**Effect of Breakfast consumption pattern on cognitive skills and nutritional status of higher primary school children**

**ABSTRACT**

A study was conducted to examine the effect of breakfast consumption pattern on cognitive skills and nutritional status of higher primary school children at University of Agricultural Science Dharwad (2021-2022). The population of the study comprised of 60 children from rural and 60 children from urban (aged between 10-13 years) in Dharwad district who attended higher primary school (5th, 6th and 7th classes) selected from door to door survey method. Self structured questionnaire was used to collect the general information and breakfast consumption pattern of children. The cognitive skills of children were assessed by using Wechsler’s Intelligence Scale for School Children (WISC-III). Results revealed that, cognitive tests and cognitive skills score was found regular breakfast consumer was higher score than the irregular breakfast consumers in both rural and urban areas. Rural areas, regular and irregular breakfast consumers had average level of cognitive indices and urban regular breakfast consumers had high average level and irregular breakfast eaters had average level of cognitive indices. Promoting and providing a healthy breakfast at home / school may particularly help breakfast skippers and should lie even in the interest of policymakers.

Introduction

Breakfast is described as the first meal which breaks the fast that had been for over twelve to fourteen hours (Wayon *et al.* 1997). It is a fact that gap between dinner and breakfast is so high that an individual is really starving without a breakfast, there is a possibility of low blood glucose level and low metabolic rate, irritability and fatigue (Marika 2003). The quality of breakfast is important as it affect nutritional status of children, as well as the metabolic rate, physical growth, health and general well being of the children.

There is also evidence that, breakfast consumption is beneficial for cognitive performance in school children. Children particularly adolescents are more sensitive to the nutritional effects of breakfast on brain activity and associated cognitive outcomes. Healthy eating breakfast pattern active play an important role in cognition of children. Skipping of breakfast has adverse effect on cognitive performance in school as the fall in glucose level result in disturbance of cerebral functioning. Regular consumption of breakfast helps in enhanced attention and problem solving ability in schools. It has been observed that poor nutritional status can adversely affect the brain functioning make an impact on cognition and individuals behavior (Bayerl *et al.* 2013)

When skipping of breakfast becomes frequent, there is a gradual decline in blood glucose and insulin concentrations. For the brain and not for other organs, glucose is pretty much source of energy. Without needed fuel, the brain cannot function at optimal performance, children become lethargic and apathetic. As a child continues to skip breakfast into adolescence, the developing brain is affected. Breakfast skipping run the risk of becoming malnourished which has been linked to delayed cognitive development (Bayerl and Stang, 2003). Breakfast is among the food which in early morning satisfies the nutritional needs and increases mental work load ability.

**MATERIALS AND METHODS**

Children were selected randomly between the age group of 10-13 years residing in the rural and urban area of Dharwad taluk, Dharwad district, Karnataka state. Four localities were selected from the Dharwad city and four villages were located from the rural areas of Dharwad taluk. From each locality and villages a sample of 15 children were randomly selected (boys and girls). Thus, a total of 120 school children were selected for the study. Home visits were made to collect child’s general information and their breakfast consumption pattern through structured schedule and children were assessed for their cognitive skills using Wechsler’s Intelligence Scale for School Children (WISC-III). All the testing procedures were followed as per the WISC-III manual. Testing for each child took around 45 min to 1 hour.

**Tools used for assessment**

**Structured schedule** **for breakfast consumption:** The schedule is used to assess the child’s breakfast consumption based on the number of days ofbreakfast consumption per week, children were catagorised as regular and irregular breakfast consumers. Children who consumed breakfast for more than 5 days in a week they were considered as regular breakfast consumers, if less than 5 days, they were considered as irregular breakfast consumers (Hazzaa *et* *al.* (2019).

List 1 : **Structured schedule for breakfast consumption of children per week**

|  |  |
| --- | --- |
| **No of days** | **Type of children** |
| >5 days in week | Regular breakfast consumer |
| <5 days in week | irregular breakfast consumer |

**Nutritional status:** Nutritional status of children was assessed by anthropometric measurements such as height and weight which were recorded and compared with standards as indicated by Jelliffee (1996).

**Body Mass Index calculation:** BMI was calculated by child’s weight (in kg) divided by the square of the child’s height (in metres (/m2), as a measure for indication of nutritional status which is classified as below:

Weight (kg)

BMI = ——————

(Height (m))2

**List 2 :Body Mass Index calculation of children**

|  |  |
| --- | --- |
| **Nutritional status** | **BMI scores** |
| Under weight | <18.5 |
| Normal weight | 18.5-24.9 |
| Over weight | 25-29.9 |

**Wechsler’s Intelligence Scale for School Children (WISC-III):** The Wechsler’s Intelligence scale for school children (WISC-III) is an individually administered clinical instrument for assessing the cognitive abilities of 6-16 years old children. This scale consists of 13 subtests, each measuring different aspects of intelligence.

