International Journal of Health Sciences and Research
DOI: https://doi.org/10.52403/ijhsr.20210709
Vol.11; Issue: 7; July 2021
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

The Relationship between Body Mass Index and Cognitive Function in Young Adults - A Correlational Study

Kena H Patel[1], Jalpa Parikh[2]

[1]Postgraduate Physiotherapy Student, Ahmedabad Institute of Medical Sciences (AIMS), Ahmedabad, Gujarat, India
[2]MPT Neurology, PhD Scholar Gujarat University Lecturer, PG Guide, Ahmedabad Institute of Medical Sciences (AIMS), Ahmedabad, Gujarat, India

Corresponding Author: Kena H Patel

ABSTRACT

Background: Cognitive functions are conscious mental activities such as thinking, remembering, learning and using language. The function of cognition is the ability of attention, memory, judgement, problem solving and executive abilities such as planning, evaluating and monitoring. Body mass index (BMI) is an estimate of body fat based on height and weight. It can help determine whether a person is at an unhealthy or healthy weight. Several studies indicate that cognitive function is impaired in elderly population with respect to BMI and also indicate that greater BMI in midlife is associated with higher risk of cognitive impairment. So, this study aimed to investigate the relationship between body mass index and cognitive function in young adults.
Methodology: A "Montreal Cognitive Assessment (MOCA) scale" was filled by the 134 young adults (18 to 35 years) through interview method.
Result: Statistical analysis was done using SPSS version 20. Pearson's test of correlation was applied between outcome measures. There is a weak negative but statistically significant correlation found between body mass index (BMI) and MOCA scores (r = -o.174).
Conclusion: This study demonstrated weak negative correlation between body mass index and cognitive function in young adults.

Keywords: Body mass index, Cognitive function, Young adults

INTRODUCTION

Cognitive functions are conscious mental activities such as thinking, remembering, learning and using language [1]. The function of cognition is the ability of attention, memory, judgement, problem solving and executive abilities such as planning, evaluating and monitoring [1]. Superior cognitive function is key to maintain a high quality of life as it helps individuals carry out day-to-day activities.

BMI stands for body mass index. It was developed in 1832 by a Belgian mathematician named Lambert Adolphe Jacques Quetelet [2].

Body mass index (BMI) is an estimate of body fat based on height and weight [2]. It can help determine whether a person is at an unhealthy or healthy weight [2]. The BMI is a simple, inexpensive and easy screening method for weight category –underweight (<18.5kg/m²), healthy weight (18.5 – 24.9kg/m²), overweight (25.0 – 29.9kg/m²), obese class I (30.0-34.9kg/m²), obese class II (35.0-39.9kg/m²), obese class III (>40kg/m²) [2]. BMI is affected by both fat and fat free mass which may have opposite effects on health [3].

According to the WHO, over 1.9 billion adults (39% adults) were overweight

among which more than 600 million (13% adults) were obese. Obesity has become a worrying health and social issues. It affects cognition mainly through altering the brain structures and functions, and motor performance through degrading musculoskeletal system [4].

Childhood obesity is related to the reduced executive function, attention, mental rotation, mathematics, and reading achievement. Obese adolescents have deficits in a range of cognitive functions, such as attention and executive functions. An animal study shows that high fat diet induces similar morphometric and metabolic changes in juvenile and adult mice; however, only early exposure to high fat diet hurts relational memory flexibility and decreases neurogenesis. Thus, early exposure to high fat diet may be particularly deleterious to cognition [4].

Studies have quantified the potential effects of high BMI on a variety of health outcomes. Several studies suggest that cognitive function in elderly impaired with overweight and obesity. There is a need to find association between BMI and cognition in young adults to know the effect of obesity on cognitive performance in this population. So, purpose of this study was to find the relationship between body mass index and cognitive function in young adults.

MATERIALS AND METHODOLOGY

A correlational study was performed in 134 young adults by convenience sampling. Data were collected from various colleges such as physiotherapy, nursing, engineering etc. and many societies located in Ahmedabad. A standard scale Montreal cognitive assessment (MOCA) was filled by the young adults. Materials used were pen, paper, digital weight machine and height scale, MOCA scale.

