

RESEARCH ARTICLE

Short term memory in obese and non-obese female school children

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Received: March 03, 2017; Accepted: March 18, 2017

ABSTRACT

Background: Obesity affects some vital parts of the brain such as pre-frontal cortex (responsible for short-term memory), hippocampus (responsible for long-term memory) frontal and temporal lobes (required for planning and memory) it damages the tissues of the brain to such an extent that a very less proportion of brain is available for retention of memory. **Aim and Objectives:** To find out the short-term memory status by visual tasks in obese and non-obese female school children of urban areas. **Materials and Methods:** A total of 30 subjects in the age group of 9-15 years were taken from the various schools in Kurnool. Among them, 13 subjects are obese (as cases), and 17 subjects are non-obese children (as controls) for this study. The following tests of short-term memory were conducted which are sub tests of Test of Memory and Learning and Weschler's intelligence scales for children. Visual tasks include the following tests; (1) Alphabetical (letter span) test, (2) numerical (digit span) test, (3) word memorization test, and (4) object recall test. **Results:** Non-obese children are having a better overall short-term memory than the obese children and also performed better in all the individual visual tasks memory tests. **Conclusion:** Obesity affects short-term memory in female school children.

KEY WORDS: Obesity; Short-term Memory; Alphabetical Test; Numerical Test


INTRODUCTION

In addition to the apparent involvement of short-term memory in arithmetic processing and language comprehension across the life span, adult studies have established links between short-term memory capacity and many intellectual abilities, such as following directions, note-taking, writing, reasoning, and complex learning.^[1] Given the range of important everyday cognitive activities that appear to be constrained by short-term memory, it seems reasonable to suppose that children with severely compromised short-term memory capacities will be educationally disadvantaged at school, experiencing

a range of learning difficulties.^[1] Obesity affects some vital parts of the brain such as pre-frontal cortex (responsible for short-term memory), hippocampus (responsible for long-term memory) frontal and temporal lobes (required for planning and memory) it damages the tissues of the brain to such an extent that a very less proportion of brain is available for retention of memory.^[2] Hence, this study was planned with the objectives to study the impact of obesity on short-term memory status in female children and also to find out the short-term memory status by visual tasks in obese and non-obese school going female children of urban areas.

MATERIALS AND METHODS

A total of 30 female subjects in the age group of 9-15 years were taken from the various schools in Kurnool. Among them, 13 subjects are obese (as cases), and 17 subjects are non-obese children (as controls) for this study. A brief history, general examination, and systemic examination

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2017.7.0307818032017	

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were performed and healthy subjects were recruited or taken based on the inclusion and exclusion criteria. Inclusion criteria: According to inclusion criteria subjects are taken in the age group of 9-15 years, obese children and non-obese children (normal weight). Exclusion criteria: Children with apparent visual defects and illness related to neurological and psychiatric disorders, diabetes mellitus, hypertension, history of head injury, family history of psychiatric illness, past or current history of drug dependence, antidepressants, and other disorders which could affect short-term memory. The selected subjects were tested in the morning hours of school after having their breakfast, anthropometric measurements - such as height and weight - are taken and body mass index (BMI) was calculated.

BMI = Weight in kg/height in meter.

Based on the BMI values, the subjects are divided into obese children, non-obese children (normal weight) according to their age and gender in accordance with center for disease control percentiles of children. Later, the following tests of short-term memory were conducted which are sub tests of Test of Memory and Learning and Weschler's intelligence scales for children.^[3]

Visual tasks include the following tests:

1. Alphabetical (Letter span) test: In this test five trials were given. Each trial contained, sets of alphabets, i.e., in first trial - 2, second trial - 4, third trial - 6, fourth trial - 8, and fifth trial - 10 alphabets, such as U, M and T, Z, L, D. Alphabets were flashed for 3 s in each trial and subjects were asked to write the alphabets immediately on the paper provided, whatever they remembered.
2. Numerical (digit span test): In this test, five trials were given. Each trial contained, sets of numbers, i.e., in first trial - 2, second trial - 4, third trial - 6, fourth trial - 8, and fifth trial - 10 alphabets, such as 4,9 and 2,7,4,1. Numbers were flashed for 3 s in each trial and subjects were asked to write the numbers immediately on the paper provided, whatever they remembered.
3. Word memorization test: Subjects were given 30 s to look at a list of 15 words which were used commonly in daily life, such as eggs, apple, and chair. Then, the subjects were asked to recall all the words or whatever they remembered and ask them to write on a paper given immediately.
4. Object recall test: A tray containing 15 commonly used objects, such as lock and key, flower, and pen was shown to the subjects for 30 s. The tray was covered with cloth and then the subjects were asked to write the names of the objects whatever they remember on a paper provided immediately.

Statistical Analysis

Statistical analysis was performed using SPSS 22.0. Mean and standard deviation were calculated for all the memory tests.

Student *t*-test was used to find out the association between the variables. *P* < 0.05 was considered for establishing the significance.

RESULTS

Table 1 describes the comparison of results of alphabetical (letter span) test in obese and non-obese children. Statistical significant difference was found in the trials 2 and 4 between obese and non-obese children. According to Table 2 significant difference was found only in the trial 5 between obese and non-obese children for the results of numerical test (digit span test). Word memorization test show that non-obese children have memorized more words as compared to obese children and the difference was statistically significant (Table 3). According to object recall test, non-obese children have performed significantly better as compared to obese children (Table 4).

