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A Cross-Sectional Study of the Relationship between Work Endurance and IQ Level of Medical Students of Universitas Islam Malang

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ABSTRACT

Medical students must maintain prolonged mental strain and different cognitive loads. Previous research has focused primarily on studying different types of intelligence and its relation to academic success and more specifically to grade point average (GPA). Yet, this leaves several questions unanswered. Most empirical research has concentrated on academic achievements and not on the psychological construct of stamina. Most of the research studies in this area focused in the western countries, and hardly any evidence exists on medical students from poorer countries. Most research in this area focused on academic achievement and failed to use psychometric tests assessing intelligence and the stamina construct. It also remains open question for academic research to explore the relationship between cognitive intelligence and work endurance. This study focused on the relationship of the emerged psychological construct and intelligence quotient (IQ) of medical students in Universitas Islam Malang, Indonesia. A cross-sectional analytic study was done on medical students who fulfilled the inclusion criteria. Absolutely, IQ was evaluated by the Culture Fair Intelligence Test (CFIT) and work endurance was evaluated by the Kraepelin Test. The data was processed by correlation analysis. The results indicated that there was no statistically significant correlation between activity endurance and IQ ($p > 0.05$). This measurement shows that both intelligence and activity endurance are distinct psychological variables. This indicates that the cognitive element of a student's personality may not be sufficient to explain the student's ability to maintain prolonged academic effort.

Keywords: *CFIT; Intelligence Quotient (IQ); Kraepelin; Medical Students; Work Endurance.*

INTRODUCTION

Potential medical students face extremely difficult challenges as a result of the long and rigorous nature of medical training that not only intellectually challenges an individual but also psychologically stretches them (Hernandez-Chavez et al., 2025; Niyomdecha et al., 2026). Medical students are required to learn a range of subjects, from

theory to the undertaking of lab work, to acquiring clinical skills and finally undertaking clinical rotations and these require sustained periods of concentration and the ability to mentally endure these challenges. To be able to successfully meet the challenges academically, students are required to use both "cognitive" and more "non-cognitive" attributes.

The single most commonly researched cognitive characteristic that is viewed as a precursor to success in a given field of academic endeavor is an individual's ability to think, commonly referred to as Intelligence Quotient (IQ). IQ is defined as a measure of an individual's cognitive ability that encompasses logic, problem solving, and the ability to think in more abstract (less tangible) terms (Iqbal et al., 2021). Research has established a positive correlation between cognitive ability and success in an academic field in both the general population of university students and more specifically in students of the health sciences (Agha et al., 2023; Febriza et al., 2022). Cognitive ability in the field of medical education has been viewed as a primary factor regarding a student's ability to understand intricate concepts, drawing from several theories, and excel in an academically challenging situation.

Nevertheless, success in medical school and education is attributable not only to one's intellect and cognitive ability, but also and equally to one's psychological ability to sustain and focus over extended periods of time. This is referred to as work endurance, and it is one's ability to remain mentally focused and continue performing under sustained cognitive stress. This is a major and significant factor in medical education, as students continually face sustained and prolonged cognitive and psychological stress, and work under high cognitive demands, and time and academically intensive schedules.

While cognitive and non-cognitive variables have both been identified as significant contributors to academic success, studies of these variables have traditionally focused on one of these two areas. In studies of academic achievement and cognitive ability, these studies have tended to focus on GPA and test score outcomes. Achievement and success independent of academic motivation and persistence, as well as the ability to manage and tolerate stress, have also been studied. It is, therefore, not surprising that the literature is focused on the relationship between cognitive ability apart from psychological and cognitive work endurance. This is very much a gap, and for the most part, something that is missing in the literature.

Additionally, many studies that empirically examine predictors of medical student performance avoid non-Western educational contexts. It is known that cultural, educational, and institutional settings influence the various ways cognitive and non-cognitive factors are expressed through learning behaviors and the resultant academic achievement. Thus, research done in Western settings is likely to overlook the realities of medical students in non-Western countries, including Indonesia. Some researchers have argued for the need to investigate the psychological factors of academic performance through specific cultural and educational lenses to have insights that are more relevant to the context (Shi & Qu, 2022; Jaehn et al., 2025).