List 3:**Wechsler’s Intelligence scale for school children**

|  |  |
| --- | --- |
| **Performance Tests** | **Verbal Tests** |
| 1. Picture completion | 1. Information |
| 1. Coding | 1. Similarities |
| 5. Picture arrangements | 6. Arithmetic |
| 1. Block design | 1. Vocabulary |
| 1. Object assembly | 10. Comprehension |
| 11. Symbol search | 12. Digit span |
| 13. Mazes |  |

In addition to the verbal performance and full scale IQ scores, four factors based index scores were also calculated.

List 4 :**Four factors based index scores of children**

|  |  |  |  |
| --- | --- | --- | --- |
| **Factor-I**  **Verbal comprehension** | **Factor-II**  **Perceptual organization** | **Factor-III**  **Freedom from distractibility** | **Factor-IV**  **Processing speed** |
| Information  Similarities Vocabulary  Comprehension | Picture organization  Picture arrangement  Block design  Object assembly | Arithmetic  Digit spas | Coding symbols search |

**Description of the subtests:**

1. **Picture completion:** A set of colourful pictures of common objects and scores each of which is missing as important part which the child identifies.

Materials-31 cards. Time limit-20 sec per each card. Discontinues - after 5 consecutive failures

1. **Information:** A series of orally presented questions to tap the child’s knowledge about objects, events, places and people.

Materials-30 questions. Time limit-immediate answers is continues - after 5 consecutive answers

**3. Coding:** A series of simple shapes (coding A) or members (coding B) each paired with a simple symbol. The child draws the symbol in its corresponding shape (coding A) under its corresponding number (coding B) according to a key.

Materials-Part A-6-7 years. Part B-8-16 years. Time limit-120 seconds, discontinues-after 120 seconds.

**4. Similarities:** A series of orally presented pairs of words for which the child explain the similarity of the common objects or concepts they represents.

Materials-19 items. Time limit-Immediate answers. Discontinues-after 4 consecutive failures.

**5. Picture Arrangements:** A set of colourful pictures, presented is mixed up order, which the child rearranges into a logical story sequence.

Materials-15 items. Time limit-45-60 sec. Discontinues- after 3 consecutive failures.

**6. Arithmetic:** A series of arithmetic problem which the child solves mentally and responds to orally.

Materials-24 items. Time limit-30-75 sec and discontinues- after 2 consecutive failures.

**7. Block design:** A set modeled or printed two-dimensional geometric patterns which the child replicates using two-colour cubes.

Materials-24 items. Time limit-30-75 sec and discontinues- after 2 consecutive failures.

**8. Vocabulary:** A series of orally presented words which the child orally defends.

Materials-30 items.Time limit-immediate answers and discontinues- after 4 consecutive failures.

**9. Object Assembly:** A set of puzzles of common objects, each presented in a standardization configuration, which the child assembles to form a meaningful whole.

Materials-5 items. Time limit-120-180 sec

**10. Comprehension:** A series of orally presented questions that require the child’s solving of every day problems or understanding the social rules and concepts.

Materials-18 items. Time limit-Immediate answers and discontinues- after 3 consecutive failures

**11. Symbol search:** A series of paired groups of symbols, each pair consisting of a target group and a search group. The child identifies the two groups and indicate whether or not a target group appears in the search group.

Materials- Part A-6-7 years. Part B-8-16 years. Time limit-120 seconds

**12. Digit span:** A series or oral presented number sequences which the repeats in the same order of digits forwarded and is reserve order.

Materials-2 sets of digits. Time limit-Immediate answers. Discontinues- failure of both trials.

**13. Mazes:** A set of increasingly difficult mazes. Printed in a response booklet, which the child solves with a pencil.

