The Body Mass - Cognition Conundrum: Unraveling the Association Between Cognitive Performance and Obesity Among Medical Students

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ABSTRACT

Objective: To investigate the association between obesity and cognition level in terms of Mini-Mental State Examination scores and to compare the cognition levels between obese and non-obese students.

Methodology: This cross-sectional study was held at Aziz Fatimah Medical and Dental College after taking ethical approval (Ref. No: IEC/221-23) from July to December 2023. A total of 159 students aged between 17 and 25 years were enrolled, including 34 obese and 125 non-obese students who fulfilled the inclusion and exclusion criteria. The Mini-Mental State Examination (MMSE) tool was used to assess the cognition levels, it is an effective screening tool to separate patients with cognitive impairment from those without it. The questionnaire consists of several tasks, including orientation, attention, language and memory.

Results: Mean age of the participants was 20.29±1.33 years. Obese students showed significantly lower scores on the Mini-Mental State Examination compared to non-obese students. A significant negative association was found between BMI and cognitive scores (p = 0.034).

Conclusion: Obese students had lower cognition performance as compared to non-obese students. Higher BMI has a negative influence on cognitive performance; however, the field remains dynamic, and the ongoing research is needed to elucidate the causal pathways and inform evidence-based interventions.

KEYWORDS: Cognition, Medical, Obesity, Students.

INTRODUCTION

Cognitive level refers to a person's ability to process and understand information, solve problems, make decisions and think critically. A person's cognitive abilities can fluctuate depending on their age and the type of activities in which they participate. A person's cognitive abilities can have an effect on his/her academic and career accomplishments as well as his/her social life and interpersonal connections.[1] Studies have indicated that obesity may result in reduction of cognitive function such as planning and organizing skills, attention, short-term memory, integrated functioning, visuospatial skills, and language comprehension and expression. It is expected that there is an inverse relationship between BMI-based body weight status and academic attainment.[2] BMI is a simple index of weight-for-height that categorizes individuals as overweight or obese. A BMI over 25 is considered obese, while a BMI of 25 or below is considered as non-obese.[3]

Recent studies have shown that obesity prevalence is rising globally. In united states the incidence of obesity is high involving 42% of the adults, among whom 9% of the adults have severe obesity. In China, the prevalence stands at 16.4%, indicating a global trend that exceeds earlier expectations.[4] Obesity has been acknowledged as a major health concern and several factors have been identified as possible causes of obesity. Physical activity and

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dietary habits have been recognized as two significant determinants of obesity.[5,6] Medical students hold a crucial role in their community as future health care providers and are often regarded as role models. Gaining a deeper understanding of the factors contributing to obesity in medical students could help us improve our strategies for preventing and managing the condition.[7] Modern research indicates that obesity may possibly have an impact on cognitive abilities.[2] The connection between obesity and reduced cognitive function is not yet fully understood, especially in the absence of other metabolic risk factors, as there is a scarcity of data available on the topic.[8] The Mini-Mental State Examination (MMSE) is a useful tool for distinguishing between individuals with and without cognitive impairment. Moreover, the tool cannot diagnose changes in cognitive function and should not substitute for a comprehensive clinical evaluation of mental status. The questionnaire consists of several tasks, including orientation, attention, language and memory. Additionally, this tool significantly relies on verbal communication and ability to read and write. As a result, individuals with hearing or visual impairments, intubation, low English literacy, or other communication barriers may score poorly even if their cognitive abilities are normal.[9]

METHODOLOGY

This cross-sectional study was conducted at Aziz Fatimah Medical and Dental College over a period of six months from July to December 2023 following ethical approval (Ref. No: IEC/221-23) granted on June 14, 2023. The sample size was calculated to be 159 using the formula derived from OpenEpi,[8] considering a population size of 600 students. The study included both obese and non-obese students aged between 17 to 25 years, selected through convenience sampling technique. Students unwilling to participate, those with psychiatric illnesses, and individuals outside the specified age range were excluded from the study. Informed consent was taken. Data collection

utilized the Mini-Mental State Examination (MMSE) to assess cognitive function, whereas measurements from a weighing machine and stadiometer were performed for calculating Body Mass Index (BMI). The study categorized BMI as the independent variable and cognition level as the dependent variable. The research hypotheses were formulated as follows: the null hypothesis suggested no difference in cognition levels between obese and non-obese students, while the alternative hypothesis proposed a significant difference in cognition levels based on BMI status. This methodology aimed to investigate potential association between obesity and cognitive levels among young adults, providing insights into the impact of BMI on cognitive performance within a collegiate setting.

