RESEARCH PAPER

# Breakfast Eating Habit and its Influence on Attention-concentration, Immediate Memory and School Achievement

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## ABSTRACT

***Objective:*** *To study the relationship of breakfast to the attention -concentration, immediate recall memory, nutritional status and academic achievement of school children.* ***Design:*** *Cross-sectional study.* ***Setting:*** *Two schools catering to middle class families in Hyderabad city.* ***Methods:*** *379 urban 11 to 13 years old school children studying in 6th, 7th and 8th grades. Data collected in a single way blind procedure using Letter Cancellation test, immediate memory from the PGI Memory Scale, school marks of the previous year and nutritional status.* ***Results:*** *Comparison between groups indicated significant differences in the letter cancellation (LC) total scores with the regular breakfast group achieving the highest mean scores compared to the no breakfast group ($P<0.05$). Marks scored by the regular breakfast group in subjects - Science, English and total Percentage were significantly higher compared to those scored by the children in the no breakfast group. Regular breakfast eating habit and weight for age percent were significantly ($P<0.001$) associated with immediate recall memory score explaining 4.3 percent variation.* ***Conclusions:*** *Regular habit of eating breakfast as opposed to irregular consumption or skipping breakfast altogether had beneficial influence on attention-concentration, memory and school achievement.*

**Key Words:** *Attention-concentration, Breakfast, Children, Immediate memory, School achievement.*

## INTRODUCTION

Eating breakfast provides energy for the brain and improves learning. The effect of glucose deprivation is noticeable by a fall in blood glucose level of sufficient degree, which is rapidly followed by disturbance in cerebral function(1). The gap of about 10 to 12 hours between dinner and breakfast causes, low blood glucose levels and habitually missing breakfast can adversely affect cognitive performance. The gradual decline of insulin and glucose level could determine a stress response, which interferes with different aspects of cognitive function, such as attention and working memory. It is plausible that the decline in cerebral iron level likely to result from diet that is deficient in heme intensifies the stress associated with overnight and morning fast(2).

Sustained contribution of breakfast to a person's health status over time is particularly relevant for children whose daily dietary intake barely meets the requirements(3). Breakfast eaters tend to have higher basal metabolism, and have less craving for the food. Children who skip breakfast but eat later on in the day may catch up their daily nutrient requirements but are unlikely to attend and concentrate on the teacher's lecture in the morning session because they are hungry. If the transitory metabolic changes due to skipping breakfast were to occur frequently, they would be likely to have a cumulative adverse effect that may place a child's school progress at risk(4).

The present study hypothesized that, the habit of consuming breakfast regularly in combination with other demographic factors, nutritional status and regular school attendance will positively influence

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attention-concentration, memory and academic performance of students. We aimed to study the relationship of breakfast to the attention-concentration, immediate recall memory, nutritional status and academic achievement of schoolchildren 11-13 years of age.

## METHODS

This cross-sectional study was conducted among 379 urban middle class children aged between 11 to 13 years studying in 6th, 7th and 8th grades in two schools catering to middle class families in Hyderabad city.

Breakfast was defined as "the first meal of the day that has been taken in the morning, before going to school (*i.e.,* before 9am)". 'Breakfast' is referred to any food item solid or liquid excluding caffeinated drinks.

Data were collected in a single way blind procedure. Those eating breakfast regularly (Group I), irregular breakfast eaters i.*e.,* those skipping breakfast 2-3 times a week (Group II) and those who habitually never ate breakfast (Group III) were identified on the basis of a pre-tested questionnaire on breakfast eating habit, that was filled up by the children after they were tested on psychological tests. Data on memory, attention-concentration, school achievement, growth and socioeconomic status were collected using the following tests and procedures:

***Letter cancellation test*:** The test takes 5 minutes and requires eye-hand coordination, speed, and sustained attention-concentration. Test-retest reliabilities ranged from 0.89 to 0.92 for the total score after a five-hour interval, and 0.92 for the total score minus errors after a 12-month interval(5). Instructions and scoring were followed as per the manual.

***PGI memory scale*:** Although this tool(6) was developed for adults to assess dysfunction, the modified version of the 'immediate recall' sub-test was used after adaptation and validation for school children(6).

The Letter cancellation and Immediate memory tests were administered to the students in each class as group tests with one following the other, during the morning session of school between 9 to 11 am.

***Assessment of nutritional status*:** The height and weight of the study children were measured and compared against NCHS standards for the respective ages(7).

***Socioeconomic status*:** Socioeconomic Status Rating Scale (SESRS) was used to assess the socioeconomic status (SES) of the families(8). Information regarding locality, religion, caste, education and occupation of parents, family type, etc., was filled up by the parents.

***School achievement***: Previous year's annual examination marks for Math, Science and English were used for analyzing school achievement.