Even though the importance of non-cognitive competencies in medical education is well established, research that studies the interplay of intelligence and work stamina is virtually non-existent, especially in the context of Indonesia. Finding out whether there is a link between cognitive ability and sustained work performance is crucial, as it

provides guidance for student selection, academic scaffolding, and the development of interventions that aim to enhance students' endurance and academic achievement.

The goal of the study is to find IQ and work endurance relationships for medical students from Universitas Islam Malang in gap that this study is trying to cover. Two of the developed and widely used psychometric tests will be used for this purpose. The first one is the Culture Fair Intelligence Test (CFIT) which is developed to measure cognitive ability with the least possible cultural bias (Shi & Qu, 2022), and the second is the Kraepelin Test, which is developed to measure work endurance through mental arithmetics with time pressure (Davies et al., 2020). The study aims to add some cognitive and non-cognitive indicators of the performance in medical education in the literature by finding some relationships of the two constructs.

For the purpose of studying IQ and its relationship with work endurance in medical students, this research aims to produce scientific results in the context of education in Indonesia. The outcome will lead to some deductions to be made regarding cognitive and non-cognitive factors in medical education and will provide guidance for education administration to improve framework of student evaluation, student support, and to build a comprehensive system for student selection and training.

METHODS

The authors used a quantitative correlational approach with a cross-sectional research design for this study. A cross-sectional design is suitable for this study as it seeks to understand the relationship between the two variables intelligence quotient (IQ) and work endurance at a single time and without intervention of the variables studied (Althewini & Al Baz, 2022). The variable cognitive ability and work endurance were studied with a correlational approach to determine if there is any statistical relation among the variables in the study, which in this case, were medical students.

Research Setting and Participants

The study was carried out at the Faculty of Medicine, Universitas Islam Malang, Indonesia. The target population was all first-year medical students for the 2025 cohort. First-year students are in a transitional phase and face a new level of cognitive and learning demands, which is why they were selected.

A total sampling technique was used which included all the students in the 2025 cohort that met the inclusion criteria to participate in the study. Total sampling was used so that the study sample could reflect the entire first-year medical student population in the cohort that was accessible. The inclusion criteria were: Registered as an active medical student in the 2025 cohort of the Faculty of Medicine, Universitas Islam Malang; Agreed to participate in the study and perform both psychometric tests; and Attended the scheduled sessions for data collection. The exclusion criteria were Students who were on academic leave at the time of data collection; Students who had any medical condition that could adversely affect their cognitive testing; Students who submitted test responses that were incomplete or did not meet the required standards. Based on these criteria, 76 students were selected for final analysis.

Research Instruments

To quantify the variables for this study, two standardized psychological instruments were used: the Culture Fair Intelligence Test (CFIT) which assesses intelligence quotient and the Kraepelin Test that assesses work endurance.

a. Measurement of Intelligence Quotient

The signified intelligence quotient was operationalized by Culture Fair Intelligence Test (CFIT) Scale 2 Form A. Developed by Cattell (1971), the CFIT aims to assess general cognitive ability without the influence of culture and language (Shi & Qu, 2022). The CFIT intends to measure fluid intelligence and focuses on cognitive functions such as pattern recognition, classification, and reasoning. The CFIT test has four matrices (subtests): Series, Classification, Matrices, and Conditions.

The problem-solving items in each subtest are presented in a nonverbal format and are subjected to time constraints, as dictated by standard testing methods. The total duration for the CFIT is 30 minutes, which is adequate for the completion of all items.

CFIT scores were computed based on test manual guidelines to yield standard IQ scores. IQ scores comprised the following intelligence classifications: Below Average (IQ < 90); Average (IQ 90–109); Above Average (IQ 110–119); Superior (IQ 120–129); and Very Superior (IQ ≥ 130). CFIT's unique ability to evaluate cognitive ability without the test's cultural bias has resulted in its extensive application in psychological research (Shi & Qu, 2022).

b. Measurement of Work Endurance

Work endurance was measured using the Kraepelin Test, which has been characterized as evaluating sustained attention, mental endurance, and working under time pressure (Davies et al., 2020). The Kraepelin Test consists of extensive mental arithmetic.

Participants in the Kraepelin Test are asked to sum small digits in given vertical columns that extend and are organized in series. For each arithmetic operation, a test taker writes the answer in a single box that corresponds to the position of the answer in the column in the proceeding series. The test was conducted for 45 minutes, which allows for assessment of work performance and sustained concentration.

