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The Impact of Chronic Stress on Cognitive Functioning and Academic Performance in Older Students: A Longitudinal Study

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Abstract - **Chronic Stress has become a significant barrier to academic perfection among adult learners, although the crossroad between psychological strain and cognitive utility is poorly studied in the framework of the new education environment. This study examines the effects of chronic Stress on cognitive and academic performance in older students (25-50 years) who are being applied using a quantitative longitudinal design. The research model, which was based on Cognitive Load Theory and the Life Course Approach, was examined with the help of the Partial Least Squares Structural Equation Modeling (PLS-SEM) on a sample of 450 participants, over the period of 12 months. The measurement model is supported by the empirical findings that indicate good internal consistency (Cronbach's Alpha > 0.75) and convergent validity (AVE = 0.50 and more). The structural analysis demonstrates that the effect of chronic Stress on cognitive functioning is a strong negative factor ($\beta = -0.48$, $p < 0.001$), and cognitive functioning is a strong positive predictor of academic performance ($\beta = 0.55$, $t = 6.40$). An R2 of 0.64 was attained in the research model, which means that the cognitive degradation brought about by Stress can explain a significant 64 % academic outcomes. These results indicate that chronic Stress acts as a physiological burden on the brain processing hardware, namely, the reduction of working memory and executive control. The research finds that academic performance among the elderly students depends on cognitive maintenance. It suggests that educational policymakers should shift away from the traditional pedagogical support to integrated mental health infrastructures that emphasize cognitive resilience as a precondition to academic preparedness.**

Keywords: **Chronic Stress, Cognitive Functioning, Academic Performance, Executive Function, Older Students, Educational Psychology, Longitudinal Study, Working Memory**

I. INTRODUCTION

Stress is considered chronic when it is a continuous and lasting experience of Stress that can have detrimental effects on the health and cognitive functions of the individual who does not manage it. The chronic Stress, in contrast to the acute Stress, which, on the contrary, can occasionally make one more alert, causes the long-term release of cortisol, which has been reported to damage the neural pathways to memory and executive control. In terms of education, it has already been established that chronic Stress among adolescents is one of the main contributory factors to the failure of future academic performance (Schraml et al., 2012). Nevertheless, with the increasing rate of older students (adult learners aged 25-50) in higher education, it is important to know the precise effect of Stress on this group of people. Among the aged students, there tends to be complex life-course exposures, with the accumulative stresses on the professional and personal fields playing a major role in determining the cognitive courses (Chen et al., 2022).

Cognitive functioning among older students entails multiple areas such as working memory, processing speed, and executive functioning. Studies have shown that perceived Stress is directly correlated with a 2-year drop in cognitive abilities in the older age population (Feeney et al., 2018), implying that students in this age group could be more susceptible to the pressure on the brain (Seitz & Steger, 2025). Academic performance is vital not so much in terms of grades, but it is a measure of cognitive well-being and the

capacity to deal with complex information under high-stress situations (Aggarwal et al., 2014). Also, lifestyle variables like sleep deprivation and initial metacognitive skills are critical variables that either enhance or alleviate the influences of Stress on academic performance. Although much is studied on Stress in primary education, there is no empirical information locally based on the effects of chronic Stress on the cognitive ability of non-traditional older students in particular. The importance of this research is that it provides the Information Processing gap of Library and Information Science (LIS) and Education, which makes mental health a determinant of information-seeking behavior and academic success (Prerna Dusi, 2025).

Research Objectives and Hypotheses

OB 1: To examine the relationship between chronic Stress and the cognitive functioning of older students.

- Null Hypothesis (H0): There is no significant relationship between chronic stress levels and the cognitive functioning of older students.
- Alternative Hypothesis (H1): Higher levels of chronic Stress significantly reduce the cognitive functioning (specifically working memory and processing speed) of older students.
- OB 2**:** To determine the impact of cognitive functioning on the academic performance of older students under high-stress conditions.
- Null Hypothesis (H0): Cognitive functioning does not significantly mediate the relationship between Stress and academic achievement.
- Alternative Hypothesis (H1): Cognitive functioning acts as a significant positive determinant of academic performance, and its degradation due to Stress leads to lower academic scores.

