

Grit as a Mediator for Medical Students: The Impact of Pre-medical Background and Demographics on Academic Success and Resilience

Myzel C. Moreno¹

¹Student, School of Health Sciences, MAPUA University in collaboration with Arizona University, Metro Manila, Philippines

Corresponding Author: morenomyzelcc@gmail.com

Abstract— The study examined grit as the mediating factor between pre-medical background, demographics (age, gender, and socioeconomic status), and its impact on academic success and resilience among medical students. Due to the unique and challenging demands of medical school, understanding how previous academic backgrounds and personal attributes shape grit (defined as perseverance and passion for long-term goals) can provide valuable insights into students' abilities to handle academic pressure, and continue the goal of becoming a medical doctor.

Index Terms—Grit Scale, Medical Students, Pre-med Courses, Academic Success, Resilience.

1. Introduction

The construct of grit, defined as the sustained perseverance and passion for long-term goals, has emerged as a critical area of research in psychology, particularly concerning its implications for academic success and resilience (Duckworth et al. 2007). Grit has been shown to be a significant predictor of both academic performance and achievement in various domains, which surpass traditional metrics such as intelligence (IQ) and talent (Duckworth et al., 2007; Crede et al., 2017). As such, understanding grit is very much relevant in the medical education, medical students encounter a unique set of challenges that require not only intellectual capability but also determination and resilience. Medical students face numerous challenges that can impede their academic performance and overall well-being.

These challenges include high levels of stress, time management issues, financial burdens, and emotional toll of clinical experiences (Alpha Academy, 2024). Such stressors contribute to elevated levels of anxiety, burnout, depression, and ultimately affect academic performance and mental health (Dyebye et al., 2005; Shanafelt et al., 2012). Acquiring attributes such as grit is essential for enhancing resilience and sustaining motivation, which can enable medical students to handle the challenges of their education and maintain commitment to the medical profession successfully.

The significance of grit is underscored by its relationship with essential psychological constructs, such as emotional intelligence, self-regulation, and adaptability (Wong et al., 2020). These constructs are vital for medical students as they develop the skills necessary for effective patient care and professional growth. The South African College of Applied Psychology (SACAP) emphasizes that grit plays a fundamental role in personal and professional success, highlighting its importance in persevering through challenges and achieving long-term aspirations (SACAP, 2019). Despite the existing studies with grit, a notable gap remains regarding its specific application to medical students. The widely utilized Grit Scale, developed by Duckworth, may not fully capture the unique experiences and contextual factors affecting grit in the field of medicine. Medical students come from diverse backgrounds of pre-medical courses (such Biology, Biochemistry, Psychology, Physical Therapy, Medical Technology, Pharmacy, and Nursing) that may influence grit levels, academic success, and resilience. Furthermore, factors such as socioeconomic status in the demographics may influence the expression of grit (Ryu et al., 2020).

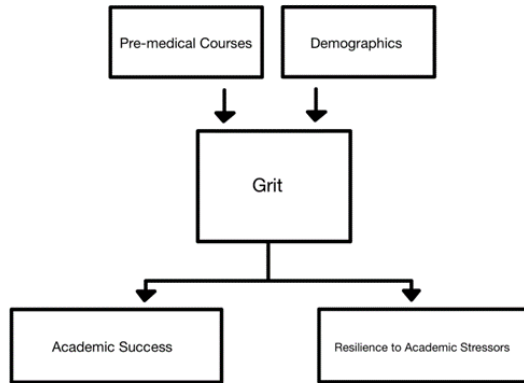
Due to the comprehensive medical education, which prioritizes student well-being alongside academic achievement, there is a compelling need to develop a grit measure specifically for the population of students pursuing the Doctor of Medicine.

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This study aims to address the gap by using the Grit Scale as a mediator for exploring the impact of pre-medical courses and demographics in the academic success and resilience of the medical students. By focusing on these variables, the researchers aim to understand how previous premedical courses and demographics impact the academic success within medical education.

A. Conceptual Framework



Hypotheses:

H1: Medical students from pre-medical courses, particularly Medical Technology, will demonstrate higher levels of grit, which will positively influence their academic success.

H2: Demographic factors such as age, gender, and socioeconomic status significantly influence the levels of grit in medical students, which in turn contributes to their resilience to academic stressors.

H3: Grit mediates the relationship between pre-medical courses and academic success in medical students.

H4: Medical students with higher levels of grit will demonstrate greater resilience to academic stressors.

H5: Medical students from science-related pre-medical courses, particularly Psychology, will demonstrate higher levels of grit, which will lead to greater resilience to academic stress rather than academic success.

1) Independent Variables

Premedical Courses: Science-related courses such as Biology, Biochemistry, Psychology, Physical Therapy, Medical Technology, Pharmacy, and Nursing may represent academic preparation and background that may influence grit levels.

