

The Relationship between the Nutritional Status and Intelligence among the Children in Selected Schools, Bengaluru.

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ABSTRACT

Background of the study Nutritional status is the condition of health of the individual as influenced by the utilization of the nutrient. It is concerned primarily with the part played the nutrients in body growth, development and maintenance. Good nutritional status means, maintaining a nutritional status that enables us to grow well and enjoy good health. Nutrition is a fundamental pillar of human life. **Methods:** A Quantitative approach was used to assess the relationship between nutritional status and intelligence among the children. The research design adopted for the study was Non-experimental correlation research design. Sample of 60 schoolchildren were selected for the study using Probability – simple random sampling technique (lottery method). The modified conceptual framework for the present study was based on Fishbone model.

Anthropometry measurement and cultural fair nonverbal intelligence test was used to collect the data from the study. The experts validated the tool for data collection and the reliability was established using test re-test method using Karl Pearson's formula. Pilot study was conducted to determine the feasibility of the study following which the main study was done. Ethical and legal parameters were taken into consideration throughout the study. The main study was conducted Aryan presidency school, Nagarbhavi Bengaluru. Among children within age group 8-10. The data collected were analyzed and interpreted by using descriptive and inferential statistics.

Result: The finding of the study showed that the finding of the study revealed that, the assessment of the nutritional by weight 51.5% (31) were in normal range, 21.7% (13) were mildly impaired, 5.0 % (3) were moderately impaired range and 21.7% (13) were severely impaired. The assessments of the nutritional status by height 73.3% (44) were in normal range, 16.7% (10) were mildly impaired, 10.0% (6) were moderately impaired range and no one were severely impaired. The assessment of the nutritional status by MUAC 76.7% (46) were in normal range, 23.3% (14) were Stunted and no one were Stunted and wasted. Intelligence level of the school children 10.0% (6) were very superior, 3.3% were superior, 16.7% (10) were high average, 56.7% (34) were average, 10.0% were low average, 1.7% (1) was borderline and 1.7% (1) was extremely low. The finding of intelligence test -1, the range was 1-12, Mean was 7.6, Standard deviation was 2.59 and Mean percentage was

63.33. With regard to test -2, the Range was 4-13, Mean was 7.8, SD was 2.31 and Mean percentage was 55.7. With regard to test-3 Range was 1-11, Mean was 6.8, SD was 2.34 and Mean percentage was 56.7. With regards to test -4 the Range was 0-8, Mean was 2.98, SD was 1.87 and Mean percentage was 37.3. The overall score of the intelligence Range was 13-39, Mean was 25.2, SD was 6.23 and Mean percentage was 54.8. Correlation between height and intelligence ($r=0.344$), weight and intelligence ($r=0.397$) and MUAC and intelligence ($r=0.352$) among the children. Hence, there is a positive correlation between the nutritional status and intelligent among children. Chi square test was used to find the association between nutritional status and intelligence among the school children with their selected demographic variables. The result of the Chi square analysis indicated that there is a significant association between the nutritional status and intelligence among school children with their selected demographic variables, such as nutritional status by weight and demographic variables among the school children and it was significant associate of type of family and Mother's occupation, nutritional status by height and demographic variables among the school children and it was found significant associate of mother's education, nutritional status by MUAC and demographic variables among the school children and it was significant associate of mother's occupation, and intelligence level and demographic variables among the school children and it was significant associate of class studying. **Conclusion:** The present study attempted to assess the relationship between the nutritional status and intelligence among the children and found that positive relationship was between the nutritional status and intelligence among the children within age 8-10 years.

