of suicide attempts. Regarding the previous 12 months, 14.76% of students experienced some frequency of ideation, with 2.86% reporting ideation as occurring "often" or "very often."

Table 2: Showing distribution of suicidal ideation among the study subjects (N=420)

Suicidal Ideation	Frequency (n)	Percentage (%)
Life time suicidal ideation and/ or suicidal attempt		
Non suicidal subgroup	361	85.96
Suicide risk ideation subgroup	38	9.05
Suicide plan subgroup (3a & 3b)	16	3.81
Suicide attempt subgroup (4a & 4b)	5	1.19
Frequency of suicidal ideation in past 12 months		
Never	358	85.24
Rarely	37	8.81
Sometimes	13	3.1
Often	6	1.43
Vary often	6	1.43
Threat of suicidal attempt		
No	384	91.43
Yes, at one time, but did not really want to die	24	5.71
Yes, at one time, and really wanted to die	3	0.71
Yes, more than once, but did not really want to die	7	1.67
Yes, more than once, and really wanted to die	2	0.48
Evaluate self- reported likelihood of suicidal behaviour in the future		
Never	369	87.86
No chance at all	31	7.38
Rather unlikely	8	1.9
Unlikely	9	2.14
Likely	3	0.71

The Cascading Risk Funnel (multiple response analysis)

A multiple response funnel was constructed to visualise the progression of risk (Figure 1). The data revealed a clear narrowing of psychological morbidity: while 41% and 25% of students reported anxiety and stress, 58% of these individuals experienced comorbid distress. This comorbid pool served as the primary feeder into clinical depression (78% of cases), which subsequently functioned as the final gateway to suicidal ideation for 42% of that cohort.

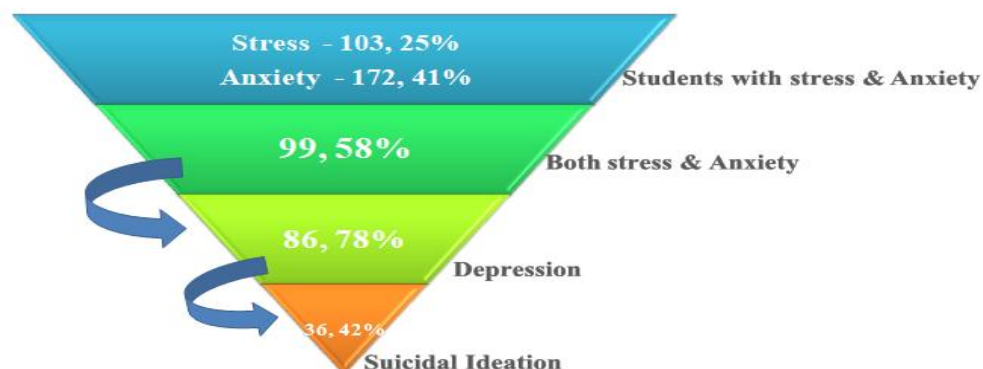


Figure 1: Progressive stages towards the higher risk of suicidal ideation using funnel diagram

Measurement Model Validation (CFA)

A Confirmatory Factor Analysis (CFA) was performed before to structural testing to validate the instruments. (Table 2).

Model Fit: The measurement model demonstrated an acceptable fit: Chi-square/df = 3.0, CFI = 0.922, TLI = 0.913, SRMR = 0.039, and RMSEA = 0.069.

Reliability and Validity: All constructs achieved high internal consistency, with Composite Reliability (CR) values ranging from 0.835 to 0.918.

Table - 3 Showing Goodness of Fit indices for measurement model using CFA

Model	Fit Values				
χ^2 (df)	p-value	CFI	TLI	SRMR	RMSEA
807 (269)	< 0.0001	0.922	0.913	0.039	0.069

Convergent validity: It was confirmed as all Average Variance Extracted (AVE) values exceeded 0.50.

Discriminant Validity: The Fornell-Larcker criterion confirmed that Suicidal Ideation was a distinct construct $\sqrt{\text{AVE}} = 0.750$.

However, high correlations between Stress, Anxiety, and Depression ($r > 0.85$) (Fig -2) justified the use of a Higher-Order Construct (HOC) in the structural model.