Materials-10 items. Time limit-30-150 sec Discontinues- after 2 consecutive failures

**Scoring and IQ index:** Each subtest has specific scoring pattern. Guidelines are given in manual in detail. On the raw scores, equivalent scaled scores are calculated and by totaling sum of scaled scores for verbal and per performance and full scaled scores are calculated. With the respective items of the scaled scores for four factors ie., verbal comprehension, perceptual organization, freedom from distractibility and for processing speed are calculated, finally for sum of scaled scores IQ are calculated and classifies as,

List 5 :**Scaled score IQ and its classification**

|  |  |
| --- | --- |
| **Composite score rang** | **Classification** |
| 130 and above | Extremely high |
| 120 – 129 | Very high |
| 110 – 119 | High Average |
| 90 - 109 | Average |
| 80 – 89 | Low average |
| 70 – 79 | Very low |
| 69 and below | Extremely low |

**Results and discussion**

**Distribution of rural and urban children by consumption of breakfast**

Results from table 1. observed that, with respect to regular intake of breakfast among rural children, around 68.30 per cent of them were having breakfast regularly and remaining 31.70 per cent were irregular consuming the breakfast. In case of urban children, 66.70 per cent of children were having breakfast regularly and about 33.30 per cent were irregular in breakfast consumption. Priya *et al*. (2010) reported that, majority of children were regular breakfast eaters. Another study conducted by Siong *et al.* (2018)revealed that, the overall prevalence of 75.60 per cent of them being regular breakfast eaters, which 11.7 per cent were breakfast skippers and 12.7 per cent were irregular breakfast eaters.

**Association between cognitive indices of regular and irregular breakfast consumers by nutritional status**

The result of table 2. And 2.a depicted that, significant association and difference was found between nutritional status and cognitive skills of regular and irregular breakfast consumers in both rural (F=0.13and 0.07) and urban( F= 1.60 and 1.01) children. where, children who were in normal weight category had higher cognitive scores comparison to other categories (underweight and overweight). The plausible reason may be that, nutrition plays a prominent role in child development and it directly linked to child’s cognitive skills. These results are in line with the Anchamo *et al.* (2015) where results revealed that, regular breakfast pattern, height for age and body mass index for age, the Z score was significantly associated. The findings of the present study also are in conformity with study byYattinamani (2012)results showed that,higher per cent of the skipper (8.14%) were in pre obese category and very less of the breakfast consumer (0.22%) were in the same category.

**Distribution of mean score of cognitive skills of rural and urban regular and irregular breakfast consumers**

Figures in table 3 indicates that, among rural and urban regular breakfast consumers, all the cognitive tests score showed mean scores compared to children of irregular breakfast consumers. In case of rural children,‘t’ value showed that, coding, similarity, picture arrangement, block design and symbol search are significant difference between regular and irregular breakfast consumers. Among urban children, ‘t’ value showed that, information, coding, similarity, picture arrangement and mazes are significant difference between regular and irregular breakfast consumers.

**Distribution of rural and urban regular and irregular breakfast consumers by cognitive tests**

Table 4 showed that, in case of rural and urban regular breakfast consumers, all the skills scores like verbal scores, performance scores, full scale scores, verbal comprehension scores, perceptual organization scores, freedom distractibility and processing speed scores showed higher mean scores compared to children of irregular breakfast consumers. t value showed that significant difference between regular and irregular breakfast consumers.

**Distribution of rural and urban regular and irregular breakfast consumers by cognitive categories**

An examination of the table 5 shows thedistribution of rural and urban regular and irregular breakfast consumers by cognitive categories**.** It is clear from the table that, among rural regular breakfast consumers, around 51.20 per cent of them were in average level of cognitive skills followed by high average (41.50%). Among irregular breakfast consumers, higher percentage (63.20%) of them were in average level of cognitive skills followed by about (36.80%) of them were in low average level. With respect to urban regular breakfast consumers, around 42.50 per cent of them were in high average level of cognitive skills followed by average (32.50 %) level. Among irregular breakfast consumers, higher percentage (55.00%) of children were in average level followed by low average (30.00 %). Similarly, the results of the study by Gajre *et al. (*2008) revealed that, comparison between groups indicated significant differences in the cognitive total scores with the regular breakfast group achieving a higher mean scores compared to the no breakfast group (p<0.05). In a study by Panel (2012) results revealed that, children who had regular breakfast showed superior performance in tests of attention and memory. Maha *et al,* (2019)who also discovered that, children who consumed breakfast regularly were more likely to achieve higher cognitive scores compared to irregular breakfast consumers. A study by Adole and Ware (2014) showed that, there were significant differences in the cognitive test scores with regular breakfast eaters achieving the highest mean score compared to irregular breakfast eaters (P< 0.05).