KEYWORDS

Height, Intelligence, MUAC, Nutritional status, Relationship, Weight

INTRODUCTION

Children are the wealth of any nation, as they constitute one of the important segments of the population. Children in the age group of 5 - 14 years are often considered as school age. United Nations Educational Scientific and Cultural Organization (UNESCO) for the purpose of statistics consider 6 -11 years as primary school age. Childhood is a crucial period that requires adequate nutrition. Children at the age of 6-12 years, needs adequate protein and calories. Malnutrition or poor nutritional status among schoolchildren is a common cause of low school enrolment, high absenteeism, early dropout and poor class performance. (Suvarana and Itagi, 2011)

The start of school coincides with the child's full entry into society. During school-age, growth is slower, but remains constant (approx. 2kg in weight and 6 cm in height per year). This phase sees the further development and maturation of the child's character and personality and the child begins to take on his first commitments and responsibilities and establish broader social relations. In this period child responds to magazine, radio, uses telephone for practical purposes, read story book, adventure book, make useful article or does easy repaired work and demonstrate affect and respect to parent and sibling. School age, children have established a particular pattern of meal intake; they continue to be affected by the influences of their peers. At the same time, they are burdened by heavy school work, class competition and proneness to communicable disease (Sheber, Basheer & Khan, 2013)

School age is considered as dynamic period of growth and development because children undergo physical, mental, emotional, and social changes. The school children are easily accessible, capacitive and responsive group. The child begins to be involved in an

increasing number of activities, from school to Sports. The activities gradually lead to personal responsibility since the activities in which the child is involved begin to be evaluated both by his parents and people outside the family. Anthropometry is a very valuable index for evaluation of nutritional status. It includes measurement of height, weight, skin fold, Arm circumference and chest circumference. These are valuable indicators of nutritional status as well as patterns of growth and development. (Datta, 2014)

Nutritional status is the best indicator of the global wellbeing of children. Poor nutritional status affects physical growth, cognitive development; physical work capacity and it consequently influence human performance of health. Poor nutritional status among the children is the common cause of low school enrollment, high absenteeism early dropout and poor classroom performance. (G.K. et al, 2010)

Anthropometry offers a reliable method to assess the nutritional status of the children (Bhasin et al.,1990). Anthropometry is the single most universally applicable, inexpensive, and non-invasive method available to assess the size proportion and composition of human body (WHO). WHO has recommended various indices based on anthropometry to evaluate the nutritional status of children. Intelligence is the aggregate capacity of individual to act purposefully to think rationally and to deal effectively with his /her environment. It can be called as the capacity to acquire knowledge one thinks different from the other. Some psychologists believe that intelligence result from the interplay between the hereditary and environmental factors. Some psychologist's emphasis genetic factors as having major significance while others emphasize environmental factors. Maintaining brain function is very important for cognitive development. The most crucial factor is the supply metabolic fuel to the brain in the form of glucose. Mental activity should be protected from fluctuation in nutritional status from one meal to another. (Ghazi et al, 2014)

Need for the study

Weight, height and mid arm circumference are considered as the most sensitive parameters for assessing nutritional status of the child. It is important to study nutritional status and intelligence because to know what is expected of child at a given age, in terms of nutritional status and intelligence.

The importance of the nutritional status and intelligence includes to observe and assess each child in terms of norms for specific levels. Nutritional status and development of intelligence is essential to determine whether the child is healthy, mentally alert and well-adjusted to environment or not. The foundation of good health and sound mind is laid during the school age period. Therefore, it is basic milestone in the life of an individual and responsible for many changes that take place during later life. School age is considered as dynamic period of growth and development because children undergo physical, mental emotional and social changes. (Gupta, 2007)

Intelligence is closely related to intellect, intellect includes observing, Understanding, thinking remembering and all ways of knowing. Both nutritional and intelligence are important for the child. In terms of educational and related areas, nutrition and intelligence are very much essential elements which are necessary for the learning. If education strives to prepare children for a productive life in society. (Dalal & Rani. 2013)

Globally, about 668 million children are the school age group, which are the largest proportion of the total population. Globally, more than one third and 60% of families in developing countries are suffering from poor nutrition and this impact would reflect in the physical and cognitive development of children. (Ranabhat et al.,2015).

Several studies show that nutritional status can directly affect mental capacity

among school-aged children. For example, iron deficiency, even in early stages, can decrease dopamine transmission, thus negatively impacting cognition. Deficiencies in other vitamins and minerals, specifically thiamine, vitamin E, vitamin B, iodine, and zinc, are shown to inhibit cognitive abilities and mental concentration. Additionally, amino acid and carbohydrate supplementation can improve perception, intuition, and reasoning. There are also a number of studies showing that improvements in nutrient intake can influence the cognitive ability and intelligence levels of school-aged children. (Extension Foundation 2013).