Inclusion criteria for this study were willingness of subject to participate in the study, age group of 18 to 35 years, male and female both. Exclusion criteria were any psychological disorders, any neurological disorders, any musculoskeletal disorders, any other systemic illness.

Outcome measures:

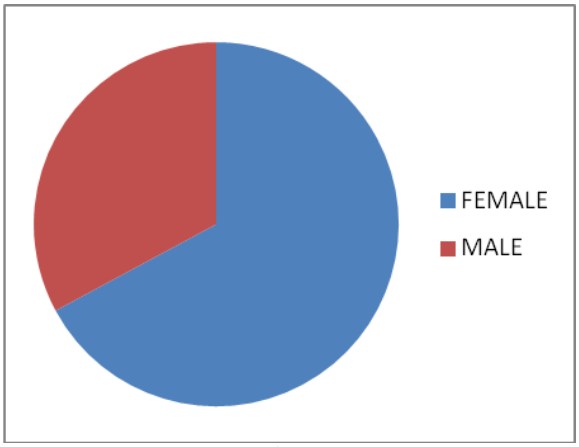
A) BMI was measured, by measuring weight in kilograms divided by the height squared in meters (Kg/m^2)

B) Montreal Cognitive Assessment (MOCA) Scale which is specifically developed for subjects with cognitive impairment was used to measure cognitive performance. It measures the visuospatial/executive function, naming, attention, language, abstracting, delayed recall and orientation. MOCA scores range between 0 and 30. A score of 26 or over is considered to be normal.

Procedure:

134 young adults were included in the study. BMI was calculated from person's body weight and height and measured by digital weight machine and height scale. All the participants were asked to remove shoes, heavy clothing and hats prior to height and weight measurements, and had the participants stand straight with heels together, legs straight and looking straight ahead and height as well as weight were taken. Their cognition was assessed using MOCA scale. Data collection for cognitive function by MOCA score was done. Data analysis to find the correlation between BMI and cognition was done using SPSS-20 software.

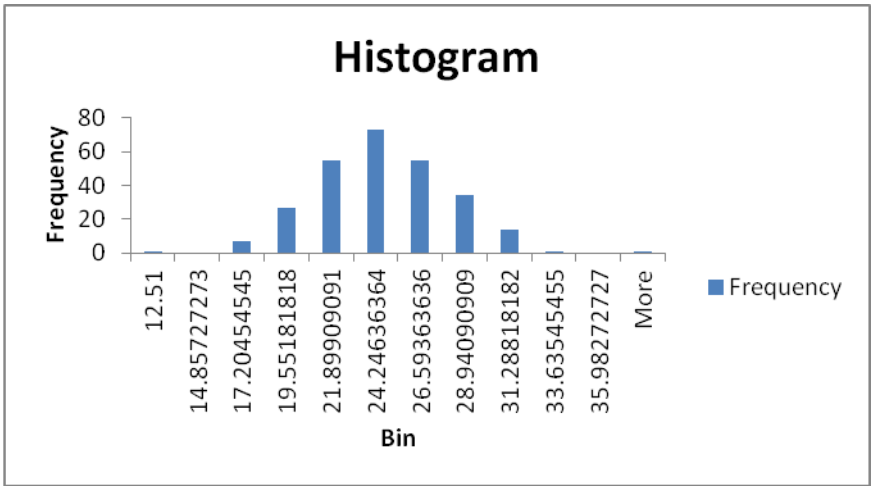
RESULTS



Graph 1. Pie chart for gender distribution

Data was analysed using SPSS version 20.0. One hundred thirty four young adults participated in the study, 44 were male and 90 were female shown in graph 1.

Data was normally distributed as shown in graph 2, so Pearson's correlation coefficient was used.



Graph 2: Normal distribution curve

Baseline characteristics of young adults are shown in table 1. Mean baseline value for age was 24.03±4.38, mean value for BMI was 22.46±3.84, mean value for MOCA score was 24.15±2.96. Level of significance was kept at 5%.