The endurance metrics of the test takers were determined based on the test criteria and the mental work capacity, that is the test endurance metrics, the practitioners were divided into two classes: Adequate endurance, and Inadequate endurance. The Kraepelin Test is mainly used to assess psychological endurance, sustained concentration, and work persistence in education, and in the workplace (Davies et al., 2020).

The Collection of Data

The collection of data spanned three days (October 15 – 17, 2025) and took place during the regular working hours of the Faculty of Medicine, Universitas Islam Malang. Each of the data collection activities occurred between 9 am - 12 pm, and were conducted in standard classroom setting, and under classroom conditions.

To ensure uniformity in the conduct of the tests, each of the data collection activities was conducted by two trained test administrators who had experience in

psychological testing. Each of the participants was guided both orally and in writing about the protocol of the testing activities. The data collection activities were conducted in the following order: the participants took the Culture Fair Intelligence Test (CFIT); after that, each of the participants was allowed 15 minutes of rest after the CFIT to reduce the impact of cognitive fatigue. Finally, the participants took the Kraepelin Test, which is an exercise in mental arithmetics that lasts 45 minutes. To reduce the impact of time-related variables, all the participants completed the two tests on the same day.

The participants' data were analyzed using version 24.0 of the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were used to summarize the data, and these included the characteristics of the participants, i.e., distributed IQ scores and work endurance categories.The Kolmogorov–Smirnov test was conducted to assess the normality of the dataset before any inferential analysis could take place. Given the information that the dataset does not follow a normal distribution, Spearman's rank correlation coefficient was utilized to assess the correlation between IQ scores, and work endurance scores. Furthermore, a Chi-square test of independence was executed to establish the relationship between the categorical variables of IQ work levels and categories of work endurance. A statistical significance was determined at a p-value < 0.05.

RESULT

Participant Characteristics

A total of 76 medical students participated in this study. The mean IQ score was 111.12 ± 15.59 (range: 80-145). Based on IQ classification, 16 students (21.1%) had below-average IQ, 32 students (42.1%) had average IQ, 18 students (23.7%) had above-average IQ, 8 students (10.5%) had superior IQ, and 2 students (2.6%) had very superior IQ. The distribution of IQ levels among participants is presented in Table 1.

Table 1. Distribution of IQ Levels among Medical Students (N=76)

IQ Category	IQ Range	Frequency (n, %)
Below Average	< 90	16 (21.1%)
Average	90-109	32 (42.1%)
Above Average	110-119	18 (23.7%)
Superior	120-129	8 (10.5%)
Very Superior	≥ 130	2 (2.6%)
Total		**76 (100%)**

For work endurance, 52 students (68.4%) demonstrated adequate work endurance, while 24 students (31.6%) showed inadequate work endurance based on Kraepelin Test performance criteria. The distribution of work endurance categories is presented in Table 2.

IQ Profile of the 2025 Medical Students

The results of IQ measurement by CFIT in Table 1 showed that the IQ scores (FIQ) of the 2025 medical students were between 55 and 152, with a mean of 111.12 ± 15.59. The median value was 113.00, and the mode value was 116.00. The distribution of IQ scores showed that most students were in the average and above-average categories,

indicating that medical students have sufficient cognitive abilities to follow the medical education program.

Table 2. Distribution of Work Endurance Categories among Medical Students

Work Endurance Category	Frequency (n, %)
Adequate	52 (68.4%)
Inadequate	24 (31.6%)

Relationship between IQ and Work Endurance

Spearman's correlation analysis revealed no significant relationship between IQ levels and work endurance scores ($r = -0.198$; $p = 0.086$). The negative correlation coefficient indicated a weak inverse trend, though not statistically significant at the $\alpha = 0.05$ level.

Cross-tabulation analysis further examined the relationship between categorical IQ levels and work endurance categories (Table 3). Chi-square test results showed no significant association between these variables ($\chi^2 = 7.203$; $df = 4$; $p = 0.126$).