The indirect effects of poor nutrition can be severely detrimental to the performance of students over time. Students with unhealthy lifestyles are far more likely to become sick. These illnesses then have an effect on the amount of class time missed. By not attending classes, students are much more likely to fall behind. In addition, when they are in class, they are more likely to have little energy and to have concentration issue (Patel et al, 2015)

There are several direct effects that involve the immediate impact of nutrition on the daily performance of a student. Mental and behavioural problems can be traced back to unhealthy nutrition and poor eating habits. Nutritional deficiencies in zinc, B vitamins, Omega-3 fatty acids and protein have been shown to affect the cognitive development of children. Scientists have also established a link between student behaviour and nutrition. Access to proper nutrition can help students maintain psychosocial well-being and reduce aggression. (Datta, 2014)

As so many researchers proved that if the nutritional status of the child is poor, it affects their intelligence. The investigator strongly feels that by providing proper nutrition for the children development their performance in the schools will be better. Hence, the researcher felt the need to take up this study is found out the relational ship between nutritional status and intelligence.

Conceptual framework based on fish bone model/ diagram (Kaoru Ishikawa model 1943)

The conceptual framework was developed based on kaoru Ishikawa model. This consists of components like causes and effect. In mode long with the long spine and various connecting branches.

The fish bone diagram organizes and displays the relationship between different causes for the effect. The major categories of the causes are put on major branches connecting to the backbone and various sub-causes are attached to the branches. A fish bone diagram consist of the causes are the nutritional status of the children, which is anthropometric measurement (weight, height and MUAC) and intelligence level of the children. If the nutritional status is poor it leads to poor intelligence of the children.

The major categories of the causes such as weight, height and MUAC which are put on major branches connecting to the backbone and various causes results for weight (normal, mildly impaired, moderately impaired and severely impaired), for height are (mildly impaired, moderately impaired and severely impaired) and for MUAC (normal, stunted and stunted and wasted) are attached to the sub- branches. The causes of the effect which are seen on the head of fish bone model as intelligence level (Very superior, Superior, High average, Average, Low average Borderline and extremely low) which is assessed by using the culture fair nonverbal intelligence test.