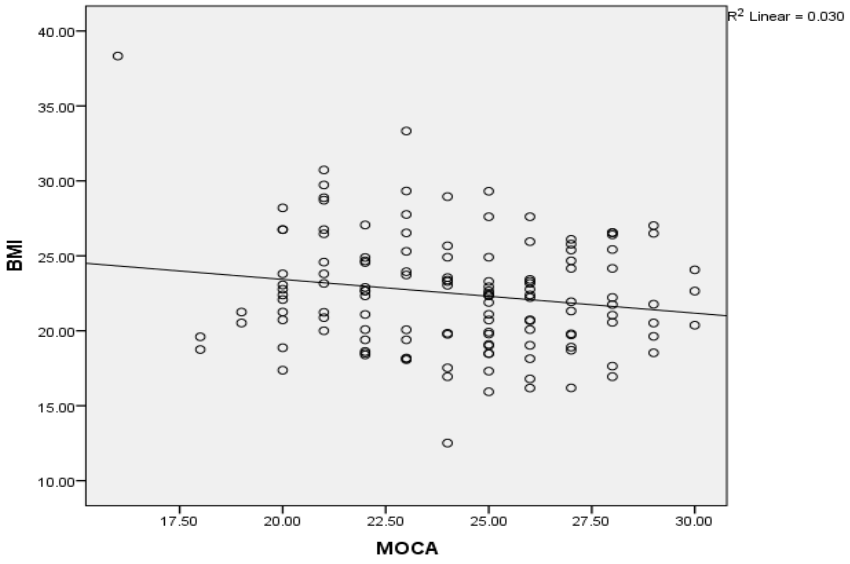
Table 1: Baseline characteristics of young adults

No.	Variable	Mean±SD
1	Age (Years)	24.03±4.38
2	BMI	22.46±3.84
3	MOCA	24.15±2.96

Correlation between body mass index (BMI) and MOCA scale are shown in Table 2. There is a weak negative but significant correlation was found between BMI and MOCA scores (r = -0.174) (p< 0.05), as shown in graph 3.

Table 2: Correlation between scores of BMI and MOCA

Correlations			
		BMI	MOCA
BMI	Pearson Correlation	1	-.174*
	Sig. (2-tailed)		.045
	N	134	134
MOCA	Pearson Correlation	-.174*	1
	Sig. (2-tailed)	.045	
	N	134	134
*. Correlation is significant at the 0.05 level (2-tailed).			



Graph 3. Correlation between scores of BMI and MOCA

DISCUSSION

This study was conducted to see the relationship between body mass index and cognitive function in young adults with age group of 18 to 35 years. In this study the weak negative but statistically significant correlation was found between BMI and MOCA scores which suggest that high BMI is associated with cognitive impairment in young adults. The outcome measure of present study, MOCA includes all aspects of measuring cognition.

Relationship between high BMI and cognitive impairment can be explained as adiposity is directly related to hyperinsulinemia, adipokines and cytokines. These two factors may affect inflammatory process in brain and modulate cognition and behaviours [5].

Possible pathways linking high BMI and cognitive deficit may be metabolic imbalance, clinically silent stroke, atherosclerotic changes, altered distribution of cerebral blood flow, demyelination or microinfarction in cerebral white matter [6].

BMI increase is also associated with lower metabolic activity in the prefrontal cortex and cingulated gyrus, smaller gray matter volume in many brain regions (particularly prefrontal cortex), and deficient white matter integrity in the uncinated fasciculus which is a structure connecting the frontal and temporal lobes [7-11]. Increased BMI has been linked to increased risk for the development of both dementia and Alzheimer's disease in later life.

Previous studies demonstrated that higher BMI is associated with chronic low-grade inflammation and with augmented production of pro-inflammatory cytokines, which may account for the detrimental effect of dopaminergic-driven cognitive functions observed in obese and overweight individuals [12, 13].

Fagundo et al. found that high BMI can disturb planning functions, problem solving, mental flexibility and inhibitory processes; these findings reflect alterations in the frontal lobe [6].