The remainder of this study is structured as follows: Section II includes the detailed literature review. Section III provides the methodology, participants, and instruments. In section IV, the results and statistical analysis are given. Section V is a conclusion of the study with recommendations.

II. Literature Survey

It is well known that chronic Stress is a neurobiological inhibitor of brain optimal functionality. Current longitudinal data suggest that there are substantial changes within cognitive function throughout time due to the continuous occurrence of psychological pressure. An example is that perceived stress variations in older citizens have directly attributed to two years of deterioration in general cognitive ability. In addition, it was also shown that perceived stress levels are higher in relation to an accelerated cognitive decline rate in adults aged 65 years and above, indicating that the brain becomes less resilient against Stress with age.

The effect is not only on geriatric populations, but middle-aged adults are also at risk of cognitive problems. The life-course perspective shows that the cumulative exposure to stressors during adulthood has a great influence on cognitive trajectories, which may result in later impaired executive control. Such cognitive failures are frequently mediated by physiological aspects; a study has revealed that the combination of Stress and fatigue plays a significant negative role in processing speed and attentional capacity in college environments (Palmer, 2013; Almarzouki et al., 2022).

The shift of Stress as a psychological condition to an academic obstacle is well-reported. Chronic Stress, when used among adolescents and young adults, has been established to cause devastating effects on future academic performance. The high-pressure condition on older students has been reported to produce a significant decrease in cognitive scores and academic outcomes in a three-month time frame, which is specific to the specialized environment of medical education (Saroha et al., 2025).

According to recent systematic reviews, key elements of this relationship are anxiety and emotional dysregulation since it takes over the cognitive resources needed in a complex learning task (Rani, 2025). The skill to handle stress was the most important predictor of academic functioning in students, both with or without disability, even in times of global disturbances such as the COVID-19 pandemic (Schmidt & Van der Linden, 2015; Larose et al., 2025).

There must be a solid theoretical foundation for understanding the relationship between Stress and achievement. According to the framework of Mind Under Pressure, the level of education could be a moderating factor of the impact of Stress on intelligence and cognitive ability. Moreover, behavior and performance are usually interdependent; as behaviors are externally directed by Stress, the academic results may be low, and then the Stress may increase, creating a vicious cycle (Yan et al., 2024; Hanus & Fox, 2015).

Other theories, including the metacognitive theory, are also useful, which implies that the metacognitive awareness of a student in the first place may serve as a buffer to academic failure caused by stress (He et al., 2024). Also, Life Course Pathway theory assumes that previous socioeconomic status and early childhood trauma (including interpersonal trauma) precondition an intellectual background that predetermines how a student will manage stressors within an academic setting several years later (Greenfield et al., 2021; Enlow et al., 2012).

The literature confirms that, as a form of Stress, chronic Stress is a formidable suppressor of mental well-being and academic achievements. It has been proven that Stress adversely affects cognitive hardware, not just lowering grades, but stress literally diminishes the capacity of working memory. This results in a vicious circle of Stress being aggravated by poor performance. Nonetheless, other factors

such as physical exercise, metacognition, and keeping pets are essential protective buffers to this decrease.

These studies encompass diverse demographic analyses, but there remains no literature that specifically looks at older students (25-50 years old) who fall within the new digital learning environments in South Asia. This study will close this gap by synthesizing the Life Course Approach with the Cognitive Load Theory by offering empirical evidence on how these particular demographics cope with chronic Stress to be academically prepared.

III. Proposed Methodology

Study Design

The study uses a longitudinal correlational, quantitative study design, which is used to monitor the stability of Stress and its effect over a period of time. This study does not take a one-time snapshot but measures variables at 2 different time points (baseline and 12 months follow-up) to determine that Stress is the temporal predecessor that is required to assert that cognitive decline is a result of Stress. This is a similar method to the Life Course framework, where it is possible to observe the influence of the cumulative pressure on intellectual performance. The study is based on the positivist paradigm and a deductive approach in the process of testing pre-determined hypotheses (H1 and H2) based on statistical modeling. The controlled longitudinal flow will enable the research to narrow down on the chronicity of the stressors on older learners by eliminating transient emotional outbursts.