Demographics: Age, older students may exhibit higher grit levels due to their life experience and developed perseverance. Gender differences in terms of coping strategies and persistence may impact grit and resilience. Socioeconomic Status, access to academic resources may contribute stress and challenge resilience.

2) Mediator

Grit: pertains to the perseverance and passion towards long-

term goals (Duckworth, 2007). For the mediation role, this can explain how premedical background and demographics can impact academic success and resilience. Students with higher grit are expected to achieve better outcomes.

3) Dependent Variables

Academic Success: these represent the objective academic achievement such as GPA and exam scores, which are highly relevant in medical school.

Resilience to Academic Stressors: refers to the ability to handle stress effectively and recover from academic setbacks. Medical students with higher levels of grit can cope with the high-pressure environment of medical school and use adaptive coping strategies.

B. Rationale

Developing a Grit Scale specifically for medical students is essential for the perseverance and resilience necessary to excel in the demanding field of medicine. Medical school presents numerous challenges, such as long hours, emotional stress, and high academic expectations. Grit, defined as the combination of perseverance and passion for long-term goals, has been shown to help students navigate these difficulties and achieve success (Duckworth et al., 2007). In this study, the grit serves as a mediator between independent variables, such as premedical backgrounds and demographic factors, and dependent variables, such as academic success and resilience to stressors. By incorporating these variables into the Grit Scale, the educators can gain a deeper understanding with regards to how different premedical backgrounds (such as Biology, Biochemistry, Psychology, Physical Therapy, Medical Technology, Pharmacy, and Nursing) and demographics (such as age, gender, and socioeconomic status) influence medical students' levels of grit, which in turn impacts the academic performance and resilience to academic stressors.

A Customized Grit Scale would enable the identification of students who may need additional support, and the implementation of targeted interventions to enhance their motivation and resilience. This comprehensive approach not only helps students remain focused and engaged but also prepares them to effectively navigate the challenges of their future medical careers of becoming a medical doctor. Grit ensures that these future doctors are not only academically capable but also resilient in the face of challenges, equipped to thrive in the complexities of the medical profession.

C. The Present Research

Angela Duckworth's concept of "grit," defined as a combination of passion and perseverance, has gained significant recognition in both academic and popular discussions. However, the Grit Scale, which was developed to measure this trait, has certain limitations that warrant critical evaluation. One key concern is the context-specific nature of Duckworth's original studies (Denby, 2016). The assumption that grit consistently correlates with success in particular

environments raises questions about the generalizability of these findings to broader contexts. Success in a specific domain may be influenced by diverse factors unrelated to grit, complicating the interpretation of results, and limiting the scale's applicability to other populations.

In medical education, the development of a Grit Scale specifically for medical students could provide valuable insights into their academic success and resilience to stressors. Research indicates that grit is a significant predictor of academic performance among medical students (Miller-Matero et al., 2018; Sharma, 2020). Therefore, a customized Grit Scale would more accurately assess the unique challenges faced by these students. Medical students encounter intense academic demands, alongside emotional and psychological stressors. Traditional grit assessments may not fully capture the specific traits needed to thrive in such a high-stakes environment. A scale developed for medical students could incorporate essential factors such as adaptability to clinical settings and the ability to manage burnout risks (Yamawaki, 2020). This customized scale would provide more relevant data for educators and administrators, helping them better understand the traits necessary for success in medical training.

Additionally, measuring grit through a specialized scale could provide interventions aimed at improving student well-being and academic performance. By identifying students with lower grit scores early in the medical education, institutions could implement targeted support programs that can promote resilience and effective coping strategies (Sharma, 2020). This proactive approach is aligned with contemporary educational practices that emphasize holistic student development. Ultimately, the development of a Grit Scale for medical students is not only beneficial but essential for preparing future healthcare professionals to navigate the demands of their roles effectively.

2. Methodology

A. Research Design

The research design for the development of a grit scale among medical students employs a quantitative approach, specifically utilizing a Likert scale within the Grit Scale framework (such as "Not at all like me" to "Very much like me"). This method is particularly effective for measuring psychological constructs such as grit, which encompasses perseverance and passion for long-term goals (Duckworth et al., 2007). The Likert scale allows for the quantification of students' self-reported grit levels, enabling statistical analyses to examine correlations between grit and key outcomes in medical education, such as academic performance and resilience to stressors.

In the context of medical education, empirical studies have shown a significant relationship between grit and academic performance. For example, Miller-Matero et al. (2018) found

that higher levels of grit were associated with better clinical knowledge scores and a shorter time to graduation among medical students. These findings highlight the value of using validated tools, such as the Grit Scale, to assess this trait across diverse student populations, ensuring the reliability and accuracy of the measurements (Credé et al., 2017).