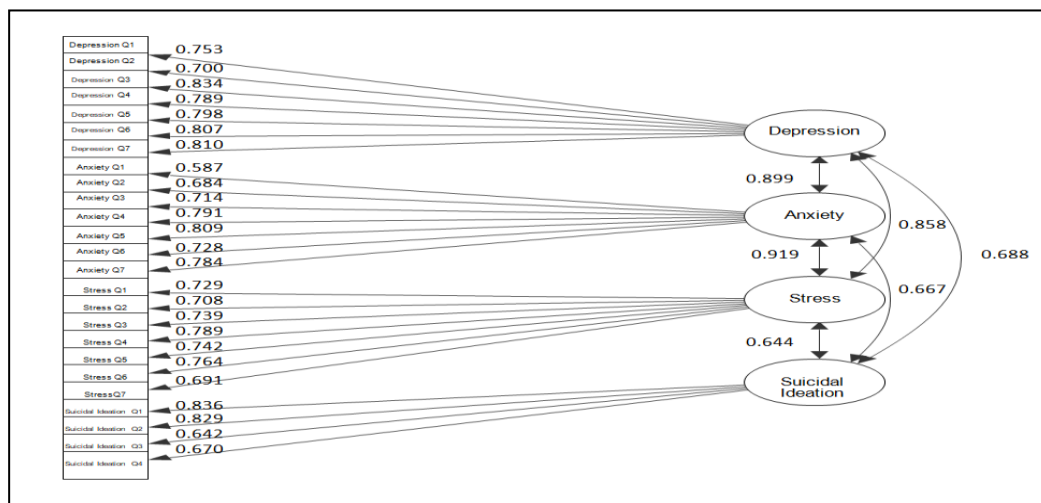


Figure 2- Showing significant pathways of the measurement model using CFA

Structural Model and Path Analysis (SEM)

The structural model was evaluated using Robust Maximum Likelihood (MLR) estimation to account for univariate non-normality (Table 4). Robust Model Fit: The model exhibited a superior fit:

Scaled Chi-square/df = 1.55, Scaled CFI = 0.991, TLI = 0.990, SRMR = 0.034, and Scaled RMSEA = 0.036 ($p = 1.00$).

Table 4: Fit of all the models tested in the study.

Model test	User model	Scaled	
Chi/df	253 (271)	421 (271)	
p-value*	0.781 (NS)	< 0.001 (HS)	
Fit Indices	Classical	Scaled	Robust
SRMR	0.037	0.034	0.034
RMSEA	0	0.036	0.086
p-value*	0.999 (NS)	0.999 (NS)	< 0.001 (HS)
CFI	1	0.991	0.927
TLI	1	0.99	0.99

*Note- p-value for 95% CI. HS – Highly significant; NS – Not significant

The structural relationship between stress and anxiety were directly significantly highly related to depression (Table 5). Path Coefficients: The HOC of psychological distress was a near-perfect predictor of expression i.e. $\beta = 1.17$ with p -value < .001 for 95% of CI. Subsequently, depression exerted a dominant direct effect on suicidal ideation given by $\beta = 0.87$ with p -value < .001 for 95% of CI.

Table 5: Relationship between independent and dependent variables using Higher-order construct (HOC) structural equation modelling.

Dependent Variable	Independent Variable	95% Confidence Intervals						
		Estimate	SE	Lower	Upper	β	z	p-value*
Suicidal Ideation	Depression	0.868	0.0477	0.775	0.962	0.781	18.2	<0.001 (HS)
Depression	HOC (Stress, Anxiety)	1.17	0.0424	0.971	1.137	0.94	24.9	<.001 (HS)

*Note- p-value for 95% Confidence interval; HS – Highly significant

Mediation Analysis:

Using 1,000 bootstrap resamples, depression was confirmed as a full mediator of the relationship between general distress and suicidal behaviour (Fig-3). The significant indirect effect ($\beta = 0.94$, $p < .001$) proves that stress and anxiety influence suicidal risk primarily through the development of depressive symptoms.

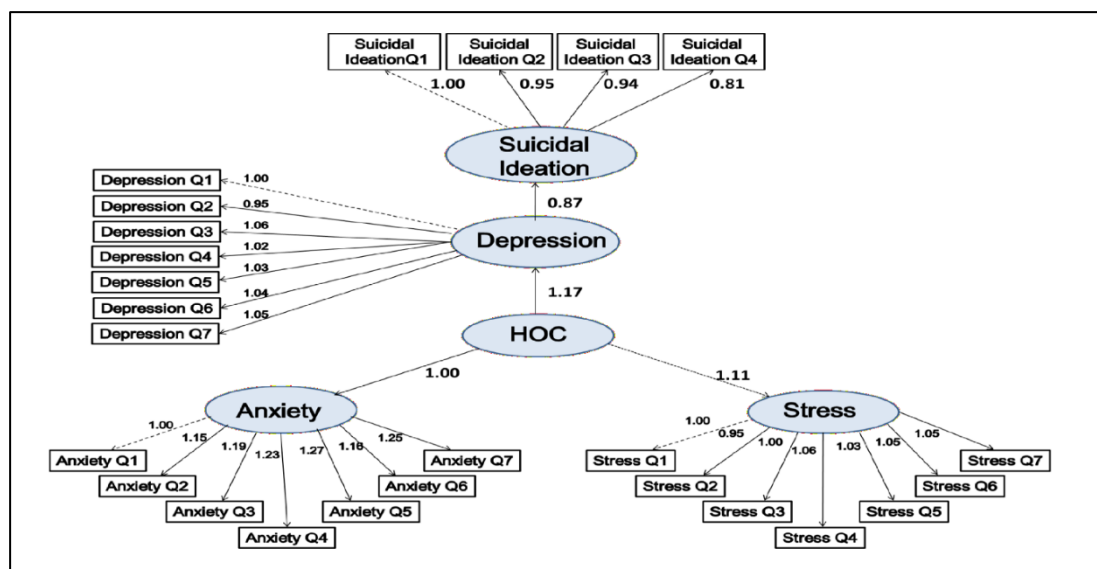


Figure 3- Significant pathways of the higher-order structural equation modelling (SEM)