Table 3. Cross-tabulation of IQ Levels and Work Endurance Categories

IQ Category	Adequate Work Endurance (n, %)	Inadequate Work Endurance (n, %)	Total (n, %)
Below Average	11 (68.8%)	5 (31.2%)	16 (100%)
Average	23 (71.9%)	9 (28.1%)	32 (100%)
Above Average	12 (66.7%)	6 (33.3%)	18 (100%)
Superior	5 (62.5%)	3 (37.5%)	8 (100%)
Very Superior	1 (50.0%)	1 (50.0%)	2 (100%)
Total	52 (68.4%)	24 (31.6%)	76 (100%)

Among students with below-average IQ (n=16), 68.8% demonstrated adequate work endurance, while 31.2% showed inadequate endurance. For students with average IQ (n=32), 71.9% had adequate endurance and 28.1% inadequate. Students with above-average IQ (n=18) showed 66.7% adequate and 33.3% inadequate work endurance. Superior IQ students (n=8) demonstrated 62.5% adequate and 37.5% inadequate endurance, while very superior IQ students (n=2) showed 50% in each category.

DISCUSSION

Interpretation of the Findings

This study examined the relationship between work endurance and intelligence quotient (IQ) among medical students at Universitas Islam Malang. The findings revealed no statistically significant correlation between the two variables ($r = -0.198$; $p = 0.086$). This suggests that cognitive ability, as measured by IQ, is not directly associated with an individual's capacity to sustain mental effort over time. In other words, students with higher IQ scores do not necessarily demonstrate higher work endurance, and those with lower IQ scores may still exhibit adequate endurance.

These findings indicate that cognitive ability and work endurance are distinct psychological constructs that contribute differently to academic performance. IQ reflects an individual's capacity for reasoning, problem solving, and abstract thinking (Iqbal et

al., 2021), whereas work endurance relates to sustained attention, persistence, and the ability to maintain effort during prolonged mental tasks. In the context of medical education, both constructs are important, but they appear to function independently.

From a theoretical perspective, these findings can be interpreted through dual-process models, which distinguish between cognitive processing and effort regulation (Davies et al., 2020). Cognitive ability is primarily associated with reasoning and executive functions, whereas work endurance is more closely linked to psychosocial factors such as motivation, emotional regulation, and stress management (Xie et al., 2022). Therefore, the absence of a significant relationship between IQ and work endurance in this study is consistent with this theoretical perspective.

These results are also in line with previous studies emphasizing the role of non-cognitive factors in medical students' academic performance. For example, Niyomdecha et al. (2026) highlighted the importance of perseverance and stress management, while Wong et al. (2024) found that various forms of intelligence and personal traits contribute to academic outcomes. These studies support the view that academic success in medical education cannot be explained solely by cognitive ability.

Furthermore, the present findings suggest that success in medical education depends on a combination of cognitive and non-cognitive factors. In addition to intellectual ability, students need psychological attributes such as persistence, resilience, emotional control, and learning motivation to cope effectively with the demands of medical training.

Although previous studies have reported a positive relationship between IQ and academic achievement (Agha et al., 2023; Febriza et al., 2022), most of them focused on outcomes such as grade point average (GPA) and test scores. In contrast, the present study examined work endurance as a psychological construct related to sustained effort rather than direct academic achievement. Therefore, the absence of a significant association may be explained by the different constructs being measured.

This interpretation is further supported by Jaehn et al. (2025), who argued that cognitive-based admission tests may predict academic achievement but do not adequately capture other important outcomes, such as resilience, clinical competence, and the ability to sustain effort during prolonged training. Accordingly, the lack of a significant relationship between IQ and work endurance in this study may indicate that these variables represent different dimensions of student potential.

Cultural and Contextual Factors

Another significant aspect is the educational and cultural context where the study is conducted. Most of the existing studies of cognitive predictors of academic success have looked at western educational systems. However, other educational systems may differ in learning environment, organizational culture, and support from peers.

In the Indonesian medical education system, culture encourages collaborative learning and the culture of peer support. This may also encourage students to exert and maintain effort in academic tasks. Psychological and social phenomena, as suggested by Yuditasari et al. (2023), can also significantly contribute to the academic performance of medical students apart from the intellectual capacity.

Thus, it can be suggested that when considering the development of work endurance in students, apart from individual cognitive capacity, other contextual factors such as the learning environment, peer support, and the institution's scaffolding may be influential. These factors could also help to explain the reason why cognitive ability was not a significant predictor of work endurance in the present study.

Implications for Medical Education

The results of this research present significant implications to be addressed when creating policies and strategies geared towards the development of students in medical education. Historically, entry requirements into most medical schools have been too dependent on cognitive measures (academic examinations, intelligence test scores). Although cognitive ability is important for academic readiness, it should not be the sole criterion. The findings suggest that relying only on cognitive measures may overlook students' ability to sustain effort in demanding academic environments.

