Association between Metacognition and Obesity in Male Individuals of South Indian Population

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Abstract

Introduction: Metamemory is the introspective knowledge of one's brain memory capability and process involved in memory self-monitoring. This self-awareness of memory has important implications for how people learn and use memories. **Aim:** The aim is to assess the metamemory in male obese individuals. **Materials and Method:** A study was conducted among 165 male obese category at random south Indian population. The participants were asked to complete a self-reported questionnaire on Metamemory. The Multifactorial Memory Questionnaire (MMQ), developed to assess separate dimensions of memory ratings that are applicable to clinical assessment and intervention, includes scales of Contentment (i.e., affect regarding one's memory), Ability (i.e., self-appraisal of one's memory capabilities), and Strategy (i.e., reported frequency of memory strategy use). **Result:** Association between corresponding subscale scores and obesity indicates a weak correlation between BMI, satisfaction (r = -.11) and strategy (r = -.11). In addition, the MMQ subscales and the total score showed good internal consistency (αs = 0.81-0.84).**Conclusion:** The results would conclude that overweight and obese male individuals had poor metamemory scores. The study would also help the overweight and obese individuals to identify any early stage of cognitive impairment and create an awareness to delay or prevent any further metacognitive dysfunction.

Keywords: *Metamemory, obese, dementia, physical activity, Cognitive performance, Cingulate gyrus*

Introduction

Metamemory refers to knowledge and monitoring of one's own memory. Metamemory monitoring can be done prospectively with respect to subsequent memory retrieval or retrospectively with respect to previous memory retrieval. [1]. This self-awareness of memory has important implications for how people learn and use memories. For example, when a person asserts that he or she is good at remembering faces, but poor at remembering names, that person is making a statement concerning metamemory knowledge. Metamemory awareness refers to our feelings or experiences of our own memory. For example, if a person feels certain that he or she will remember later something just learned now, that person is having a metamemory experience [2-5]. Metamemory is a subarea of Meta cognitions. Accordingly refers to people's self-monitoring and self-control of their own memory process and strategies that can aid memory. Due to a sedentary lifestyle, more and more people are becoming obese nowadays. In addition to health-related problems, obesity can also impair cognition and motor performance(6).

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Obesity is related to several diseases (e.g., diabetes, stroke, and high blood pressure; [7] and it leads to early death [8] and cognitive decline(9). What are the cognitive causes to enforce, maintain and to eliminate obesity are at a center of an extensive research effort (10,11] .. It is increasingly evident that obesity negatively impacts human health and the prevalence of obesity is increasing world-wide [10]. Both overall obesity (body mass index (BMI) >30 kg/m^2) and fat distribution (waist-hip-ratio (WHR) >1.0 in men and >0.85 in women indicative of abdominal fat accumulation) have been linked to cardiometabolic diseases and death in observational studies (12-15). Compared to BMI, central adiposity has a stronger association with the risk of developing cognitive impairment and dementia in women (16). Therefore it is important to evaluate the state of metamemory in obese female individuals. The state of metamemory in overweight or obese person will surely result in better understanding of the cognitive condition by the physicians. Therefore, the purpose of this study is to investigate and understand the relation between the decrease or increase in metamemory in obese individuals.

Materials and Method

Ethical Consideration:

The study proposal was approved by the board of the Saveetha medical college and hospitals (IRB No. SMC/IEC/2020/03/029). The purpose and objective of the study was clearly explained to the participants through an information sheet. It was emphasized that their participation was optional and the confidentiality of data was assured. The participants were requested to sign a consent form attached with the questionnaire, to ensure their willingness to participate in the study.

Study setting and design:

This was a cross-sectional, descriptive correlational study. This standard questionnaire was done by 165 male obese individuals who volunteered to participate in this study. A convenience sample of participants from 19 to 55 years old female individuals was recruited from Medicine OP, Saveetha Hospitals. The questionnaire was administered through face-to-face contact by the investigator with potential participants. Potential participants who expressed interest in the study were screened for eligibility based on the inclusion/exclusion criteria. Inclusion criteria were as follows: ages from 19 to 55; BMI ranges between 30 to 40; ability to read, speak, and understand english. Participants with comorbidities like diabetes mellitus, hypertension and hyperlipidemia were excluded. Individuals with cognitive impairment (Alzheimer's disease) were also excluded. After the inclusion/exclusion criteria were applied, 165 participants have received paper copies of the study's survey instrument. The questionnaire included about age, height and weight, hence BMI calculated BMI = Weight/Height in meter^2. The participant's BMI ranges are between 30 and 40. Individuals falling under obese I & II category were included.

Procedure:

Perceived memory:

The multifactorial memory questionnaire is a standard metamemory questionnaire (MMQ) which helps to assess a Metamemory of a person. It consists of three scales measuring separate aspects of metamemory. Items are rated on a 5-point Likert scale (0 = strongly agree, 1 = agree, 2= undecided, 3 = disagree, 4 = strongly disagree) based on the test's takers experiences. The three MMQ scales and their respective metamemory domains include: MMQ-Satisfaction (formerly called MMQ-Contentment). This scale measures satisfaction, concern, and overall appraisal of one's own memory. Each of 18 statements is rated based on degree of agreement. The score range is 0 to 72, with higher scores indicating a higher degree of satisfaction. MMQ-Ability. This scale measures self- perception of everyday memory ability. Respondents rate how often they experienced each of 20 common memory mistakes over the previous two weeks. The score range is 0 to 80, with higher scores indicating better self-reported memory ability. MMQ-Strategy. This scale measures the use of practical memory strategies and aids in day-to-day life. Respondents rate how often they used each of 19 memory strategies over the previous two weeks. The score range is 0 to 76, with higher scores indicating greater use of memory strategies. Based on questionnaire data total score ranges are measured. Using a method formula; Prorated Score = Number of possible items X (Obtained score/ Number of completed items).