Context: Aryan Preidency School, Nagarbhavi Bengaluru

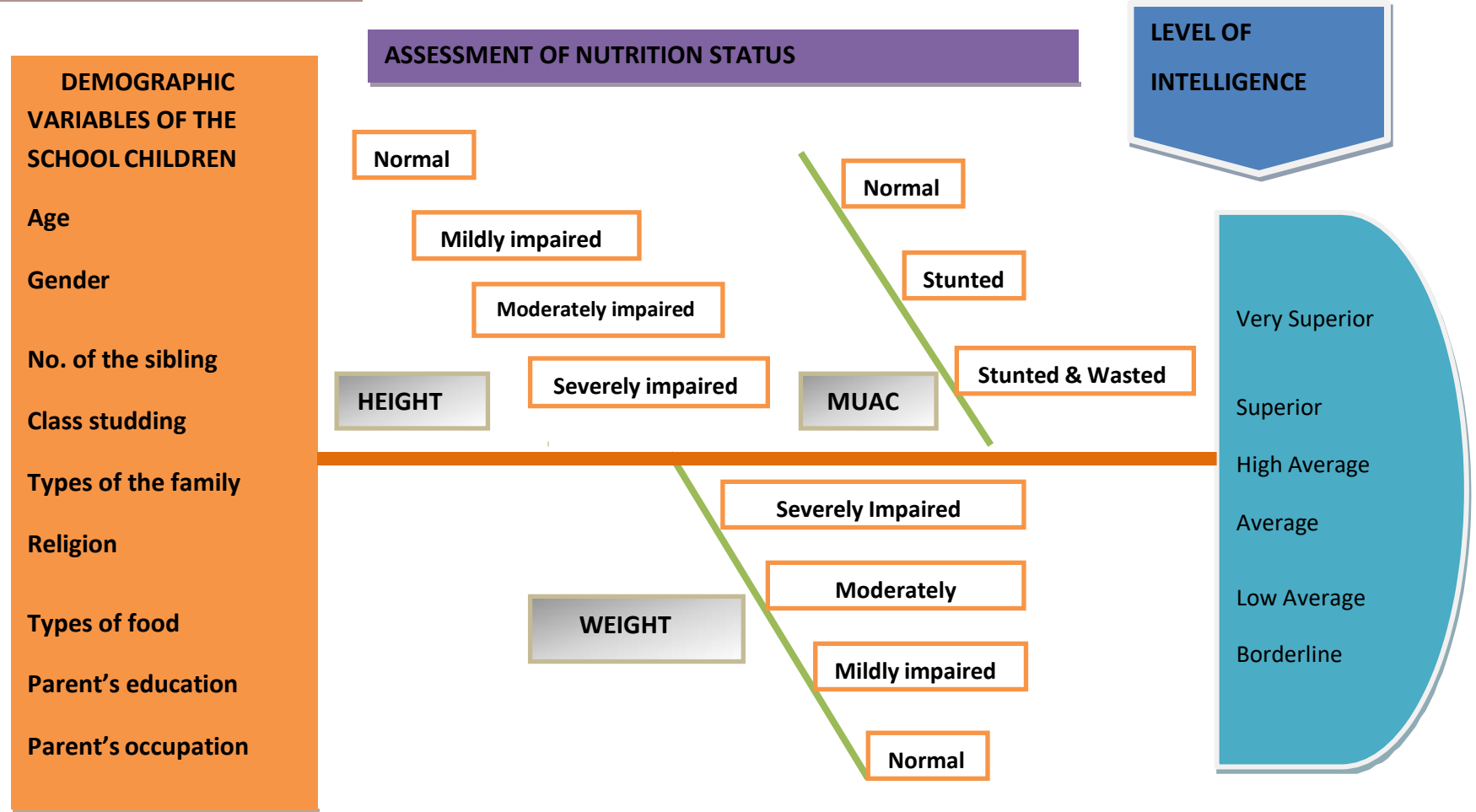


Figure 1: Modified Conceptual Framework based on Fish Bone Diagram

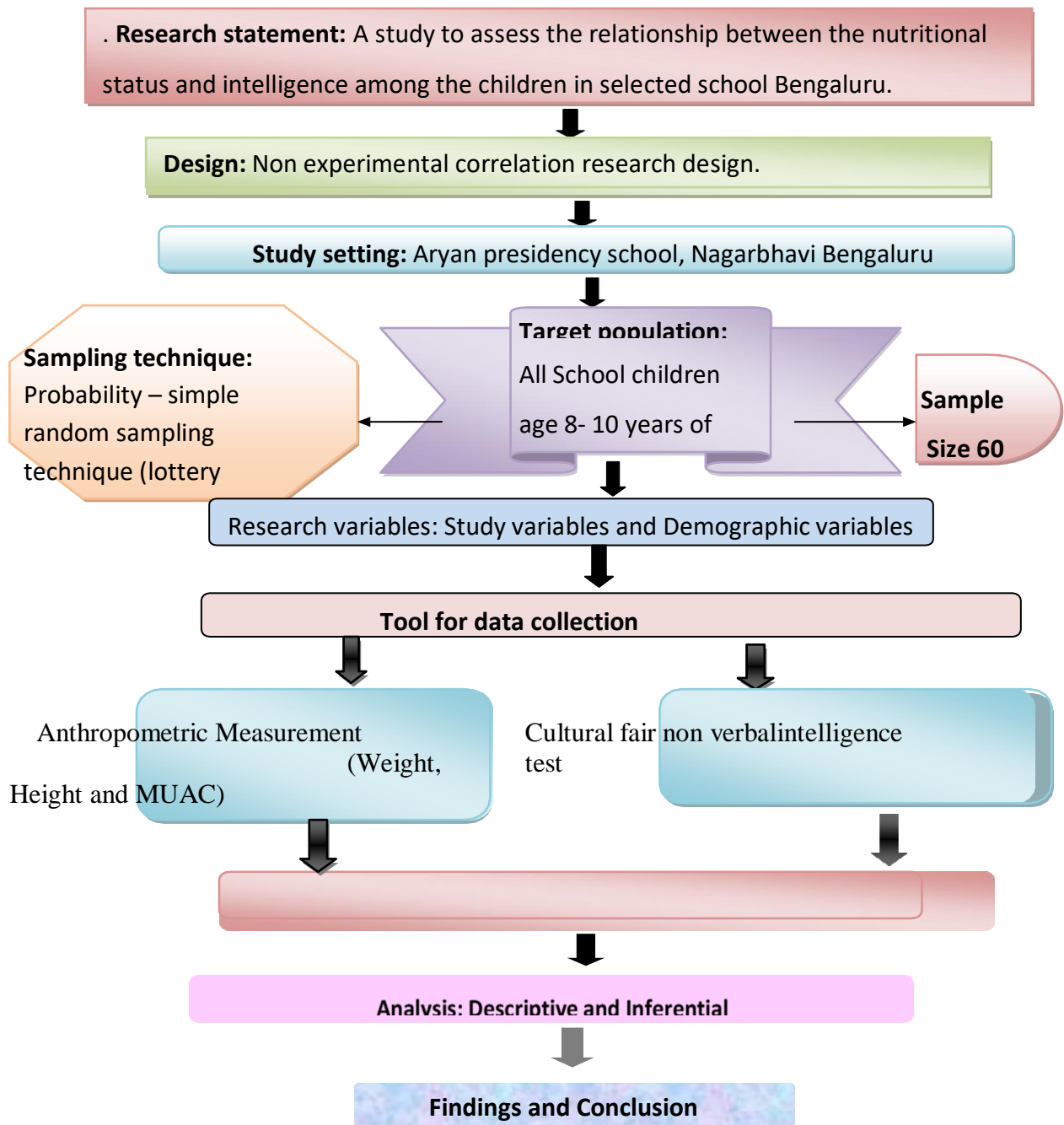


Figure 2: Schematic Representation of Research Plan

Research approach

Quantitative research approach was used.

Research design

Non experimental correlation research design was used for this study.

METHOD OF DATA COLLECTION

Research variables

Study variables

Nutritional status and Intelligence among the schoolchildren

Demographic variables

The demographic variables of children such as age, gender, standard studying, number of siblings, types of food, parent's education, parent's occupation, family income per month and academic performance of the children.

Setting

The study was conducted in Aryan Presidency school, Nagarbhavi Bengaluru.

Population

All the children between 8-10 years of age in Aryan Presidency school, Nagarbhavi Bengaluru.

Sample

The children who fulfill the inclusion criteria were considered as sample and the sample size was 60.

Criteria for sample collection

Inclusion criteria

The study includes the children between the age of 8-10 years, who were able to read and write English

Exclusion criteria

Children who were not willing to participate in the study and Children who were not available at the time of data collection

Sampling technique

Probability - Simple random Sampling technique. Lottery method was used to select the sample.

Tool for data collection

The tool consists three sections

Section A

It consists of demographic variables of children such as age, gender, standard studying, and number of siblings, types of food, parents' occupation and family income per month.

Section B

It consists of Nutritional status of the children. Nutritional status was assessed by Anthropometric measurement such as Height, Weight, Mid upper arm circumference. Weight was measured by weighing scale, Height and MUAC by inch tape.