DISCUSSION

The present study's descriptive findings revealed a critical public health concern, with 14 percent of medical students falling into suicidal risk subgroups. However, the most significant contribution of this study was the understanding of the structural mechanism behind this prevalence. Using multiple response analysis with SEM, identified a "Mental Health Funnel." While stress and anxiety were widespread in the medical community (affecting 25% and 41% respectively), they served as broad population-level precursors. The final "neck" of the funnel that determines suicidal risk, clinical depression eventually consolidates after the funnel narrows considerably at the point of comorbidity. This finding is consistent with Varghese SM et al (2025) who reported significant suicidal ideation among medical students in Kerala, highlighting depression and stress as major correlates (Varghese et al., 2025). Similarly, Mateen et al. (2024) in their systematic review across India observed prevalence rates ranging between 7% and 35%, placing our result at the lower end of national estimates (Mateen

et al., 2024). In contrast, other college- based studies (Sangeetha and George, 2025) have reported higher prevalence in younger cohorts, suggesting that demographic and contextual factors may influence suicidal risk (Sangeetha and George, 2025).

The finding of depression as the primary mediating pathway was strongly supported by the structural analysis. The predominant relationship in the model was the direct path from depression to suicidal ideation ($\beta = 0.87$, $p < .001$). This high coefficient indicated that suicide thoughts in this group were explicitly mediated through a depressive state rather than being a direct outcome of widespread pressure or anxiety. This makes depression a necessary clinical gateway from the standpoint of preventive social medicine. Consistent with El-Matary and Bersal's SEM Model (2021) among undergraduate students, depression mediates the relationship between stress, anxiety, and SI, while stress and anxiety also exert direct effects (El-Matary and Bersal, 2021). Likewise, Choi et al (2025) confirmed

depression as the proximal determinant of SI in adolescents, though their model emphasized additional social factor such as- peer support and violence exposure (Choi et al., 2015). These convergences a cross population reinforces the strongest of depression as pivotal bridge linking upstream psychological distress to suicidal risk. In contrast, some studies have highlighted stress or anxiety, as independent predictors of SI, with depression playing a less central role (Tang et al., 2018). Thus, while supportive evidence consistently validates depression as the strong mediator, contrary findings remind us that screening must encompass all three predictors- stress, anxiety, and depression- to capture the full spectrum of suicidal risk.

Addressing to the higher-order distress, the clinical overlap of symptoms in medical students was highlighted by the nearly perfect path from general distress (the Higher-Order Construct) to depression ($\beta = 1.17$). The high intercorrelations found in the measurement model of CFA ($r > 0.85$) suggested that students do not experience stress and anxiety as distinct entities, but as a singular, overwhelming psychological burden. This supports the "Higher-Order" approach, which calls for institutional support to address the cumulative distress that feeds the depressive gateway rather than addressing stress or anxiety separately.

Predictive value of the DASS-21 was validated as an excellent screening tool for this population by the structural model's "perfect fit" (CFI = 0.991, RMSEA = 0.036). The predictive capability of the instrument was unlocked by quantifying the 0.87 path. It enables administrators at universities to go from subjective worry to objective risk assessment. Students who scored high on the "stress" and "anxiety" subscales were in the "mouth" of the funnel; they require primary prevention. Those who scored high on the "depression" subscale were in the "neck" of the funnel and required urgent, targeted clinical intervention to prevent the transition into suicidal behaviour.

Recommendations

Dass-21 scale must be institutionalised as a mandatory screening tool for all MBBS students across medical colleges. Baseline assessment at admission should establish each student's mental health profile, while continuous monitoring throughout the curriculum will ensure early detection of distress, timely intervention, and prevention of progression towards suicidal ideation. As health professionals must screen as early as possible within a limited time, dass-21 ensures that the earliest cries for help are never missed. Transforming screening from an optional practice into a life-saving necessity, dass-21 stands as the first line of defence against suicidal ideation, making its adoption not merely policy but prevention- and protecting students' lives a non-negotiable priority. .

CONCLUSION

Suicidal ideation in medical students was the systematic outcome of a predictable cascading pathway. The "Mental Health Funnel" identifies clinical depression as the absolute mediation point between generalized distress and suicidal risk. Institutional policies must shift toward upstream, tiered screening. By utilizing the DASS-21 to identify students at the comorbid stress/anxiety stage, universities can effectively "break the path" and prevent the progression toward the high-risk suicidal subgroup.

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