Furthermore, the study will use principal component analysis, exploratory factor analysis, and reliability analysis to evaluate the structured items, and identify the validity, and internal consistency of the Grit-MD scale. Principal Component Analysis (PCA) will identify the main components within the scale, while the Exploratory Factor Analysis (EFA) will explore the constructs and ensure that the scale accurately reflects the dimensions of grit specific to medical students. Reliability Analysis, using the cronbach's alpha, will assess the internal consistency of each variable to confirm that the items measure the intended construct. These analyses are essential to provide comprehensive results, ensuring that the items are reliable and valid for the medical students.

B. Samples and Sampling Techniques

The targeted population for this study comprises medical students enrolled in accredited medical institutions. Medical students represent a unique cohort facing high levels of academic pressure and stress, making them particularly relevant for exploring the construct of grit, which is defined as perseverance and passion for long-term goals (Duckworth et al., 2007). The sample size will consist of approximately 105 participants, providing significant support for the statistical analysis. Simple random sampling will be utilized as the sampling technique to ensure that every medical student in selected medical institutions has an equal chance of being selected, thereby reducing selection bias, and enhancing the representativeness of the data. This method not only supports the integrity of the research but also contributes valuable insights into the role of grit in medical training and its implications for academic performance and resilience to stressors.

C. Instrumentation

1) Grit Scale (Adaptation for Medical Students)

The Grit Scale, created by Angela Duckworth, is a tool that evaluates the two key dimensions such as perseverance and passion for long-term goals. The scale is essential in assessing how individuals maintain focus and effort over extended periods, specifically in challenging situations. Since medical education is demanding, developing a scale fit for the medical students can further provide an understanding with how grit impacts academic performance.

2) Number of Items

The adaptation of the Grit Scale (by Angela Duckworth) for medical students, Grit-MD: The Medical Student Grit Scale, will be composed of 35 items divided into 5 variables (pre-medical courses, demographics, grit, academic success, and

resilience) with 7 items each. The modified scale will use Grit as a mediator to assess the role of premedical courses and demographics in academic success and resilience of the medical students.

3) *Response Format*

The participants will respond to each statement on the adapted Grit Scale using a 5-point Likert scale, which captures the level of which they agree and disagree. This type of response format allows the participants to express more specific feedback and can provide further understanding of their experiences with Grit. The scale is structured as follows: 1 indicates “Not at all like me”, 2 indicates “Mostly not like me”, 3 corresponds to “Somewhat like me”, 4 corresponds to “Mostly like me”, and a score of 5 corresponds to “Very much like me”.

D. *Procedures for Data Collection*

The data collection aims to assess grit among medical students using an adapted Grit Scale as a mediator, and will adhere to a systematic and ethical approach. The target population includes medical students currently enrolled in the Doctor of Medicine program at accredited medical institutions. The recruitment of participants will be conducted through online platforms, specifically Facebook and Instagram, where announcements will be posted within relevant medical student groups and forums. These announcements will provide a clear overview of the study, emphasizing its significance and the importance of participants’ contributions. To facilitate informed participation, the potential participants will receive an informed consent form outlining the study’s objectives, procedures, potential risks, and benefits. Consent must be obtained prior to participation to uphold ethical standards. A simple random sampling method will be employed to achieve a target sample size 105 participants, ensuring that each individual has an equal opportunity to participate in the study. This method is essential for minimizing bias and enhancing the generalizability of the findings.

Data collection will utilize an adapted version of the Grit Scale specifically designed to reflect the constructs of perseverance and passion within medical education. The scale will incorporate a 5-point Likert-type response format, with response options ranging from “1 = Not like me at all” to “5 = Very much like me.” This format will allow participants to assess their perspective with various statements regarding their levels of grit. The survey will be administered via Google Forms, which offers an organized, secure and user-friendly platform for participants to complete the assessment. The survey will be accessible for a duration of two weeks, during which participants will be encouraged to respond at their convenience. To ensure confidentiality, all responses will be anonymous, ensuring that no identifiable information is linked to every survey submission. Data collected through the Google Forms survey will be systematically organized for analysis,

focusing on the statistical evaluation of grit scores in relation to demographic variables and previous academic experiences.

Relevant ethical considerations will be prioritized throughout the data collection process, including obtaining Institutional Review Board (IRB) approval to safeguard participant rights and welfare. Upon completion of the data collection phase, participants will receive a debriefing that provides insights into the study’s objectives and its relevance to the medical education community. The debriefing will also include information on how the findings may contribute to enhancing support systems for medical students.