DISCUSSION

Results of this study were correlating with the earlier studies where obese children have less scores in letter span test

Table 1: Alphabetical (letter span test) in obese and non-obese children

Trial	Mean±SD		t value	P value
	Obese	Non-obese		
Trial 1	100.000±0	100.000±0	ns	NS
Trial 2	78.846±33.612	100.000±0	2.609	0.014*
Trial 3	69.230±38.397	88.235±21.861	1.714	0.097
Trial 4	57.692±38.709	81.617±26.189	2.019	0.031*
Trial 5	45.384±31.784	48.235±27.439	0.263	0.794

**P*<0.05 (significant difference), SD: Standard deviation

Table 2: Numerical test (digit span test) in obese and non-obese children

Trial	Mean±SD		t value	P value
	Obese	Non-obese		
Trial 1	96.153±13.868	100.000±0	1.1499	0.260
Trial 2	100.000±0	97.059±12.127	0.8708	0.391
Trial 3	88.461±29.957	100±0	1.5969	0.122
Trial 4	47.115±36.853	60.294±38.587	0.9449	0.353
Trial 5	44.615±27.573	65.294±26.720	2.0719	0.048*

**P*<0.05 (significant difference), SD: Standard deviation

Table 3: Word memorization test in obese and non-obese children

Mean±SD			t value	P value
	Obese	Non-obese		
53.333±15.635	67.059±14.428	2.491	0.0190*	

**P*<0.05 (significant difference), SD: Standard deviation

Table 4: Object recall test in obese and non-obese children

Trial	Mean±SD		t value	P value
	Obese	Non-obese		
Trial 1	49.230±17.751	60.784±15.791	1.882	0.070
Trial 2	44.691±17.813	63.769±16.432	3.9101	0.000*

* $P < 0.05$ (significant difference), SD: Standard deviation

compare to non-obese children.^[4,5] All the subjects showed a progressive decrease in short-term memory status from third trial onward. This may be due to an increase in a number of alphabets in each trial. Normal individual can hold 7 + 2 bits of information in working memory where these bits can be manipulated and other discontinued or retained as a more permanent memory store. The number of items a person can remember from a single glance at a visual display is quite small usually 5-7 items. This amount called the span of apprehension is limited because people can only remember as many items as they can identify and store in memory while the visual display is available. In second trial, third trial, fourth trial, and fifth trial, memory status was low in obese female children compared to non-obese female children as there is difference in mean value, and the difference is statistically significant in trial 2 and trial 4 as $P < 0.05$.

Correlating results of this study with earlier studies it was found that obese children scores were less in digit span test compare to non-obese children.^[6-9] Opposing results were found in some other studies.^[10-12] All the subjects showed a progressive decrease in short-term memory status from third trial onward in numerical test or digit span test. This may be due to an increase in a number of numerical in each trial. The cause for the progressive decrease in memory status for numerical test remains same as that for Alphabetical test.

Obese children scored less in word memorization test compare to non-obese children.^[9,10,13] The decrease in memory status for words test when compared to fourth trial (of 8 letters/numbers) or fifth trial (of 10 letters/numbers) of alphabetical/numerical tests may be due to several factors. The word recall will depend on its position in the list. If subjects attempt to recall the words immediately; they remember first few words and the past few words. In this study, 15 words with least of 3 letters to maximum of 7 letters were displayed in the visual task. When words are displayed the visual image persists for <1.0 s. The memory system used to hold this image has been called iconic memory.^[14] George Miller argued that human short-term memory has a forward memory span of approximately 7 items or more accurately within the information theoretic single digit or letter, while an item can indeed be a single digit or letter, it can also be a whole number, word or abstract concept.^[15]

Results are correlating with earlier studies where non-obese children have a better memory for object recall test compare

to obese children.^[16] This better memory status for object test may be due to several factors. Sight enriches one's relation with the world around. Through sight, one can register millions of facts. Memories of the faces, colors, and objects around exemplify the capacity of one's visual memory. Main areas of the brain that are reported to be effected in obesity are; frontal and temporal lobes (for planning and memory), anterior cingulate gyrus (responsible for attention and executive functions), hippocampus (for long-term memory), and basal ganglia (essential for proper movement and coordination).^[17] Excessive caloric intake may lead to oxidative damage leading to structural changes in the brain, less intake of calories and eating healthy diet may be a simpler way to prevent memory loss as we are advancing in age.^[18]

There are several alternative explanations that might better account for how obesity affects memory, such as endothelial dysfunction, reduced cardiovascular functions, inflammatory processes, dysregulation of neuroendocrine functions, and deficiency of micronutrients. All the above-mentioned conditions are prevalent in obese individuals than the non-obese children and they are associated with poor cognition.^[19] Physically fit children are having 12% bigger hippocampal volume. They performed better on remembering information. Physical exercise has beneficial effect on improvement of memory and learning.^[20] Results are showing positive correlation with the hypothesis that obesity affects short-term memory in school going female children.

CONCLUSION

Obesity affects short-term memory in female school going children.

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How to cite this article: Sorrakayala S, Rao MV. Short-term memory in obese and non-obese female school children. *Natl J Physiol Pharm Pharmacol* 2017;7(7):733-736.

Source of Support: Nil, **Conflict of Interest:** None declared.