***Breakfast questionnaire*:** A questionnaire to identify breakfast eating pattern was developed and pre-tested for the study. This questionnaire also assessed the type of breakfast foods, and reason for not taking breakfast on a regular basis.

***Data analysis:*** Sample size estimates were based on a confidence interval of 0.95 and power efficiency (1-$\beta$) of 0.80, which are accepted international norms. Statistical package for social science (SPSS) version 11.5 was used for the data analysis. ANOVA with Post-hoc square was used to study the association of nutritional status and the breakfast eating pattern. Multiple linear regression analysis was done to assess the contribution of each independent variable (SES, type of breakfast eating habit, and nutritional status) in explaining the variation in the dependent variables (attention-concentration, immediate recall, and school marks). The level of the significance considered was $P<0.05$.

## RESULTS

The 379 subjects selected for the study were in the age group of 11-13 years. 62.3 % of children habitually consumed breakfast (Group I), 33.8 % consumed it irregularly, skipping it 2 or 3 times a week (Group II) and, 3.9 % did not consume breakfast at all (Group III). 44.3% subjects had completed 11 years of age, 38.5% had completed 12

years of age and 17.2% had completed 13 years of age. About 55% were boys and 45% girls.

***Maternal education and occupation:*** Majority of mothers were housewives (68.6%, Group I; 76.6%, Group II; and 73.3%, Group III). Percent post graduate mothers were the highest in the Group I (61.4 %) compared to Group II (56.3%) and Group III (46.7%). However, these differences were not significant.

***Nutritional status:*** There were 4.7%, 9.4% and 6.7% underweight children in Group I, Group II and Group III, respectively. The percentage stunting among children in the 3 groups was 12.7%, 12.5% and 13.3%, respectively. These differences were not statistically significant.

***Attention-concentration, memory and school achievement: Table* I** shows that there were significant differences in the letter cancellation (LC) total scores with Group I achieving the highest mean scores compared to Group III ($P<0.05$). Marks scored by Group I in Science, English and total percentage was significantly higher compared to those scored by Group III, but not Group II.

***Multivariate analysis: Table* II** shows that regular breakfast eating habit was found to be significantly ($P<0.02$) associated with LC scores of the children explaining 1.4 percent variation. Regular breakfast eating habit and weight for age percent were significantly ($P<0.001$) associated with immediate recall memory explaining 4.3 percent variation.

**TABLE I** LETTER CANCELLATION (LC) AND IMMEDIATE RECALL MEMORY SCORES, AND SUBJECT MARKS IN CHILDREN ACCORDING TO BREAKFAST EATING PATTERNS

| Variables | **Group I** ($n$=226) Mean ± SD | **Group II** ($n$=128) Mean ± SD | **Group III** ($n$=15) Mean ± SD |
|---|---|---|---|
| Letter cancellation score | 145.3 ± 32.4 | 140.6 ± 33.4 | 124.8 ± 32.8 |
| Immediate memory recall | 4.3 ± 1.9 | 4.0 ± 1.7 | 3.6 ± 1.9 |
| Marks obtained | | | |
| Math | 56.7±18.1 | 56.3±15.6 | 45.9±18.9 |
| Science | 66.2±18.3 | 62.5±17.4 | 55.3±14.8 |
| English | 66.2±18.5 | 61.9±15.1 | 55.5±16.9 |
| %Total | 63.3±18.5 | 60.0±14.5 | 52.2±15.2 |

*Breakfast eating pattern: Group I-Regular, Group II-Irregular(skipping breakfast 2-3 times/wk), Group III-No breakfast.*

**TABLE II** ORDER AND SET OF VARIABLES ASSOCIATED WITH LETTER CANCELLATION SCORE, IMMEDIATE RECALL MEMORY AND SCHOOL MARKS OF PREVIOUS YEAR ANNUAL EXAM

| Dependent variable | Order of variable | $R^2$% | F Ratio | $P$ value |
|---|---|---|---|---|
| Letter cancellation score | Habit (regular breakfast) | 1.4 | 5.3 | 0.02 |
| Immediate recall memory | Weight for age and regular breakfast habit | 4.3 | 8.5 | 0.001 |
| Math marks | Occupation of mother | 2.5 | 9.6 | 0.01 |
| Science marks | Type of family, regular breakfast habit and height for age | 6.2 | 8.3 | 0.001 |
| English | Regular breakfast habit and education of mother | 4.8 | 9.4 | 0.001 |
| Percentage of marks | Regular breakfast habit | 1.9 | 7.3 | 0.01 |

*Step-wise multiple linear regression analysis: Independent variables = Community, Education of mother, Education of father, Occupation of father, Occupation of mother, Type of family, Type of house, Height for age, Weight for age and Breakfast habit (regular, irregular, no breakfast).*