E. *Data Analysis*

The following data analysis techniques that are essential to validate the scale and examine the relationships between the variables:

- Principal Component Analysis (PCA): PCA will be conducted per variable to identify the items that capture the most variance in the dataset. Varimax rotation will be applied to clarify item grouping.
- Exploratory Factor Analysis (EFA): EFA will be conducted to identify the underlying structure of the modified grit scale. The goal is to determine if distinct factors emerge as expected (Floyd & Widaman, 1995). Principal components analysis with varimax rotation will be first used to identify and interpret factors.
- Reliability Analysis: Cronbach’s alphas will be used to assess the internal consistency of each factor (pre-medical background, demographics, grit, academic success, and resilience). The analysis will be essential to confirm that items within each factor consistently measure the intended construct. Reliability values above 0.7 will be acceptable and consistent, this will verify the reliability of the factors, and the overall scale.

F. *Grit-MD: The Medical Student Grit Scale (35 Items)*

1) *Premedical Background*

- My premedical education has provided me with a strong foundation for my medical studies.
- I have developed effective study habits during my premedical education that I continue to use in medical school.
- I often reflect on how my premedical background shapes my approach to learning in medical school.
- My premedical background has helped me develop critical thinking skills that are essential for medical school.
- The hands-on experiences I gained during my premedical course have increased my confidence in clinical settings.
- My premedical studies have equipped me with time management skills that I apply in medical school.

- The research projects I participated in during my premedical studies have enhanced my understanding of medical concepts.

2) Demographics (Influence of Age, Gender, and Socioeconomic Status)

- My age has influenced my approach to studying and managing stress in medical school.
- I feel that my gender impacts my experiences in the academic environment.
- My socioeconomic background shapes my access to resources and support during my medical education.
- My socioeconomic status influences my relationship with peers in medical school.
- I am capable of learning medicine regardless of my age.
- I believe I am capable of learning medicine regardless of my gender.
- I believe I am capable of learning medicine regardless of my socioeconomic status.

3) Grit

- I am fully committed to my long-term goal of becoming a medical doctor, regardless of the difficulties I encounter in medical school.
- I consistently work hard, even when faced with difficult challenges such as retdems, and practical exams
- I never give up when I encounter setbacks in my medical education, such as receiving lower-than-expected grades.
- I believe that every challenge in my studies is an opportunity for growth and improvement.
- I have overcome difficulties during my medical education.
- Setbacks motivate me to learn more in medical school.
- I always push through difficulties in medical school.

4) Academic Success

- I feel more confident in my academic abilities in medical school due to the foundational knowledge I acquired from my previous pre-med program.
- I believe that my success in medical school is a result of the grit I developed during my earlier education.
- I actively reflect on my performance to identify areas for improvement in my studies.
- I never felt passive in learning new concepts in medical school.
- I always participate in learning sessions pertaining to my studies.

- I am open to more opportunities that offer a high understanding in the field of medicine.
- I always give my best performance in being part of the training about medical studies.

5) Resilience to Academic Stressors

- I manage the stress of medical school better due to the perseverance I built during my pre-medical studies.
- I believe that my grit allows me to stay resilient in medical school despite facing various stressors.
- I maintain a support network of friends and mentors to help manage academic stress.
- I often use stress management techniques to maintain my focus during high-pressure situations.
- I regularly engage in self-care practices to support my mental health during stressful periods.
- My belief in myself helps me get through all the challenges I encounter in medical school.
- I can thrive in a stressful environment like medical school

3. Results And Discussion

Principal Component Analysis for Pre-Medical Background

Component Loadings

	Component	
	1	Uniqueness
1. My premedical education has provided me with a strong foundation for my medical studies.	0.748	0.440
2. I have developed effective study habits during my premedical education that I continue to use in medical school.	0.662	0.561
3. I often reflect on how my premedical background shapes my approach to learning in medical school.	0.719	0.483
4. My premedical background has helped me develop critical thinking skills that are essential for medical school.	0.755	0.430
5. The hands-on experiences I gained during my premedical course have increased my confidence in clinical settings.	0.713	0.491
6. My premedical studies have equipped me with time management skills that I apply in medical school.	0.564	0.682
7. The research projects I participated in during my premedical studies have enhanced my understanding of medical concepts.	0.639	0.591

Note. 'varimax' rotation was used

The results of the Principal Component Analysis (PCA) indicated that all items loaded positively on a single component after a varimax rotation, suggesting a cohesive factor representing “pre-medical preparation for medical school.” Each item showed moderate to high loadings (0.564 to 0.755), signifying a significant contribution to the component. High loadings on items such as “strong foundation” (0.748), “critical thinking” (0.755), and “clinical confidence” (0.713) suggested that these items in pre-medical education contribute meaningfully to the underlying factor. The single component appeared to highlight essential skills developed during pre-medical studies, such as critical thinking, effective study habits, and hands-on experience, which students felt supported their readiness for medical school. Higher uniqueness values, as seen in items such as “time management skills” (0.682), indicated

that some aspects of the pre-medical experience may have unique variance that are not fully explained by the component. The use of varimax rotation, aimed at maximizing the variance in item loadings, enhanced interpretability but did not significantly alter findings in the case of a single component. Overall, the PCA results supported an essential factor reflecting students' perceptions of how the pre-medical background had equipped them for medical school.