RESULTS

The study consisted of 159 participants with a mean age of 20.29±1.33 years. The majority of the participants were female, constituting 108 (67.9%) of the total among whom 10 were obese and 98 were non-obese, while male participants numbered 51 (32.1%) constituting 24 obese and 27 non-obese. A comprehensive overview of the study population can be found in Table 1.

| Table 1: Descriptive Statistics of Study Population	
Variables	**Mean ± Standard deviation**
Age (years)	20.29 ± 1.33
Weight(kg)	61.69 ± 12.30
Height(m)	1.65 ± 0.09
BMI (kg/m^2)	22.49 ±4.58
MMSE score	27.42 ± 1.89

[kg: kilogram, m: meter, kg/m^2: kilogram per square meter, MMSE: Mini-Mental State Examination]

The majority of participants were enrolled in the second year of the MBBS program, with the first year following closely in frequency. Figure 1 provides the distribution of students across different academic years, showing frequencies and percentages for each cohort.

Upon analysing the cognitive status of the study subjects, it was observed that 21 students (13.2%)

exhibited impaired cognition levels, indicated by an MMSE score below a certain threshold, while

Figure 1: Distribution of Study Subjects According to Academic Year
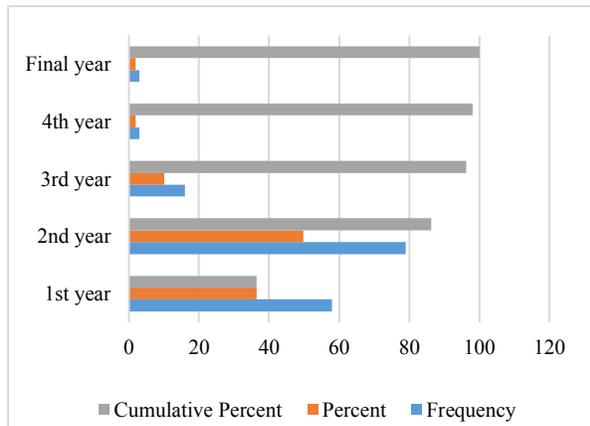
the remainder demonstrated normal cognition scores. The results from the current study indicated that 20.6% of obese subjects showed impaired cognition, defined by an MMSE score below 26, whereas impaired cognition was observed in only 11.2% of non-obese subjects (figure 2).

Figure 2: Cognition Level by the Status of Obesity
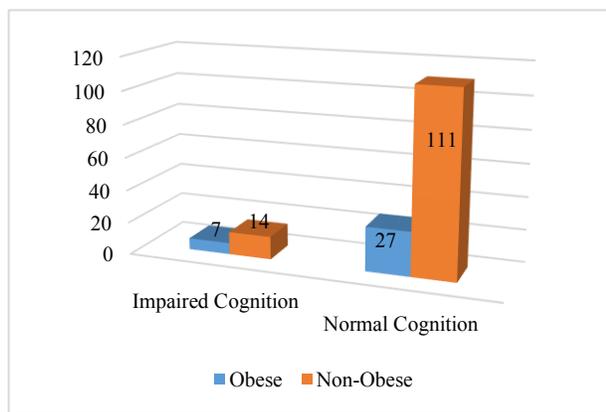
The mean MMSE scores were compared between obese and non-obese study subjects using an independent t-test. The analysis revealed slightly higher scores among non-obese subjects compared to obese subjects; however, this difference in mean scores did not reach statistical significance (Table 2).

The association between BMI and MMSE scores was examined using regression analysis, revealing

a significant negative relationship. The beta coefficient of -0.070 indicated that for every one unit increase in BMI, there was a corresponding decrease of 0.070 units in MMSE scores (p-value = 0.034).