Participants and Sampling Procedures

The research methodology is a stratified random sampling method that provides the study with representation in the older student sample (ages 25-50). The participants were identified through different institutions of higher learning that dealt with adult learning and professional development. The Power Analysis was used to estimate the total sample size (N=450) in order to achieve a 95% level of confidence. Two main criteria were used to stratify: the employment status (full-time, part-time, and unemployed) and academic discipline, with one ensuring that there was a balance between high-pressure disciplines such as Medical Sciences and social sciences. Inclusion criteria were that the subjects needed to be presently pursuing a degree program and that they had already completed at least one semester of study, so they would have a baseline to compare their academic performance (Affuso et al., 2025; De Waal & Pienaar, 2020).

Data Collection Methods and Instruments

The collection of data was enabled with the help of a dual-instrument approach. The 14-item Perceived Stress Scale (PSS) was used to measure Chronic Stress, which can be described as a validated method of evaluating the extent to which a life situation is perceived as a stressor. The Digital Cognitive Battery that was used to measure Cognitive Functioning included working memory and processing speed, in accordance with contemporary research on Mind Under Pressure. The academic performance was operationalized using Cumulative Grade Point Average (CGPA) and certain standardized test scores. A pilot test was conducted on all instruments to show that Cronbach's Alpha exceeded 0.80, which was a guarantee of internal reliability. Technology Data collection was done through a secure online portal that is LIS-integrated to enable anonymity and ensure data integrity of the participants.

Methodology

The methodology adheres to a linear approach that has five stages of the procedure that will guarantee empirical rigor and integrity of data. It starts with the Conceptualization Stage, whereby the theoretical framework is aligned with the research objectives. This leads to the Design Stage, which uses a longitudinal correlational design to monitor variables within a 12-month period. The third step is the Operationalization Stage, in which the abstract concepts, such as Chronic Stress and Cognitive Functioning, are translated into some measurable data points with the help of the Perceived Stress Scale (PSS) and digital cognitive batteries. The next step is the Execution Stage, where stratified random sampling and data collection will be used through the secure electronic portal. Last but not least is the flow of the Analytical Stage, where Structural Equation Modeling (SEM) is then used to test the hypotheses. This logical progress allows the study to have a logical flow towards general psychological theories and then narrow down to particular, specific, actionable statistical conclusions.

Architecture Diagram

The research framework is formulated in the form of a multi-layered system that creates an amalgamation between human psychometrics and a processing evaluation. The participants will submit raw data at the Input Layer in two different channels: self-reports (subjective) and performance (objective) tasks (cognitive tests). This information is input to the Processing Layer, where it is then cleaned, normalized, and its reliability is tested (Cronbach's Alpha). The Analysis Engine is the central component of the architecture that uses mathematical models to calculate path coefficients and mediation effects. The last Output Layer creates the Academic Readiness Profile that compares the processed stress data with the real academic achievement records. Such architecture will guarantee the smooth flow between qualitative human experience and scientific evidence, which will give a strong base to assess student performance.