Scoring Interpretation

Nutritional assessment of the children Weight (Water law's classification)

$$\text{Weight (\%)} = \frac{\text{Weight of the children}}{\text{Weight of the normal child at same age}} \times 100$$

Height (Water low's classification for Height and weight)

$$\text{Height/Age (\%)} = \frac{\text{Height of the child}}{\text{Height of the normal child Age}} \times 100$$

Nutritional status	Stunting /shortness (% of height /age)	Wasting /weight loss (%of weight /height)
Normal	> 95	> 90
Mildly impaired	87.5 -95	80-90
Moderately impaired	80 – 87.5	70 -80
Severely impaired	< 80	< 70

MUAC of children

Age	Boys			Age	Girls		
	Normal	Stunted	Stunted and Wasted		Normal	Stunted	Stunted and Wasted
8years	16.1+1.3	14.7+1.0	14.0+0.9	8 years	15.3+1.5	13.9+0.9	13.1+0.9
9 years	17.4 +1.0	16.6+0.9	15.9+0.9	9 years	16.2+1.4	15.7+1.2	14.5+0.9
10 Years	18.7+1.4	17.8+0.9	17.4+0.9	10 years	17.5+1.0	16.6+1.2	15.7+1.0

Section C

Children Intelligence status was assessed by Culture fair Nonverbal intelligence test. It consists of 46 items with the 4-sub test. Test- 1 series with 12 item, test -2 Classification with 14 items, test - 3 matrices with 12 items and test - 4 condition with 8 items.

Intelligent assessment of the children

Total item was 46. The raw score was taken and match with the age of the child withscore given in the scoring table

Scoring interpretation

S.no	Level of Intelligence	Score
1.	Very superior	(130 and above)
2.	Superior	(120 -129)
3.	High average	(110 -129)
4.	Average	(90 -109)
5.	Low Average	(80 -89)
6.	Borderline	(70 -79)
7.	Extremely low	(69 and below)

Validity and Reliability

The content validity of the test instrument was established by extensive literature review, consulting with subject matter experts, nursing research faculty as well as peer review. The tool consists of 12 items on demographics, measurement on Anthropometrics and for intelligence, 4 tests (46 items) related to Culture fair Nonverbal Intelligence test. The reliability of the tool was established through test retest method by using KarlPearson's formula. Reliability of assessing the level of intelligence among the children was $r = 0.81$ and the developed tool were found to be reliable.

Pilot study

After obtaining the formal permission from the concern authorities of Oxford English Medium High School Bengaluru. The investigator selected 10 school children among populations by using Probability – simple random sampling technique (lottery method). The assessment of the nutritional status by using the anthropometry measurement and intelligent level by using the cultural fair non verbal intelligence test. Hence, the study was considered feasible and practicable.

Procedure of data collection

After obtaining the formal permission from the concern authorities of Aryan Presidency School, Bengaluru. Main study was conducted, for period of 4 weeks, among 60 samples by using Probability – simple random sampling technique (lottery method). After which the data was collected in following phases.

Phase I

The investigator identified school students within age group (8-10) with the help of teacher.

Phase II

The data on demographic variables was collected from children such as age, gender, standard studying, number of siblings, types of food, parent's education, parent's occupation and family income per month and academic performance of the children.

Phase III

The investigator measured the anthropometric measurement of the children such as Height, weight, Mid upper arm circumference to assess the nutritional status.

Phase IV

The investigator assessed the intelligence level of children by using the Culture fair Nonverbal intelligence tool

DATA ANALYSIS

The data collected was analyzed by means of descriptive statistics and inferential statistics.

Descriptive statistics

Frequency and percentage distribution were used to analyze demographic profile of the children. Range Mean and Standard deviation was used to assess the anthropometric measurement and intelligence level among the children.

Inferential statistics

Karl Pearson's correlation was used to assess the correlation between nutritional status and intelligence among the children. Chi-square test was used to determine the association of anthropometric measurement and intelligence with the selected demographic variables of children

RESULTS

Table 1: Assessment of Level of Nutritional Status and Intelligence Quotient among Children

n=60

S. no	Nutritional status by weight	Frequency	Percentage
	Normal (>90) %	31	51.7
2	Mildly impaired(80-90) %	13	21.7
3	Moderately impaired (70-80) %	3	5.0
4	Severely impaired (<70) %	13	21.7
	Over all	60	100

The above Table 1 shows the assessment of the weight, 51.5% (31) were in normal range, 21.7% (13) were mildly impaired, 5.0% (3) were moderately impaired and 21.7% (13) were severely impaired.