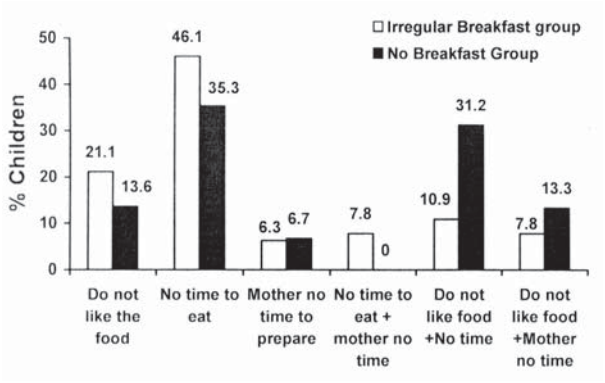


FIG. 1 *Reasons for skipping breakfast.*

Significant association ($P<0.01$) was found between maternal occupation and maths marks of the previous year explaining about 2.5 percent variation. Family type, regular breakfast habit and height for age were significantly ($P<0.001$) associated with children's science marks explaining about 6.2 percent variation. However, among these, height for age was negatively associated, a finding that is difficult to explain in the present study. Education of the mother (≥graduate) and regular breakfast habit were significantly associated with the English marks, explaining 4.8 percent variation. Regular breakfast was significantly ($P<0.01$) associated with total aggregate marks and explained about 2 percent variation in it.

***Types of foods consumed for breakfast*:** Foods that were routinely consumed at breakfast by Group I and Group II were cereal (23.3%) and, cereal and pulse (42.4%) based items. 9.7% consumed cereal and milk based or cereal, pulse and milk combination or just milk. 3.4% consumed eggs and 2.11% fruits.

***Self report of symptoms by the subjects:*** Self reports of feelings of children indicated that 91.4% in Group I did not feel sleepy during the morning session of the school compared to 59.4% in Group II and nearly 75 % in Group III. The difference was significant at $P<0.001$. Group I (97.5%) was able to concentrate better during morning session of the school compared to Group II (77.3%) and Group III (54%). These differences were statistically significant ($P<0.001$).

***Reasons for skipping or not eating breakfast: Fig.* 1** shows the distribution of groups according to their reasons for skipping breakfast. These results indicate poor time management as a major reason that prevented children from eating breakfast and mothers from preparing the same.

## DISCUSSION

Results indicate that regular habit of eating breakfast as opposed to irregular consumption or skipping breakfast altogether had beneficial influence on attention-concentration, memory and school achievement. More than any other meal, the eating of breakfast is probably the first to get compromised as a result of poor time management. This fact is borne out in the study by Ortega, *et al.*(9) that found children eating a more substantial breakfast during holidays than on school days. The findings of the present study also indicate constraints on time as the major reason for skipping, apart from mothers not having the time to cook and a monotonous type of breakfast preparation.

Seventy percent children consumed cereal based or cereal and pulse based breakfast. Almost 10 percent consumed cereal plus milk based or cereal, pulse and milk combination or just milk. Few children consumed eggs and fruit. Studies elsewhere, found that cereal, milk and dairy products were major breakfast constituents among children and adolescents(10). Notwithstanding the type of breakfast, the results in the present study showed that eating breakfast on a regular basis had beneficial effect on school achievement and attention-concentration.

Children's subjective feelings of sleepiness and lack of concentration during the morning session of the school substantiated the findings on the Letter Cancellation test. Group I children responded that they were able to concentrate in class during the morning session of school. These results were not observed by many other studies, except the one by Fernald, *et al.*(11) who found that children in well-equipped classrooms paid more attention in class after having breakfast. Group III children responded that they did not feel hungry in the morning session of the school. This finding may be attributed to the formation of the habit of remaining hungry to the extent that it becomes imperceptible over time. The

**WHAT IS ALREADY KNOWN?**

- Micronutrient supplementation improves attention concentration among school children.

**WHAT THIS STUDY ADDS?**

- Regular habit of consuming breakfast can improve attention-concentration, memory and school achievement.

differences between the groups on feelings of hunger were not significant. On the contrary, another study(12) demonstrated that participation in school breakfast program enhanced daily nutrient intake and decreased feelings of hunger.

The results of the multiple regression analysis indicate significant association between the independent variables *viz*., regular breakfast eating habit, maternal education (higher) and maternal employment, weight for age and nuclear type of family with the dependent variables *viz*., attention-concentration, immediate memory and school achievement. Maternal employment was not an obstacle to consumption of breakfast. Students who regularly consumed breakfast were better nourished (weight for age index) and achieved higher scores on the immediate recall memory test and performed significantly better on the letter cancellation test (attention-concentration).

*Contributors:* NSG was involved in the data collection, and preparation of the manuscript. SF was involved in data collection for psychological parameters and drafting of the manuscript. NBK was instrumental in data analysis. SV developed the concept, interpreted the results, and corrected the manuscript. She will act as guarantor of the study.

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