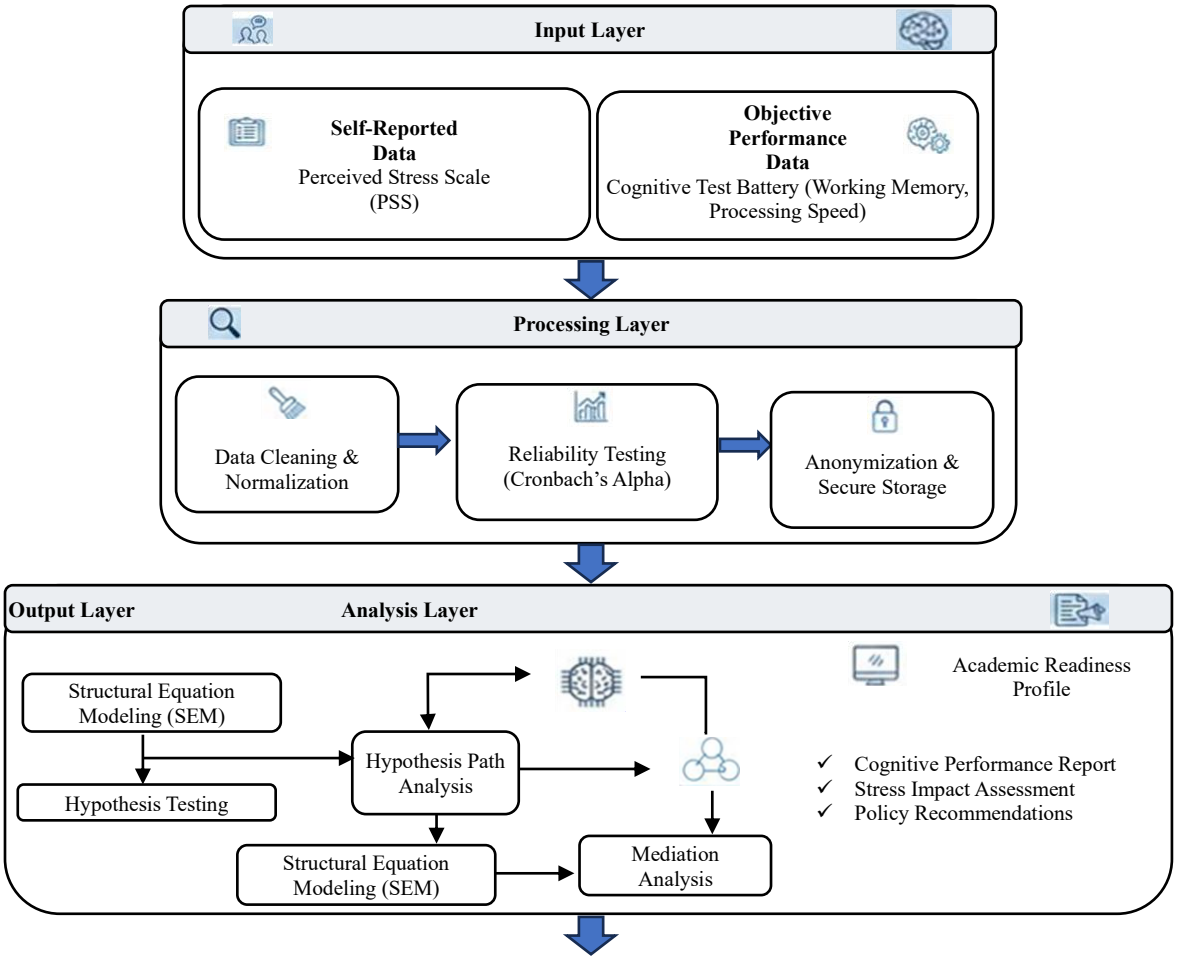

Fig. 1 Longitudinasl Analysis of Academic Readiness in Adult Learners

As Fig. 1 shows, this study examines how long-term Stress has a detrimental effect on cognitive functioning and academic achievement of students in higher grades. With a longitudinal approach and Structural Equation Modeling, the research traces the pathway of the conversion between psychological strain and academic impairment, to offer a technical way that educational institutions can improve the resilience and performance of adult learners.

To validate the hypotheses, the study utilizes a Structural Equation Modeling (SEM) approach. The relationship between the independent variable (Chronic Stress), the mediator (Cognitive Functioning), and the dependent variable (Academic Performance) is defined by the following equations:

Mediator Equation (Cognitive Functioning):

$$C = \beta_0 + \beta_1 S + \epsilon_1 \rightarrow (1)$$

Where C is Cognitive Functioning, S is the Chronic Stress score, β1 is the path coefficient, and ϵ1 is the error term, are shown in equation (1).

Outcome Equation (Academic Performance):

$$A = \beta_0 + \beta_2 C + \beta_3 S + \epsilon_2 \rightarrow (2)$$

Where A is Academic Performance. This equation (2) determines if the effect of Stress (S) on Performance (A) is direct or if it is primarily exerted through the degradation of Cognition (C).

The total effect of Stress on academic success is calculated as in equation (3):

$$Total\ Effect = Direct\ Effect(\beta_3) + (Indirect\ Effect\beta_1 \times \beta_2) \rightarrow (3)$$

This mathematical framework allows the study to pinpoint exactly how much of a student's academic failure is due to brain drain (cognitive impairment) versus other environmental stressors.

IV. Results and Discussion

PLS-SEM was used to analyze the research model. This part presents the empirical findings of the measurement and structural model validation, and then the theoretical and practical implications of the findings must be discussed in detail.