Table 2: Assess the Nutritional Status by Height among school Children
n=60

S. N	Nutritional status by height	Frequency	Percentage
1	Normal (>95) %	44	73.3
2	Mildly impaired (87.5-95) %	10	16.7
3	Moderately impaired (80-87.5) %	6	10
4	Severely impaired (<80) %	-	-
	Over all	60	100

The above Table 2 shows the assessment of the height 73.3% (44) were in normal range, 16.7% (10) were mildly impaired, 10 % (6) were moderately impaired and no one were severely impaired.

Table 3: Assess Nutritional Status by Mid Upper Arm Circumference among School Children n=60

S. N	Nutritional status by MUAC	Frequency	Percentage
1	Normal	46	76.7
2	Stunted	14	23.3
3	Stunted and wasted	-	-
	Over all	60	100

The above Table 3 shows the assessments of the MUAC 76.7% (46) were in normal range, 23.3% (14) were stunted and no one were stunted and wasted.

Table 4: Assess Level of Intelligence Score among School Children n=60

S. N	Level of intelligence	Frequency	Percentage
1	Very superior (130 and above)	6	10.0
2	Superior (120-129)	2	3.3
3	High average (110-119)	10	16.7
4	Average (90-109)	34	56.7
5	Low average (70-79)	6	10.0
6	Borderline (70-79)	1	1.7
7	Extremely low (69 and below)	1	1.7
	Over all	60	100

The Table 4 shows regarding intelligence level of the school children about 10% (6) were very superior, 3.3% (2) were superior, 16.7% (10) were high average, 56.7% (34) were average, 10% were low average, 1.7% (1) were borderline and 1.7% (1) were extremely low.

**Table 5: Range, Mean, SD and Mean Percentage of Intelligence Level Test Score among the schoolchildren
 n=60**

S. N	Intelligence test	Max score	Range	Mean	SD	Mean %
1.	Test-1(series)	12	1-12	7.6	2.59	63.3
2.	Test-2 (classification)	14	4-13	7.8	2.31	55.7
3	Test-3(Matrices)	12	1-11	6.8	2.34	56.7
4	Test-4 (condition)	8	0-8	2.98	1.87	37.3
5	Over all	46	13-39	25.2	6.23	54.8

The above Table 5 shows regarding test -1, the range was 1-12, Mean was 7.6, Standard deviation was 2.59 and Mean percentage was 63.33. With regard to test -2, the Range was 4-13, Mean was 7.8, SD was 2.31 and Mean percentage was 55.7. With regard to test-3 Range was 1-11, Mean was 6.8, SD was 2.34 and Mean percentage was 56.7. About test -four the Range was 0-10, Mean was 2.98, SD was 1.87 and Mean percentage was 37.3. The overall score of the intelligence Range was 13-39, Mean was 25.2, SD was 6.23 and Mean percentage was 54.8.

Table 6: Correlations between nutritional status and intelligence level of the schoolchildren

n=60

S. N	Nutritional status	Intelligence	
		R	p-value
1	Height	0.344 *	p<0.05
2	Weight	0.397 *	p<0.05
3	MUAC	0.352 *	p<0.05

Table 6 shows that the correlation coefficient between nutritional status and intelligence level of the children. The correlation was obtained between height and Intelligence level of the children was found 0.344, between weight and Intelligence level of the children was 0.397 and between MUAC and Intelligence level of the children was 0.352. Which is statistically significant at 5% level (i.e ,p< 0.05).It evident that there is a positive linear between nutritional status and intelligence level of the children.

Association between nutritional status and intelligence among schoolchildren with their selected demographic variables

Chi square test was conducted to find out association between nutritional status by weight and demographic variables of children and it was found significant for type of family ($\chi^2=6.37$, $df=2$) and Mother "occupation ($\chi^2=8.340$, $df=3$), significant at 5% level (ie, $p < 0.05$).

Chi square test was conducted to find out association between nutritional status by height and demographic variables of children and it was found significant for dietary pattern ($\chi^2=10.95$) and mother's education ($\chi^2=8.475$, $df=3$), significant at 5% level (ie. $p < 0.05$).