Principal Component Analysis for Demographics (Age, Gender, Socioeconomic Status)

Component Loadings	Component		Uniqueness
	1	2	
R1 SCORE My age has influenced my approach to studying and managing stress in medical school.	0.587	0.652	
R2 SCORE I feel that my gender impacts my experiences in the academic environment.	0.681	0.509	
R3 SCORE My socioeconomic background shapes my access to resources and support during my medical education.	0.655	0.549	
R4 SCORE My socioeconomic status influences my relationship with peers in medical school.	0.673	0.541	
5. I am capable of learning medicine regardless of my age.	0.855	0.257	
6. I believe I am capable of learning medicine regardless of my gender.	0.831	0.310	
7. I believe I am capable of learning medicine regardless of my socioeconomic status.	0.543	0.652	

Note. 'varimax' rotation was used

The Principal Component Analysis (PCA) for demographics (Age, Gender, and Socioeconomic Status) revealed two components after varimax rotation. The loadings suggested the distribution of items across the two components and their respective uniqueness values. The first component showed high loadings for items related to age (0.855), gender (0.831), and socioeconomic status (0.543), indicating that these items primarily contributed to this component, which likely reflected students' perceptions of their capability to learn medicine despite demographic factors. The second component showed loadings for the R1, R2, R3, and R4 scores, suggesting that these items were more influenced by other factors, potentially capturing a different dimension of students' perspectives. The uniqueness values, ranging from 0.257 to 0.652, indicated the variance in each item not explained by the components. Overall, this PCA suggested that perceptions of age, gender, and socioeconomic status formed one distinct factor, while other variables contributed to a separate factor.

Principal Component Analysis for Grit

Component Loadings	Component		Uniqueness
	1	2	
1. I am fully committed to my long-term goal of becoming a medical doctor, regardless of the difficulties I encounter in medical school.	0.713	0.491	
2. I consistently work hard, even when faced with difficult challenges such as retests, and practical exams.	0.638	0.593	
3. I never give up when I encounter setbacks in my medical education, such as receiving lower-than-expected grades.	0.671	0.550	
4. I believe that every challenge in my studies is an opportunity for growth and improvement.	0.737	0.456	
5. I have overcome difficulties during my medical education.	0.634	0.598	
6. Setbacks motivate me to learn more in medical school.	0.785	0.383	
7. I always push through difficulties in medical school.	0.814	0.337	

Note. 'varimax' rotation was used

The Principal Component Analysis (PCA) for grit revealed a single component after varimax rotation, indicating a cohesive factor related to perseverance and determination in medical education. All items loaded positively on this component, with loadings ranging from 0.634 to 0.814, showing a significant contribution from each item. High loadings on items such as "I always push through difficulties in medical school" (0.814), "Setbacks motivate me to learn more in medical school" (0.785), and "I am fully committed to my long-term goal of becoming a medical doctor" (0.713) suggested that these aspects of grit like commitment, resilience, and persistence were useful components of the factor. The uniqueness values, ranging from 0.337 to 0.593, indicated the variance in each item not explained by the component, with items such as "Setbacks motivate me to learn more in medical school" having a higher uniqueness value, suggesting that some aspects of grit may have captured unique variance not fully represented by the component. Overall, the PCA results supported a unified factor that reflected students' grit and their ability to overcome challenges in medical education.

Principal Component Analysis for Academic Success

Component Loadings	Component	
	1	Uniqueness
1. I feel more confident in my academic abilities in medical school due to the foundational knowledge I acquired from my previous pre-med program.	0.508	0.742
2. I believe that my success in medical school is a result of the grit I developed during my earlier education.	0.687	0.528
3. I actively reflect on my performance to identify areas for improvement in my studies.	0.747	0.443
4. I never felt passive in learning new concepts in medical school.	0.664	0.559
5. I always participate in learning sessions pertaining to my studies.	0.737	0.457
6. I am open to more opportunities that offer a high understanding in the field of medicine.	0.683	0.534
7. I always give my best performance in being part of the training about medical studies.	0.635	0.597