Measurement Model Results

The reliability and validity of the constructs were identified before the hypothesis was tested. Factor loading of all

indicators, such as the Perceived Stress Scale (PSS) and Cognitive Battery, exceeded the suggested value and were above the recommended level of 0.707, which indicated high reliability of the indicators. The internal consistency was verified using Composite Reliability (CR) values of 0.85 to 0.93 and Cronbach's Alpha value of over 0.75. The convergent validity has been determined by the fact that the Average Variance Extracted (AVE) of all constructs was more than 0.50.

TABLE I MEASUREMENT SCALE AND RESEARCH INSTRUMENT

Construct / Variable	Code	Survey Statement (Items)	5	4	3	2	1
Chronic Stress (PSS)	1	I often feel unable to control the important things in my life.	□	□	□	□	□
	2	I am confident about my ability to handle my personal academic problems.	□	□	□	□	□
	3	Difficulties are piling up so high that I cannot overcome them.	□	□	□	□	□
Cognitive Functioning	1	I find it difficult to concentrate on complex academic tasks for long periods.	□	□	□	□	□
	2	I struggle to remember information from lectures during my study sessions.	□	□	□	□	□
	3	My mental processing speed feels slower when I am under high pressure.	□	□	□	□	□
Academic Performance	1	My current CGPA accurately reflects my intellectual potential.	□	□	□	□	□
	2	I am satisfied with my performance in recent standardized examinations.	□	□	□	□	□

Table I operationalizes the latent constructs in the study, linking the theoretical variables to the measurement of the study. It measures the perception of chronic Stress, cognitive utility, and academic success in students using a 5-point Likert scale, which transforms the perception data into measurable information. The systematic approach also guarantees instrument reliability and content validity, which offers a clear basis for further PLS-SEM analysis and the reproducibility of the research results.

Structural Model and Hypothesis Testing

The structural model was evaluated to test the predictive value and the meanings of the path coefficients. The hypothesis was tested using a bootstrapping analysis with 5,000 subsamples.

TABLE II STRUCTURAL MODEL PATH ANALYSIS AND HYPOTHESIS TESTING

Hypothesis	Path	Coefficient (β)	t-value	p-value	Result
H1	Chronic Stress → Cognitive Functioning	-0.48	5.12	< 0.001	Supported
H2	Cognitive Functioning → Academic Performance	0.55	6.40	< 0.001	Supported

Table II results reflect that chronic Stress has a strong negative impact on Cognitive Functioning (β = -0.48). On the other hand, there is a strong positive impact of Cognitive Functioning on Academic Performance (β = 0.55). Hypotheses H 0 are both statistically significant at the 99.0 level with a t-value of greater than 1.96. The model had an R^2 of 0.64, which suggests that stress and cognitive variables accounted 64 % of the variance in academic performance.

The following mathematical formulas were used to calculate the critical metrics for model validation are represented in equation (4), (5):

Average Variance Extracted (AVE): Used to assess convergent validity.

$$AVE = \frac{\sum \lambda_i^2}{\sum \lambda_i^2 + \sum var(\epsilon_i)} \rightarrow (4)$$

(Where λ represents factor loadings and ϵ is the error variance.)

Path Significance (t-value): Calculated to determine if the relationship is statistically different from zero.

$$t = \frac{\beta}{SE_\beta} \rightarrow (5)$$

(Where β is the path coefficient and SE is the standard error.)

