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Comparing ability of anthropometric measurements as adiposity indicators in identifying decline in cognitive functions

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Abstract

Introduction: Cognitive function refers to mental processes involved in the acquisition of knowledge, manipulation of information, and reasoning. Obesity is a complex disorder of energy balance, related to range of health- problems. In addition it is associated with poorer cognition. The present study was undertaken to assess effect of obesity on cognitive function in younger age group. Various anthropometric parameters body mass index (BMI), waist circumference and waist-hip ratio (WHR) have been used to determine obesity. Upper body fat deposition is concerned with vascular and metabolic dysfunction which increases risk of dementia. Neck circumference (NC) is a simple and convenient screening measure for upper body fat distribution.

Method: A total of 80 health care subjects in age group of 20-35 years who have satisfied inclusion and exclusion criteria and have consented to participate in study were enrolled. Each enrolled subject's anthropometric parameters (NC, BMI. WC and WHR) and cognitive function was recorded and evaluated

Result & conclusion: our result showed that increased NC, BMI and WHR were significantly associated with the increased risk of cognitive decline. Our study concluded that NC can be used as a convenient and effective tool to predict overweight/obesity and relate with decline in cognitive function.

Keywords: neck circumference, young age group, Cognitive functions

Introduction

Overweight and obesity refer to excessive body fat accumulation leading to adverse health effect. It is 5th leading risk to global health challenge.[1,2] India is following the trend with 5% of its population affected with morbid obesity.[3] In addition to health problems, higher BMI is also predictor of progression of normal cognition to cognitive dysfunction. Cognitive function refers to mental processes involved in the acquisition of knowledge, manipulation of information, and reasoning. It includes domains of attention, perception,

memory, learning, decision making, and producing languages.[4]

Similar to obesity, dementia has been increasing. The 2015 World Alzheimer Report predicted that the number of people living with dementia worldwide is expected to increase from 46.8 million in 2015 to 131.5 million in 2050.[5] Growing evidence supports the notion that midlife obesity confers dementia risk in late life.[6,7] Furthermore, considering that accelerated cognitive decline at an early stage is an important predictor of high risk for dementia, though less compelling, but consistent, evidence links obesity at younger age to a steeper subsequent cognitive decline.[8,9] since there is no proper treatment to modify AD. Therefore identifying and correcting of risk factors can lower incidence of dementia and Alzheimer's disease (AD).

Assessment of overweight and obesity is widely done using anthropometric measures like, Body mass index (BMI). BMI is established parameter for grading obesity. Waist circumference (WC) and waist-to-hip ratio (WHR) is used to determine central or visceral adiposity. Recently, neck circumference (NC) is recognized as simple, convenient and easy screening measure for upper body fat distribution and useful as predictor of metabolic syndrome.[10]The studies indicated that NC increase may be due to the presence of pathogenic, fatty deposits.[11]

The Present study was undertaken to1) study association of obesity and decline in cognitive functions in younger age group 2) use of NC as anthropometric measurement to predict obesity/ overweight, by correlating with other measurement parameters. 3) Compare NC and other anthropometric parameters in assessing cognitive health in younger age group. So that implementation of early interventional programs (weight reduction, life style changes and physical exercise) to prevent obesity related decline in cognitive functions, dementia, AD in future.

Materials and Methods

Study Design: 80 normal healthy health care subjects in the age group 20-35 years, willing to get enrolled were randomly selected to obtain mixed group of students from medical, dental and paramedical streams and were screened to identify based on BMI as per world health organization (WHO) for Asian population.[1] 1) Group A - 40 non obese with BMI < 23 kg/m2; and 2) Group B - 40 obese with BMI > 23 kg/m2. The exclusion criteria comprised of subjects suffering from any medical ailments like hypertension, anxious, apprehensive and uncooperative, neurological disorder, any history of smoking, addiction of tobacco, alcohol and use of any medications, surgery and GA. Institutional ethical clearance was obtained.