Table 2: Comparison of MMSE scores between obese and non-obese subjects (N= 159)

Groups	Mean ± Standard deviation
0bese (≥ 25 kg/m^2) (N=34)	26.91±2.15
Non-obese (< 25 kg/m^2) (N=125)	27.55±1.79
p value	0.199

p-value ≤ 0.05 is considered significant

DISCUSSION

Several studies have explored the link between obesity and cognitive performance in both school-aged adolescents and elderly adults.[10,11] Current study focused on young adults performing cognitive tasks and compared these tasks between obese and non-obese individuals. Prior research has not extensively explored the relationship between cognition and obesity in adults. Current results align with Ranjeet et al.'s findings, suggesting that obesity correlates with poorer cognitive performance and lower MMSE scores, indicating a potential link between body weight changes and cognitive decline.[12]

This association could be attributable to a variety of physiological and behavioural factors. Obesity has been linked to increased systemic inflammation, metabolic dysfunction, and vascular impairments, all of which can lead to decreased cognitive performance. Obese people are also more likely to engage in less physical activity and consume less nutritious foods, which exacerbates cognitive deterioration.[13]

An opposing viewpoint contends that cognitive impairment may result in changes in eating habits and weight increase. Neurological changes impacting decision-making, impulse control, or metabolic processes may occur prior to obesity rather than as a result of it.[14]

Past investigations have consistently revealed that obesity in adulthood adversely affects cognitive

function.[15] Previously, a systematic literature review conducted by Prickett C, assessed whether adults aged 18-65 with obesity (BMI > 30kg/m²) exhibited deficits in specific cognitive domains and determined if these studies have identified an independent link between obesity and cognitive function that was not influenced by other relevant health conditions.[16] The present study also explored this correlation, focusing on young adults aged 17–25 years with obesity (BMI > 25 kg/m²).Our study observed a significant cognitive delay among students with higher BMI compared to those with normal BMI. These results have been supported by previous findings suggesting that increased BMI can affect attention, memory, and recognition abilities.[10]

Obesity has an impact on brain health, which may explain this association. Excess body fat has been linked to systemic inflammation, insulin resistance, and vascular dysfunction, all of which can lead to cognitive impairment. Obesity related metabolic abnormalities may also impact neurotransmitter function, which could affect cognitive processing speed and executive functioning.[13]

Aside from physiological issues, lifestyle variations between students with higher and lower BMI could have a role. Poor food habits, low physical activity, and interrupted sleep patterns, all typical in those with a higher BMI, have been related to cognitive impairment. These conditions may have a cumulative effect, gradually reducing cognitive ability over time.[17] Given these findings, treatments that promote healthy lifestyle choices, such as balanced nutrition, frequent exercise, and cognitive stimulation, may be effective in preventing cognitive deterioration in students with higher BMI.[18] Implementing early weight management and cognitive function techniques may result in long-term improvements in academic achievement and mental health.

A lower baseline BMI appears to be linked to accelerated cognitive decline in individuals with mild cognitive impairment (MCI). This association suggests that body composition may play a role in influencing the pace of cognitive deterioration in MCI, or alternatively, that factors associated with MCI could impact body composition.[19] A lower BMI may indicate a loss of muscle mass and dietary inadequacies, both of which have been shown to impair brain function and cognitive resiliency. Furthermore, metabolic alterations linked with MCI, such as altered energy metabolism, inflammation, or hormone imbalances, may contribute to accidental weight loss and worsen cognitive decline. It is also likely that people experiencing cognitive decline struggle to maintain optimal nutrition and physical activity, resulting in changes in body composition over time. These findings highlight the significance of BMI as a potential biomarker for cognitive health, and they suggest that interventions centered on dietary assistance and physical exercise may help reduce cognitive decline in people with MCI.[14,20] Future study should investigate the causal mechanisms underlying this association in order to create focused preventative and treatment measures.

CONCLUSION

Obese students exhibited lower cognitive performance compared to their non-obese peers. Higher BMI has negative impact on cognitive levels; however, the topic remains contentious, preventing definitive conclusions.

Significance of the Study*:* The novelty of this study is that so far, no studies have been documented to assess the cognition level in youth within a collegiate setting. However, cognition has been assessed in older people in different research settings.

Limitations*:* As this is a cross-sectional study; causal relationships cannot be established. Moreover, only BMI has been used to measure obesity in current study. Although BMI plays a crucial role in obesity research, but it does not address important aspects such as body composition and fat distribution.

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