Data Analysis

Statistical analysis was done using SPSS Version 25.0. Descriptive variables were reported (Mean with standard deviation, Percentage) for all demographic variables. Pearson's correlation analysis was used to assess correlations between BMI and the survey scores (Satisfaction, ability and strategy) and Cronbach's alpha was calculated to measure internal consistency among the individual scores [17]. The significance level was set at 0.05.

Results

Among the 165 participants, the mean and SD for age, height & weight were calculated (Table 1). Mean and SD for BMI and MMQ Subscale scores (Satisfaction, ability and strategy) are given in Table 2. Age and BMI were correlated with MMQ subcomponents (Table 3). The internal consistency of subscale scores are measured by cronbach's alpha to check the reliability. There was a weak negative relationship between age and MMQ subscales (Satisfaction, ability and strategy). This relationship suggests that in obese male individuals, increasing age is associated with decreased satisfaction and strategy. Based on the MMQ subcomponent scores the study participants were found to have more worries about their memory (MMQ-contentment), reported significantly more instances of forgetfulness (MMQ-ability), and use less memory aid strategies in their day-to-day activities (MMQ-strategy) (Table 2 & 3). BMI had a weak negative correlation with MMQ-contentment ($r = -.11$) or MMQ-ability ($r = -.19$) or MMQ-strategy ($r = .11$). In our evaluation with a sample of 165 middle-aged and older obese male individuals analyses using Cronbach's alpha indicated good internal consistency for the Satisfaction ($\alpha = .84$), Ability ($\alpha = .81$), and Strategy ($\alpha = .83$) scales (Table 3).

Table 1: Demographic characteristics of the participants

	Mean	SD	Range
Age (yrs)	45.12	10.2	22 - 67
Height (cms)	155.88	4.1	142 - 165
Weight (kgs)	90.73	9.7	55 - 109

Table 2: Summary statistics for BMI and MMQ raw scores:

Scale	Mean	SD	SEM
BMI	32.23	4.1	0.39
Satisfaction	47.87	8.3	1.3
Ability	51.41	10.4	1.4
Strategy	52.44	10.5	1.4

Table 3: Correlations between demographic characteristics and cognitive variables & internal consistency of MMQ subscales

Scale	Age	BMI	Cronbach's α
Satisfaction	r = - .11	r = - .01	.84
Ability	r = - .19	r = - .03	.81
Strategy	r = - .11	r = - .07	.83

Discussion

In the present study, Obesity in male individual adults showed a negative correlation on all the metacognitive components. When the BMI values were correlated with metamemory components it showed a weak negative correlation. Simply, the study has indicated that male with overweight and obese reported more worries about their memory, more forgetful-ness, and more use of strategies to ameliorate memory difficulties. Based on BMI data, individuals who are overweight or obese, fall in the lowest quartile of global cognition, verbal fluency, delayed recall, immediate logical memory, and intelligence [18]. Other than BMI, other adiposity measures are also related to cognitive performance and brain changes. Visceral adiposity is inversely correlated with verbal memory and attention. High visceral adiposity is associated with smaller hippocampus and larger ventricular volume [19]. There is also a negative correlation between waist-to-hip ratio and hippocampal volume and a positive correlation between waist-to-hip ratio and white matter hyperintensities [20].

Global loss and regional alterations in gray matter volume occur in obese male subjects, suggesting that male subjects with a high BMI are at bigger risk for future declines in cognitive skills or other brain functions [21]. Statistical parametric mapping has revealed a significant negative correlation between BMI and metabolic activity in prefrontal cortex (Brodmann areas 8, 9, 10, 11, 44) and cingulate gyrus (Brodmann area 32) but not in other regions [22-24]. These results further indicate the urgency of creating awareness on obesity in the society. A host of previous literature has suggested that exercise can improve both obesity-related cognitive and motor declines. As more and more people develop obesity in young age, introducing exercise intervention early would result in the greatest benefits towards good health [6].

Conclusion

Obesity has become a worrying health and social issue. The current study also has shown that obese and overweight individuals had poor metamemory scores. Obesity affects cognition mainly through altering the brain structures and functions and motor performance. The study would help the obese individuals to identify any early stage of cognitive impairment and create an awareness to delay or prevent any further metacognitive dysfunction. Regular physical activity and exercise benefits both cognition and motor behaviours.

Limitations:

The small sample size from a single area of the country also limits generalizability. The current study had taken individuals who were obese for past 2 years. BMI measurements were independent of the quantity of total body fat and a number of potential confounders, including age and household income. The study did not differentiate metamemory values between overweight and obesity. Physical activity was not measured. Future research is needed to investigate relationships between these metacognition variables, objective neuropsychological tests, and functional MRI imaging.

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