Chi square test was conducted to find out association between nutritional status by MUAC and demographic variables of children and it was found significant for dietary pattern ($\chi^2=5.190$, $df=1$), significant at 5% level (ie. $p < 0.05$).

Chi square test was conducted to find out association between intelligence level and demographic variables of children and it was found significant for class studying ($\chi^2=6.190$, $df=2$) significant at 5% level (i.e., $p < 0.05$).

DISCUSSION

Characteristics of Demographic variables described in terms of their frequency and percentage distribution of the children by age, gender, number of sibling, class studying, type of the family, religion, types of the food, father's education, mother's education, father's occupation, mother's occupation, family monthly income in rupees and academic performance of the child (in grading).

Majority 45.00% (27) of schoolchildren belongs to 9 years age group, more than half 51.7% (31) of school children belong to female. Majority 63.3% (38) of schoolchildren belongs to two siblings. Schoolchildren were studying in 4th, 5th, and 6th, 33.3% (20). Of school children were studying in 4th standard, 33.3% (20) of school children were studying in 5th standard and 33.3% (20) of school children were studying in 6th standard. Type of family, majority 63.3% (38) of them were from nuclear family. Majority 81.00% (49) of them belongs to Hindu religion, dietary pattern majority 70.00% (42) of them were non-vegetarian. With regard to father's education status, more than half 51.7% (31) had higher secondary level, similarly to mother's education, majority 40.0% (24) of them had higher secondary. With regard father's occupational status, half 50.0% (30) of them were private employee similarly mother's occupational status majority 73.3% (44) of them were homemaker, With regard to family income half 50.0% (30) of them had >15000 per month and Academic performance of the child in grades, one third 33.3% (20) of them had B+.

There are children with various nutritional status, some may be normal some may be impaired. Performed the anthropometric measurement and intelligence assessment of the age 8, 9, and 10 from the class of 4th, 5th and 6th standards with the help of class teacher.

The assessment of the nutritional status by weight more than half 51.5% (31) were in normal range, nutritional status by height majority 73.3% (44) were in normal

range and the nutritional status by MUAC majority 76.7% (46) were in normal range, Intelligence level of the school children more than half 56.7% (34) were average.

Regarding test -1, the range was 1-12, Mean was 7.6, Standard deviation was 2.59 and Mean percentage was 63.33. With regard to test -2, the Range was 4-13, Mean was 7.8, SD was 2.31 and Mean percentage was 55.7. With regard to test-3 Range was 1-11, Mean was 6.8, SD was 2.34 and Mean percentage was 56.7. With regards to test -4 the Range was 0-10, Mean was 2.98, SD was 1.87 and Mean percentage was 37.3. The overall score of the intelligence Range was 13-39, Mean was 25.2, SD was 6.23 and Mean percentage was 54.8.

Correlation between the nutritional status (height, weight and MUAC) regarding the intelligence. It shows that there is a significant positive correlation between height and intelligence ($r=0.344$), between weight and intelligence ($r=0.397$) and between MUAC and intelligence ($r=0.352$) among the school children.

Chi square test was used to find the association between nutritional status and intelligence among the school children with their selected demographic variables .the result of the Chi square analysis indicated that there is a significant association between the nutritional status and intelligence among school children with their selected demographic variables, such as nutritional status by weight and demographic variables among the school children and it was significant associate of type of family and Mother's occupation, nutritional status by height and demographic variables among the school children and it was found significant associate of mother's education, nutritional status by MUAC and demographic variables among the school children and it was significant associate of mother's occupation, and intelligence level and demographic variables among the school children and it was significant associate of class studying.

CONCLUSION

Based on finding it can be concluded that there is a positive correlation between the nutritional status and intelligent among children. The correlation between height and intelligence ($r=0.344$), weight and intelligence ($r=0.397$) and MUAC and intelligence ($r=0.352$) among the children.

RECOMMENDATIONS

The study can be replicated with a large number of the samples and longitudinal study can be conducted.

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necessary facilities to conduct for study and also thank all the Participants who had extended their unflinching co-operation and participation for this study.

CONFLICT OF INTEREST

The authors do not have conflict of interest regarding the publication

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