Note. 'varimax' rotation was used

The results of the Principal Component Analysis (PCA) for academic success revealed a single component after varimax rotation, indicating a cohesive factor related to students' academic performance in medical school. All items loaded positively on the component, with loadings ranging from 0.508 to 0.747, showing a significant contribution from each item. High loadings on items such as "I actively reflect on my performance to identify areas for improvement in my studies" (0.747), "I always participate in learning sessions pertaining to my studies" (0.737), and "I believe that my success in medical school is a result of the grit I developed during my earlier education" (0.687) suggested that factors such as self-reflection, participation, and grit were key elements contributing to academic success. The uniqueness values, ranging from 0.443 to 0.742, indicated the variance in each item not explained by the component, with "I feel more confident in my academic abilities in medical school due to the foundational knowledge I acquired from my previous pre-med program" having a higher uniqueness value, suggesting it captured unique

variance not fully represented by the component. Overall, the PCA results supported a unified factor reflecting students' perceptions of their academic success in medical school.

Principal Component Analysis for Resilience to Academic Stressors

Component Loadings

	Component	
	1	Uniqueness
1. I manage the stress of medical school better due to the perseverance I built during my pre-medical studies.	0.600	0.641
2. I believe that my grit allows me to stay resilient in medical school despite facing various stressors.	0.759	0.424
3. I maintain a support network of friends and mentors to help manage academic stress.	0.711	0.494
4. I often use stress management techniques to maintain my focus during high-pressure situations.	0.756	0.429
5. I regularly engage in self-care practices to support my mental health during stressful periods.	0.709	0.497
6. My belief in myself helps me get through all the challenges I encounter in medical school.	0.719	0.483
7. I can strive in a stressful environment like medical school.	0.671	0.549

Note. 'varimax' rotation was used

The results of the Principal Component Analysis (PCA) for resilience to academic stressors revealed a single component after varimax rotation, indicating a cohesive factor related to students' ability to cope with the stresses of medical school. All items loaded positively on the component, with loadings ranging from 0.600 to 0.759, showing a significant contribution from each item.

Exploratory Factor Analysis

Factor Loadings

	Factor			Uniqueness
	1	2	3	
1. My premedical education has provided me with a strong foundation for my medical studies.	0.7	20		0.474
2. I have developed effective study habits during my premedical education that I continue to use in medical school.	0.5	54		0.599
3. I often reflect on how my premedical background shapes my approach to learning in medical school.	0.6	61		0.423
4. My premedical background has helped me develop critical thinking skills that are essential for medical school.	0.6	82		0.503
5. The hands-on experiences I gained during my premedical course have increased my confidence in clinical settings.	0.7	31		0.463
6. My premedical studies have equipped me with time management skills that I apply in medical school.	0.4	38	0.4	0.620
7. The research projects I participated in during my premedical studies have enhanced my understanding of medical concepts.	0.4	88		0.700
R1 SCORE My age has influenced my approach to studying and managing stress in medical school.				0.936
R2 SCORE I feel that my gender impacts my experiences in the academic environment.				0.902
R3 SCORE My socioeconomic background shapes my access to resources and support during my medical education.				0.961
R4 SCORE My socioeconomic status influences my relationship with peers in medical school.				0.821
5. I am capable of learning medicine regardless of my age.				0.839
6. I believe I am capable of learning medicine regardless of my gender.	0.5	09		0.737
7. I believe I am capable of learning medicine regardless of my socioeconomic status.				0.885
1. I am fully committed to my long-term goal of becoming a medical doctor, regardless of the difficulties I encounter in medical school.	0.6	04		0.571
2. I consistently work hard, even when faced with difficult challenges such as retests, and practical exams.	0.4	33		0.607
3. I never give up when I encounter setbacks in my medical education, such as receiving lower-than-expected grades.	0.5	56		0.640
4. I believe that every challenge in my studies is an opportunity for growth and improvement.	0.5	70		0.560
5. I have overcome difficulties during my medical education.	0.6	37		0.583
6. Setbacks motivate me to learn more in medical school.	0.5	58		0.546
7. I always push through difficulties in medical school.	0.6	08		0.382

High loadings on items like “I believe that my grit allows me to stay resilient in medical school despite facing various stressors” (0.759), “I often use stress management techniques to maintain my focus during high-pressure situations” (0.756), and “I manage the stress of medical school better due to the perseverance I built during my pre-medical studies” (0.600) suggested that resilience, grit, and effective stress management techniques were key factors contributing to students' ability to handle academic stressors. The uniqueness values, ranging from 0.424 to 0.549, indicated the variance in each item not explained by the components, with “I can strive in a stressful environment like medical school” having a higher uniqueness value, suggesting that some aspects of resilience may have captured unique variance not fully represented by the components. Overall, the PCA results supported a unified factor reflecting students' resilience to academic stressors in medical school.