**Table 1. Distribution of rural and urban children by consumption of breakfast**

**N=120**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Consumption of breakfast** | **Rural (n=60)** | | **Urban (n=60)** | |
| **N** | **(%)** | **N** | **(% )** |
| **Regular** | 41 | 68.30 | 40 | 66.70 |
| **Irregular** | 19 | 31.70 | 20 | 33.30 |
| **Total** | **60** | **100.00** | **60** | **100.00** |

**Table 2 Association between cognitive indices of regular and irregular breakfast consumers by nutritional status N=120**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Nutritional status** | **Rural (n=60)** | | | | | | | |
| **Regular BC** | | | **Modified**  **χ²** | **Irregular BC** | | | **Modified**  **χ²** |
| **High average** | **Average** | **Total** | 6.38\* | **Average** | **Below average** | **Total** | 4.92\* |
| Underweight | 9(42.85) | 12(57.14) | 21(100.00) | 2(25.00) | 6(75.00) | 8(100.00) |
| Normalweight | 8(47.06) | 9(52.94) | 17(100.00) | 9(90.00) | 1(10.00) | 10(100.00) |
| Overweight | 2(66.64) | 1(33.33) | 3(100.00) | 1(100.00) | - | 1(100.00) |
| Total | 19(46.34) | 22(53.65) | 41(100.00) | 12(63.16) | 7(36.84) | 19(100.00) |
| **Urban (n=60)** | | | | | | | | |
|  | **High average** | **Average** | **Total** | 3.68NS | **High average** | **Average** | **Total** | 3.35\* |
| Under weight | 9(60.00) | 6(40.00) | 15(100.00) | 1(10.00) | 9(90.00) | 10(100.00) |
| Normalweight | 10(58.823 | 7(41.17) | 17(100.00) | 1(12.50) | 7(87.50) | 8(100.00) |
| Over weight | 6(75.00) | 2(25.00) | 8(100.00) | 1(50.00) | 1(50.00) | 2(100.00) |
| Total | 25(62.50) | 15(37.50) | 40(100.00) | 3(15.00) | 17(85.00) | 20(100.00) |

NS-Non Significant \* Significant at 0.05 level

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Nutritional status** | **Rural (n=60)** | | | | | | | |
| **Regular BC** | | | | **Irregular BC** | | | |
| **N** | **Mean** | **SD** | **‘F’ value** | **N** | **Mean** | **SD** | **‘F’ value** |
| Under weight | 21 | 105.43 | 8.21 | 0.13\* | 8 | 93.90 | 7.65 | 0.07\* |
| Normal weight | 17 | 111.67 | 8.80 | 10 | 95.12 | 8.04 |
| Over weight | 3 | 107.41 | 6.02 | 1 | 89.00 | 2.36 |
| **Urban (n=60)** | | | | | | | | |
| Under weight | 15 | 96.85 | 41.92 | 1.60\* | 10 | 89.33 | 4.04 | 1.01\* |
| Normal weight | 17 | 114.24 | 11.13 | 8 | 100.86 | 13.51 |
| Over weight | 8 | 102.50 | 33.28 | 2 | 92.66 | 5.13 |

**Table 2.a Comparison of mean indices of cognitive skills of regular and irregular breakfast consumers by nutritional status N = 120**

\* Significant at 0.05 level

**Table 3. Distribution of rural and urban regular and irregular breakfast consumers by cognitive tests** **N=120**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cognitive sub tests** | **Rural (n=60)** | | | | | **Urban (n=60)** | | | | |
| **Regular**  **BC (41)** | | **Irregular BC(19)** | | **“t” value** | **Regular  BC(40)** | | **Irregular BC(20)** | | **“t” value** |
| **Mean** | **SD** | **Mean** | **SD** |  | **Mean** | **SD** | **Mean** | **SD** |  |
| **Picture Completion (30)** | 13.50 | 1.06 | 12.00 | 2.00 | 4.51 | 12.97 | 1.79 | 11.52 | 2.06 | 0.48 |
| **Information (30)** | 16.45 | 3.10 | 16.25 | 1.71 | 1.49 | 17.56 | 3.04 | 15.15 | 1.77 | 3.28\* |
| **Coding (65)** | 37.40 | 4.78 | 32.55 | 5.48 | 3.38\* | 39.02 | 5.71 | 34.89 | 4.45 | 0.20\* |
| **Similarities(33)** | 14.22 | 2.14 | 12.25 | 2.86 | 3.73\* | 14.51 | 2.45 | 11.42 | 2.26 | 0.65\* |
| **Picture Arrangement(64)** | 19.10 | 2.56 | 15.35 | 3.80 | 4.01\* | 20.70 | 3.52 | 15.73 | 3.19 | 2.64\* |
| **Arithmetic(30)** | 12.12 | 1.68 | 12.02 | 2.75 | 5.31 | 13.02 | 2.63 | 10.21 | 1.93 | 0.68 |
| **Block Design(69)** | 23.90 | 3.60 | 20.55 | 4.27 | 4.72\* | 26.46 | 3.76 | 24.31 | 4.94 | 2.25 |
| **Vocabulary(60)** | 18.40 | 2.64 | 18.40 | 3.45 | 1.79 | 18.85 | 3.29 | 17.21 | 4.02 | 3.62 |
| **Object Assembly(44)** | 21.22 | 3.73 | 20.15 | 1.49 | 3.67 | 23.63 | 3.77 | 22.47 | 2.16 | 1.51 |
| **Comprehension(36)** | 15.35 | 2.86 | 14.00 | 1.97 | 4.56 | 17.04 | 3.45 | 15.42 | 2.94 | 1.86 |
| **Symbol Search(45)** | 40.75 | 2.80 | 36.15 | 3.91 | 2.08\* | 42.58 | 4.96 | 34.05 | 6.19 | 0.77 |
| **Digit Span(30)** | 11.27 | 1.51 | 11.05 | 2.25 | 5.96 | 13.39 | 12.52 | 10.42 | 2.65 | 2.16 |
| **Mazes(28)** | 16.45 | 3.69 | 16.10 | 3.95 | 6.32 | 19.04 | 2.81 | 14.84 | 2.83 | 3.13\* |