In this study, a considerable number of students classified as low IQ displayed a positive threshold of work endurance. This suggests that students who do not perform well on standard measures of cognitive ability may possess the psychological traits that support work endurance and sustained effort. The research corroborates the increasing understanding that more integrated methods of evaluation may capture students with the greatest potential to successfully navigate the complexities of medical training. Some researchers have argued for the need to modify admissions criteria to include assessments that measure both the cognitive and non-cognitive domains to forecast more accurately the likely success and the well-being of the students (Alam et al., 2023; Liberty et al., 2022).

In addition, the ability to identify students with low stamina for work early on, irrespective of their cognitive capacity, opens the possibility for institutions to provide specific assistive measures. Interventions that target improved coping with work through the teaching of stress management, resilience, time management, and mindfulness have been shown to enhance both the psychosocial and academic functioning of medical students (Lampe & Müller-Hilke, 2021; Park et al., 2023). The medical educational system may provide coping tools to students through the incorporation of these systems into the curricula.

Strengths and Limitations of the Study

The strengths of study lie in its contributions to the relevant field of research in medical education. First, the study used the Culture Fair Intelligence Test (CFIT) and the Kraepelin Test, both standardized and accepted in cognitive and psychological studies. This means the study has a structured way of evaluating cognitive and work endurance.

Second, the study's participant cohort was first year medical students, which means the study was able to minimize variability caused by differences in academic experience or training. Studying students in their initial years is crucial as they are in the phase of adjusting to rigorous academic ecosystem. Despite these strengths, there are some weaknesses. First, a cross-sectional approach was used, which means, one cannot establish any relationships of intelligence and work endurance in a cause and effects manner. Any future studies on these psychological attributes and their impact on academic performance would be better off using a longitudinal approach.

Second, conducting the study in one medical school limits the scope of findings and how they might be applied in differing medical schools with alternative educational contexts or curriculum designs. Future research across multiple schools may cast light on the interplay of cognitive and non-cognitive attributes across varied educational contexts.

Third, the current study omitted several psychological factors, including motivation, emotional intelligence, and work endurance and academic performance, which might interact with a person's socio-economic status. Other researchers have pointed out that these factors could be significant in defining students' academic journeys (Abdulla Alabbasi et al., 2023; Žuljević & Buljan, 2022). Future studies that include these factors may provide a more refined understanding of academic performance of medical students.

Future Research Directions

Research on the interplay of cognitive and non-cognitive attributes should be expanded in medical education. The interaction of intelligence and work endurance would be a fruitful area for longitudinal studies of students across the continuum of medical education, including preclinical and clinical training and professional board examinations.

Furthermore, multi-institutional studies that include medical schools from various regions in Indonesia could provide researchers with opportunities to study possible differences in educational culture, learning ecosystems, and systems of institutional support. Such studies could improve the applicability of the findings and strengthen evidence for educational policy recommendations (Septiawati et al., 2024).

Lastly, later studies could examine the possible mediating or moderating roles of self-efficacy, learning motivation, teaching methods, and systems of peer learning. Utilizing more refined methodological tools, particularly structural equation modeling, to study these variables may help delineate how cognitive and non-cognitive factors operate in concert to influence the educational achievement of medical students (Abdulla Alabbasi et al., 2023).

CONCLUSION

The study focused on assessing the relationship between the intelligence quotient (IQ) and the work endurance of medical students at Universitas Islam Malang using the Culture Fair Intelligence Test (CFIT) and the Kraepelin Test. The study found that there is no statistically significant relationship between IQ and work endurance of study subjects. This implies that one might not be able to predict an individual's capability to sustain mental effort for long arduous academic tasks just by looking at level of the individual's cognitive capacity.

The study shows that work endurance, as the Kraepelin Test, and IQ could be based on different psychological traits that could affect learning behavior differently in medical teaching. Although IQ shows ability of reasoning and problem solving, work endurance is the ability to sustain effort, maintain focus, and keep attention for a long duration and intensive academic work. Therefore, one-dimensional cognitive ability may lead to under estimation of students' ability to endure stress in medical education.

In teaching and learning process, the study found that psychological traits in the form of work endurance that could affect students' behavior should be looked at considering the study as one of the preliminary papers in the field. The study found that on work endurance, academic persistence and psychological endurance, assessing, supporting, and intervening should be focused.

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