Cortese and Castellanos found that the relationship between high BMI and cognition may have a reverse direction such that specific cognitive attributes increase the risk of obesity [6].

Moreover, high midlife BMI is related to neuron and myelin abnormalities [4]. All these mechanisms explain cognitive impairment with overweight/obesity supporting the results of present study.

CONCLUSION

High BMI is associated with reduced cognitive performance in young adults and midlife is a critical period in which overweight/obese status can predict one's cognitive functions and brain health in later life.

Clinical Implication:

Along with cognitive training dietary management, Resistance training and other physical activities can be incorporated in physiotherapy protocol to improve cognitive function.

ACKNOWLEDGEMENT

I am thankful to all the subjects who participated in this study to make this study successful.

Conflict of Interest: None

Source of Funding: None

Ethical Approval: Approved

REFERENCES

1. Alam IG, Negara JD, Zelphira F. Effect of Obesity on Cognitive Function: A Comparative Study of Cognitive Level in Normal Weight and Obesity Students at Senior High School in West Java Indonesia. In4th International Conference on Sport Science, Health, and Physical Education (ICSSHPE 2019) 2020 Feb 19 (pp. 273-275). Atlantis Press
2. https://www.healthline.com/health/body-mass-index
3. Zhang T, Yan R, Chen Q, Ying X, Zhai Y, Li F, Wang X, He F, Ye C, Lin J. Body

mass index, waist-to-hip ratio and cognitive function among Chinese elderly: a cross-sectional study. BMJ open. 2018 Oct 1;8(10):e022055.
4. Chuanming Wang, John S. Y. Chan, Lijie Ren, Jin H. Yan, "Obesity Reduces Cognitive and Motor Functions across the Lifespan", Neural Plasticity, vol.2016, Article ID 2473081, 13 pages, 2016. https://doi.org/10.1155/2016/2473081
5. Kim S, Kim Y, Park SM. Body mass index and decline of cognitive function. PLOS one. 2016 Feb 11;11(2):e0148908.
6. Shaker NM, El Moneam MH, El Shahhat MA, Rabei SH. Correlating cognitive and executive functions to BMI. Egyptian Journal of Psychiatry. 2020 Sep 1;41(3):147.
7. Bolzenius JD, Laidlaw DH, Cabeen RP, Conturo TE, McMichael AR, Lane EM, Heaps JM, Salminen LE, Baker LM, Scott SE, Cooley SA. Brain structure and cognitive correlates of body mass index in healthy older adults. Behavioural brain research. 2015 Feb 1;278:342-7.
8. Taki Y, Kinomura S, Sato K, Inoue K, Goto R, Okada K, Uchida S, Kawashima R, Fukuda H. Relationship between body mass index and gray matter volume in 1,428 healthy individuals. Obesity. 2008 Jan;16(1):119-24.
9. Volkow ND, Wang GJ, Telang F, Fowler JS, Goldstein RZ, Alia-Klein N, Logan J, Wong C, Thanos PK, Ma Y, Pradhan K. Inverse association between BMI and prefrontal metabolic activity in healthy adults. Obesity. 2009 Jan;17(1):60-5.
10. Walther K, Birdsill AC, Glisky EL, Ryan L. Structural brain differences and cognitive functioning related to body mass index in older females. Human brain mapping. 2010 Jul;31(7):1052-64.
11. Willette AA, Kapogiannis D. Does the brain shrink as the waist expands?. Ageing research reviews. 2015 Mar 1;20:86-97.
12. Mathieu P, Lemieux I, Després JP. Obesity, inflammation, and cardiovascular risk. Clinical Pharmacology & Therapeutics. 2010 Apr;87(4):407-16.
13. Mathieu P, Pibarot P, Larose E, Poirier P, Marette A, Després JP. Visceral obesity and the heart. The international journal of biochemistry & cell biology. 2008 Jan 1;40(5):821-36.

How to cite this article: Patel KH, Parikh J. The relationship between body mass index and cognitive function in young adults – a correlational study. *Int J Health Sci Res.* 2021; 11(7): 58-62. DOI: *https://doi.org/10.52403/ijhsr.20210709*

******