All anthropometric parameters were measured as per the standard guidelines in a fasting state.[2]All measurements were obtained using a non-elastic measuring tape. Height was measured using Stadiometer to the nearest centimeter. The subject was requested to stand upright without any shoes with back against the wall, heels together and eyes directed forward. Weight was measured with single electronic weighing scale for all subjects. 'BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m2)'[1] WC was measured at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest, in standing position after normal expiration. Hip circumference (HC) is the perimeter at the level of the greatest posterior protuberance of the gluteus. WHR was calculated from WC and HC. NC was obtained with the subject sitting with head in the horizontal

plane position. A measuring tape was applied around the neck below the laryngeal prominence and perpendicular to the long axis of the neck. The minimal circumference was measured and recorded to the nearest 0.1 cm.

Cognitive functions were assessed (Attention, perception, execution and working memory) using online cognitivefun.net program. Attentional tasks were assessed by Visual Reaction Time (VRT), perceptual tasks were assessed by Fast Counting (FC), executive tasks were assessed by doing Stroop Test (ST) colour interference reading and working memory task was assessed by picture 2-back remembering.

Statistical Analysis

Results were analyzed by using unpaired Student T-test with "P" value < 0.05 for significance. Correlation analysis was done to between anthropometric measures and cognitive impairment, based on two-sided tests with a significance level of 0.05.

Results

80 subjects, 40 group A (non obese) and 40 group B (obese) that have satisfied the inclusion and exclusion criteria were selected.

Table 1: Comparison of mean (± SD) of demographic and anthropometric parameters in groups

Parameters	Group A (n-40) mean ± SD	Group B (n-40) mean ± SD	t-value	p-value
Age (yrs)	26.78 ± 2.95	27.10 ± 3.50	0.4492	0.6545 (NS)
Body weight (Kgs)	54.528 ± 8.70	82.750 ± 12.22	11.8930	0.0001 (HS)
SBP(mm Hg)	112.40 ± 9.21	118.43 ± 9.27	2.9152	0.0046 (HS)
DBP (mm Hg)	70.93 ± 6.68	72.93 ± 3.98	1.6262	0.1079 (NS)
BMI	20.042 ± 2.26	30.905 ± 2.64	19.7116	0.0001 (HS)
WC (cm)	66.90 ± 7.58	85.65 ± 13.82	7.5237	0.0001 (HS)
WHR	0.81 ± 0.05	0.88 ± 0.02	8.4316	0.0001 (HS)
NC (cm)	30.03 ± 2.34	35.48 ± 3.04	8.9929	0.0001 (HS)

(p > 0.05 for significance, NS – statistically not Significant, HS - statistically highly significant, SD – standard deviation, SBP – Systolic blood pressure, DBP – Diastolic blood pressure)

Table- 1, participants showed statistically significant difference in body weight, BMI, WC, WHR, NC and SBP. Age and DBP were not statistically significant in groups.

Table 2: Comparison of mean (± SD) of cognitive functions in groups

Parameters	Group A (n-40) mean ± SD	Group B (n-40) mean ± SD	t-value	p-value
Attention	504.61 ± 105.69	521.61± 126.49	0.6520	0.5163 (NS)
Perception	(83%) 946.54 ± 178.59	(67%) 1040.91 ±133.65	2.6756	0.0091 (HS)
Execution	(92%) 920.14 ± 88.74	(87%) 1112.48 ± 158.03	6.7114	0. 0001(HS)
Working memory	(63%) 1076.78 ±244.82	(54%) 1253.97 ± 426.52	2.3974	0.0232 (S)

(p > 0.05 for significance (S), NS – statistically not Significant, HS - statistically highly significant, Correct responses (%)

Table 2: shows statistically significant increase in duration of cognitive functions (perception, execution working memory) and decreased correct responses (%)

in groups. Attention domain did not show statistically significant change in duration.

Table 3: correlations of anthropometric parameters with cognitive functions in obese group

	BMI		WHR		NC	
	r-value	p-value	r-value	p-value	r-value	p-value
Attention	0.4269	0.0060(S)	0.3991	0.0173(S)	0.4003	0.0104(S)
Perception	0.3914	0.0125(S)	0.260	0.1051(NS)	0.340	0.0318(S)
Execution	0.466	0.0024(S)	0.350	0.0268 (S)	0.35	0.0268(S)
Working memory	0.2736	0.0875(NS)	0.061	0.7084(NS)	0.290	0.0694(NS)

($p > 0.05$ Not Significant(NS), $p < 0.05$ Significant (S))

Table-3, Pearson correlation analysis was done to assess the strength of association of various domains of cognitive functions with anthropometric parameters in obese group. BMI, WHR and NC were significantly positively correlated with domains attention and execution but positive correlation with working memory was not statistically significant. BMI and NC also showed significant positive correlation with perception. WHR was not statistically correlated with perception.