1. I feel more confident in my academic abilities in medical school due to the foundational knowledge I acquired from my previous pre-med program.	0.7	57		0.365
2. I believe that my success in medical school is a result of the grit I developed during my earlier education.	0.6	32		0.445
3. I actively reflect on my performance to identify areas for improvement in my studies.			0.4	0.674
4. I never felt passive in learning new concepts in medical school.	0.4	74		0.719
5. I always participate in learning sessions pertaining to my studies.	0.6	16		0.593
6. I am open to more opportunities that offer a high understanding in the field of medicine.	0.4	41	0.5	0.534
7. I always give my best performance in being part of the training about medical studies.	0.4	88		0.699
1. I manage the stress of medical school better due to the perseverance I built during my pre-medical studies.	0.6	61		0.442
2. I believe that my grit allows me to stay resilient in medical school despite facing various stressors.	0.4	85		0.528
3. I maintain a support network of friends and mentors to help manage academic stress.	0.5	10		0.650
4. I often use stress management techniques to maintain my focus during high-pressure situations.	0.6	81		0.487
5. I regularly engage in self-care practices to support my mental health during stressful periods.	0.6	62		0.538
6. My belief in myself helps me get through all the challenges I encounter in medical school.	0.7	20		0.382
7. I can strive in a stressful environment like medical school.	0.4	63	0.4	0.581

Note. 'Minimum residual' extraction method was used in combination with a 'varimax' rotation

In the Exploratory Factor Analysis (EFA), three distinct factors were identified, which was able to provide insights into how medical students' experiences in pre-medical education, grit, and academic success contribute to their current medical education. The analysis was conducted using the varimax rotation method, which aimed to create clear and interpretable factor structures.

The first factor, include items related to pre-medical education and foundational skills, such as the development of critical thinking skills, study habits, and confidence in clinical settings. Items like “My premedical education has provided me with a strong foundation for my medical studies” (0.720) and “The hands-on experiences I gained during my premedical course have increased my confidence in clinical settings” (0.731) suggest that students perceived the pre-medical

education as essential to their medical school readiness. The second factor, Grit, captures the perseverance and passion for long term goals that are necessary for academic success in a demanding environment like medical school. Items such as “I am fully committed to my long-term goal of becoming a medical doctor, regardless of the difficulties I encounter in medical school” (0.604) and “I always push through difficulties in medical school” (0.696) reflect how grit helps students stay motivated and overcome challenges. The third factor, focused on students’ academic success. Items such as “I feel more confident in my academic abilities in medical school due to the foundational knowledge I acquired from my previous pre-med program” (0.757) and “I actively reflect on my performance to identify areas for improvement in my studies” (0.674), highlighting the importance of self-assessment and continued academic growth. Some of the items had higher uniqueness values, which means that these items contribute more variance that was not fully captured by the three factors. For instance, “I believe I am capable of learning medicine regardless of my gender” (0.737) and “I regularly engage in self-care practices to support my mental health during stressful periods” (0.662) appear to capture individual aspects of resilience and self-management that are not as strongly tied to the broader factors. Overall, the results were able to suggest that medical students’ preparedness and resilience are shaped by a combination of foundational pre-medical education, grit, and a reflective approach to their academic performance.

A. Reliability Analysis for Pre-Medical Background

Scale Reliability Statistics	
Cronbach's α	
scale	0.810

The reliability analysis for the Pre-Medical Background revealed Cronbach's α of 0.810, indicating strong internal consistency. This suggested that the items within the scale were able to measure a single underlying construct—students’ perceptions of how the pre-medical education had contributed to their preparedness for medical school. A Cronbach’s α value above 0.70 is generally regarded as acceptable, with higher values indicating more reliable measurement. Therefore, the obtained value of 0.810 demonstrated a high degree of reliability, supporting the scale’s effectiveness in assessing the intended construct.

B. Reliability Analysis for Demographics (Age, Gender, Socioeconomic Status)

Scale Reliability Statistics	
Cronbach's α	
scale	0.533

Demographics do not require internal consistency as they represent distinct characteristics rather than traits or constructs that should correlate with each other. Despite the low Cronbach’s α value, the factor analysis has still been helpful in identifying how these demographic factors (age, gender, socioeconomic status) may relate to other variables in the study, providing context for interpreting participants’ responses. Therefore, the analysis remains a useful tool for understanding the potential influence of demographic variables in the context of the scale development.

C. Reliability Analysis for Grit

Scale Reliability Statistics	
Cronbach's α	
scale	0.834

The reliability analysis for the Grit revealed Cronbach's α of 0.834, which indicated good internal consistency. This value suggested that the items on the Grit were able to reliably measure the underlying construct, making the scale a trustworthy tool for assessing grit for medical students.