BC= Breakfast consumers

**Table 4. Distribution of mean score of cognitive skills of rural and urban regular and irregular breakfast consumers N=120**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cognitive skills** | **Rural (n=60)** | | | | | **Urban (n=60)** | | | | |
| **Regular BC (41)** | | **Irregular BC (19)** | | **“t”**  **value** | **Regular  BC (40)** | | **Irregular BC(20)** | | **“t”**  **value** |
| **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** |
| **Verbal score** | 100.90 | 7.64 | 87.52 | 5.50 | 0.16\*\* | 108.72 | 11.34 | 90.65 | 11.29 | 0.26**\*\*** |
| **Performance score** | 112.54 | 10.92 | 103.37 | 10.80 | 0.27**\*\*** | 117.35 | 12.73 | 106.50 | 12.24 | 0.08\*\* |
| **Full scale score** | 106.71 | 8.33 | 94.36 | 7.41 | 0.11\* | 114.02 | 11.77 | 98.35 | 12.03 | 0.26**\*\*** |
| **Verbal comprehension score** | 92.26 | 6.98 | 80.00 | 5.06 | 0.25**\*** | 95.95 | 13.21 | 85.70 | 9.21 | 0.23**\*** |
| **Perceptual organization score** | 85.02 | 6.90 | 79.10 | 5.56 | 0.18**\*** | 88.67 | 9.33 | 82.85 | 8.02 | 0.32**\*** |
| **Freedom distractibility score** | 93.02 | 8.19 | 83.84 | 4.41 | 0.26**\*** | 97.95 | 10.59 | 81.30 | 11.13 | 0.10\* |
| **Processing speed score** | 108.66 | 10.09 | 106.89 | 13.19 | 0.07 | 112.20 | 11.55 | 104.85 | 11.03 | 1.23\*\* |

**Table 5. Distribution of rural and urban regular and irregular breakfast consumers by cognitive categories**

**N = 120**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Categories of cognitive indices** | **Rural (n=60)** | | | | **Urban (n=60)** | | | |
| **Regular BC** | | **Irregular BC** | | **Regular BC** | | **Irregular BC** | |
| **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** |
| Superior (120-129) | 2 | 4.90 | - | - | 8 | 20.00 |  | - |
| High Average (110-119) | 17 | 41.50 | - | - | 17 | 42.50 | 3 | 15.00 |
| Average (90-109) | 21 | 51.20 | 12 | 63.20 | 13 | 32.50 | 11 | 55.00 |
| Low Average (80-89) | 1 | 2.40 | 7 | 36.80 | 2 | 5.00 | 6 | 30.00 |
| Borderline (70-79) | - | - |  |  | - | - | - | - |
| Total | 41 | 100.00 | 19 | 100.00 | 40 | 100.00 | 20 | 100.00 |

**Conclusion :**

Regular breakfast consumer had higher cognitive score compared to irregular breakfast consumers in both rural and urban areas. Regular breakfast consumers had better mean scores of cognitive skills score than the irregular breakfast consumers in both rural and urban children. In rural areas, regular and irregular breakfast consumers had average level of cognitive skills and urban regular breakfast consumers had high average level and irregular breakfast consumers had average level of cognitive skills. A child who was skipping breakfast contributes to the less cognitive score. Therefore, it should be addressed in targeted interventions. Children, parents and teachers should be involved in those interventions preventing information on importance of breakfast and promoting health-conscious behavior, healthy lifestyle, positive knowledge about breakfast consumption should be built up. Promoting and providing a healthy breakfast at home / school may particularly help breakfast skippers and should lie even in the interest of policymakers.

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