Discussion

The prevalence of abnormal or excessive fat accumulation and its related health impairments is increasing worldwide.[1] According to National Family Health Survey data, 12.1% males and 16% females in India are obese or overweight.[3] Irrespective of its genesis, obesity is related to range of health-related problems. Due to increase in sedentary habits, over consumption of fast foods rich in fats have contributed to the rapid increase in the incidence of obesity and its complications. However, some individuals are more prone to these changes than others and get overweight. Inability to control overeating or binge eating may be related to decrease in efficiency of cognitive control.[12] Studies has shown an association between western high fat food and impaired cognitive functions.[13] Mechanisms underlying cognitive dysfunction in older, obese, studied by neuroimaging, demonstrate atrophy in prefrontal cortex and cingulated gyrus, hippocampus and thalamus.[14] Obesity related changes in metabolism are associated with vascular changes which increases risk of dementia.[15] Individuals with high midlife BMI have lower cognition.[16-17] However midlife BMI with metabolic abnormality is related with higher dementia risk in older adulthood.[18-20] Studies in juvenile and adult mice showed early exposure to high fat diet decreases neurogenesis and affects learning, memory and affect cognition.[21] Number of other factors responsible for effect of obesity on cognition are change in brain structure, Leptin [22] and insulin[23] dysregulation, oxidative stress & inflamation,[24] impaired cerebrovascular function, impede leptin transportation across the blood-brain barrier and increase inflammatory signaling in the brain.[25]

The previous study of midlife and elderly reported increased BMI was related to cognitive impairment as measured by questionnaire. However, our study is the first to investigate whether decline in cognitive functions is seen with overweight/ obese younger age group using online cognitive test.

BMI and WHR commonly used indicator of overweight/obesity. WHR considered for measurement of central obesity, contributing to visceral fat and subcutaneous fat. NC is also used as index of upper

body fat to identify and to predict obesity-related metabolic abnormality.[26]

In our cross sectional study on younger health care population, NC was significantly higher in overweight or obesity than non-obese, suggesting high BMI, high WHR and high NC associated with overweight or obesity. Sharma. et al investigated 400 Type -2 diabetic mellitus cases of age group 20-80yrs and concluded NC correlates well with other anthropometric parameters of obesity such as BMI, WC, and WHR in both male and female subjects. [27]

Our results indicated that high BMI, high WHR and high NC were significantly associated with greater cognitive declines, in otherwise healthy young adults. Similarly, in Chen JM et al cross sectional study on elderly population which included 269 participants of more than 60yrs age group, NC and other anthropometric measurements were significantly associated with increased risk of cognitive impairment .[15] NC as an anthropometric measurement is easy and convenient to use, as compare to WC and WHR, to identify overweight or obesity and predict related abnormality including cognitive impairment.

Limitation of Study

Our study does not give the mechanism of link between decline cognition and obesity in young age. It did not evaluate possible effect of hypertension, grip strength training, diet pattern, sleep deprivation, genetics on cognitive function in obese. Larger samples size, studies from other communities, compare with other age groups would have been preferable.

Conclusions

The overall findings of this study indicate detection of obesity is based on anthropometric measurements. Our result indicated increased NC, BMI and WHR were significantly associated with the increased risk of cognitive decline. NC correlates well with other anthropometric parameters of obesity such as BMI WC, and WHR in assessing obesity in young adult subjects. Our study concluded that NC can be used as a convenient and effective tool to predict overweight/obesity related decline in cognitive function.

Understanding of risk with obesity, with decline in cognitive function in younger age group. However it can be reversed by early implementation of interventional programs (yoga, life style changes, and weight reduction) to prevent permanent changes in brain leading to dementia, Alzheimer's disease in future.

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