D. Reliability Analysis for Academic Success

Scale Reliability Statistics	
Cronbach's α	
scale	0.781

The reliability analysis for the Academic Success revealed Cronbach's α of 0.781, indicating good internal consistency. The value suggested that the items on the Academic Success reliably measured the same underlying construct.

E. Reliability Analysis for Resilience to Academic Stressors

Scale Reliability Statistics

Cronbach's α	
scale	0.822

The reliability analysis for the Resilience to Academic Stressors scale revealed a Cronbach's α of 0.822, indicating good internal consistency. This value suggested that the items on the scale reliably measured the same underlying construct. A Cronbach's α value above 0.8 is considered excellent, supporting the scale's reliability as an effective tool for assessing resilience to academic stressors in the study.

F. Discussion

The study was able to develop and validate a comprehensive scale measuring constructs that significantly influence the performance of medical students in medical education, including pre-medical background, demographic factors, grit, academic success, and resilience to academic stressors. The findings were able to support the scale's effectiveness in assessing these constructs, and its utility for future research in medical education.

G. Pre-medical Background

The results from the factor analysis confirm that pre-medical background is an influential determinant of academic success in medical school. Students with a background in disciplines such as Biology, Biochemistry, Psychology, Physical Therapy, Medical Technology, Pharmacy, and Nursing performed significantly better academically. The findings are consistent with the literature that highlights the importance of a strong foundation in the sciences, which facilitates the comprehension of medical school curricula and overall academic performance (Siegler et al., 2012). The data also suggested that specific pre-medical coursework serves as a strong predictor of how well students adjust to the academic rigors of medical education. This outcome implies that pre-medical preparation can act as a safeguard, providing students with the knowledge, and cognitive skills necessary to excel in a demanding educational environment. Accordingly, these findings suggested the need for medical institutions to consider the pre-medical experiences when designing support structures, ensuring that students from diverse educational backgrounds have an equal opportunity to succeed.

H. Demographics

The study also assessed the role of demographic factors, such as the influence of age, gender, and socioeconomic status, in shaping academic outcomes and resilience of the medical

students. Although demographic factors did not emerge as distinct constructs in the factor analysis, the influence on students' experiences and outcomes are still relevant. Specifically, younger students, and those from higher socioeconomic background tended to have greater resilience, and higher levels of grit. The findings are supported by existing research that points to the advantages of socioeconomic resources in promoting academic success, particularly in highly competitive fields such as medicine (McLoyd, 1998). Furthermore, age-related differences in resilience may reflect the varying levels of maturity, and life experience that impact students' coping strategies, with older students potentially demonstrating greater emotional regulation, and stress-management skills.

I. Grit

Grit (commonly known as perseverance and passion for long-term goals) plays a significant role in predicting academic success, especially in achieving success in challenging environments (Duckworth et al., 2007). The scale's focus on persistence in the face of adversity, and commitment to long-term goals was a reliable predictor of students' self-reported academic achievement. Students who scored higher on the grit measures demonstrated greater persistence and resilience, suggesting that grit serves as an essential trait for success in medical school. These results revealed the importance of obtaining grit in medical education, as it can significantly influence the ability to navigate the often-overwhelming demands of medical school.

J. Academic Success

Academic success in the study was primarily measured through perceived academic performance, with a clear association between grit, pre-medical background, and academic achievements. The findings supported the hypothesis that academic performance is influenced by both intrinsic factors like grit and extrinsic factors such as the knowledge base provided by pre-medical courses. This aligns with prior studies suggesting that intrinsic motivation, and foundational academic preparation are crucial predictors of medical students' success (Siegler et al., 2012). The results highlight the importance of the scale for identifying students who may benefit from additional academic support.

K. Resilience

Resilience to academic stressors emerged as a significant predictor of students' ability to cope with the demands of medical school. Students with higher resilience scores demonstrated greater adaptive coping strategies, reduced levels of academic distress, and were more likely to persist through setbacks. This finding is consistent emphasizing the protective role of resilience in mitigating stress, and preventing burnout in high-pressure academic environments (Dyrbye et al., 2006). The data suggest that resilience is a dynamic quality influenced

by both individual factors (e.g., personality traits like grit) and external support systems. Integrating resilience training into the medical curriculum could help students develop the coping skills necessary to thrive despite the significant emotional and academic pressures they are facing.

4. Conclusion

The study developed and validated a scale that provides a comprehensive measurement of the factors influencing academic success in medical school, including pre-medical background, grit, resilience, and demographic factors. The findings were able to show the importance of these constructs in shaping students' ability to cope with academic stress and achieve long-term success of becoming a medical doctor. By acknowledging these constructs, educational institutions can help students navigate the challenges of medical education, and improve the overall academic performance.

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