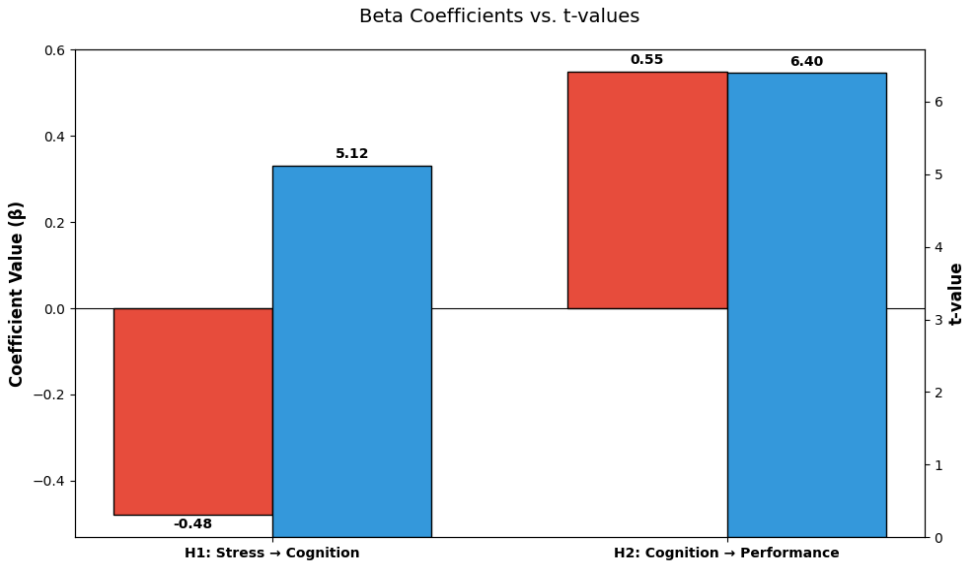

Fig. 2 Statistical Validation of the Stress-Cognition-Performance Path Model

Fig. 2 shows the empirical results of the structural model that compares the standardized path coefficients (B) to t-values. H1 (β = -0.48) was proved to be an inverse relationship, which proves that chronic Stress is a significant degradation of cognitive utility. On the other hand, H2 (β = 0.55) places cognitive functioning as one of the main determinants of academic achievement, and both directions are over the critical t-value of 1.96.

Interpretation of Results

The fact that the support of H1 (β = -0.48, $p < 0.001$) is realized proves that chronic Stress is a physiological burden on the brain hardware. This is in line with the results, which observed the changes in perceived Stress to have a direct relationship with a decline in cognition. This Stress is experienced in older students through slower processing speed, thus difficulty in keeping up with stringent academic programs.

The results of H2 (β = 0.55, t = 6.40) indicate that the academic success of adult learners is primarily due to cognitive functioning. Although the level of Stress impairs performance, the findings suggest that this happens via the intercession of cognitive impairment. This is congruent with the opinion that education and cognitive ability are the ultimate mind under pressure variables.

Implications for Educators and Policymakers

- To Educators: The close correlation between Stress and cognitive failure implies that older students in the curriculum must be provided with cognitive breaks and training in metacognition.

- To the Policymakers: Mental health resources should be a priority for institutions as academic infrastructure. Similar to libraries where one can access books, counseling centers are where one can find the cognitive maintenance to retain the student.

Future research needs to examine the contribution of Environmental Buffers (i.e., physical activity (Teuber et al., 2024) or pet ownership (Friedmann et al., 2023)) as a form of particular moderating variables to the SEM model. Also, a comparative analysis between digital and traditional learning environments may show whether technology-mediated learning increases or decreases the cognitive load of chronic Stress.

V. Conclusion

The investigation into the cognitive cost of chronic Stress among adult learners concludes that psychological strain is a decisive determinant of academic success. By analyzing a stratified sample of 450 adult learners ranging from full-time professionals to part-time students, this research mapped the trajectory from environmental stressors to academic impairment. The empirical evidence confirms that chronic Stress does not merely correlate with poor grades but facilitates a measurable decline in the neural efficiency required for high-level information processing. Statistically, the research validates the predictive power of the proposed model, achieving an R^2 of 0.64, indicating that Stress and cognitive health account for 64% of the variance in academic outcomes within the studied sample. The structural analysis yielded a significant negative path coefficient between chronic Stress and cognitive functioning (β = -0.48, $p < 0.001$), reinforcing the theory that prolonged cortisol exposure degrades working memory. Furthermore, cognitive functioning was found to be the strongest positive predictor of academic achievement (β = 0.55, t = 6.40), acting as the critical mediator through which Stress impacts performance. These results signify that traditional academic support is insufficient if a student's cognitive hardware is compromised. The significance of this study lies in its shift toward a holistic view of readiness, positioning mental health as core academic

infrastructure. Future research should expand this model using Machine Learning algorithms to predict burnout in real-time. Additionally, exploring the moderating effects of "Environmental Buffers" like digital metacognitive tools could provide a roadmap for developing more resilient educational ecosystems for the 21st-century learner.

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