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### **Cognitive Performances Of Preschool Children- Do Blood Haemoglobin Levels Have Significant Role?**

**\*\*HJyothi<sup>1</sup> and PremaL.<sup>2</sup>**

Department of Home science,(food and Nutrition),Govt College for women,  
Trivandrum,University of Kerala,Kerala. [Jyothiunni8@gmail.com](mailto:Jyothiunni8@gmail.com), ph-9446353173

Former Professor and Head,(food and Nutrition), Kerala Agricultural University, Vellayani,  
Trivandrum, Kerala.[premalalitha@gmail.com](mailto:premalalitha@gmail.com), ph-9349318528

#### **ABSTRACT**

**INTRODUCTION :** - Iron deficiency is the most prevalent nutritional disorder in the world. One of the most worrying consequences of iron deficiency in children is the alteration of behaviour and cognitive performance.

**OBJECTIVE:-**The present research paper aimed to study iron deficiency anaemia in preschool children and to study the association of cognitive performance and haemoglobin level.

**MATERIALS AND METHODS:-** The sample for the study comprised of 50 preschool children of 48-54 months , selected randomly from the rural areas of Malappuram district, Kerala. 25children evidenced of anaemia formed the experimental group and 25 children with normal haemoglobin levels were included as the control group. Modified version of Wechslersintelligence scale for preschool children was administered to assess the cognitive performance. The statistical methods adopted were Chi-square test and Anova using SPSS version 21.0.

**RESULTS:-** The results of the study indicated that there was significantly different correlation between the cognitive performance score andHb level of the children in the two groups. Lower theHb level, the time taken to perform the activity was found to increase and Hbwas observed to be correlated negatively with performance time.

**CONCLUSION:-**The present study indicated that haemoglobin level in children have significant role in cognitive performance.The present research paper also concluded that there is significant association between Hb level and cognitive performance in preschool children.

**KEYWORDS:-**Cognitive performance, anaemia, wechslers intelligence scale, Preschool children,haemoglobin.

#### **Corresponding author**

#### **Jyothi.H**

Assistant Professor,

Department of Home science,(food and Nutrition),

Govt College for women, Trivandrum, University of Kerala ,Kerala.

Email: [Jyothiunni8@gmail.com](mailto:Jyothiunni8@gmail.com), ph-9446353173

## **INTRODUCTION**

Health, education and living standards of people determine the quality of life of a nation. As per the census of India 2011, 30% of Indian population fall under the age group 0-14 years and 13% below 6 years. The future of nation depends a lot on these age group and their health and education deserve special focus.

The nutritional status of under-five children is not only a susceptible indicator of the health and nutrition of a country but also can be considered as a measurement of the quality of life.

Globally, one quarter of under five children is stunted (estimated 162 million). South Asia particularly has a high prevalence of stunting (38%), underweight (32%) and alarmingly high percentage of wasting (16%) as compared to other regions in the world (Megha et al., 2014)<sup>1</sup>.

Shibili .R.M 2016<sup>2</sup> reported among the 400 preschool children studied in Kerala, 31% of the children were identified as underweight by IAP classification. Under nutrition is more prevalent amongst rural children, socially deprived societies and amongst children with illiterate mothers.

Iron depletion continues to be one of the major nutritional deficiency among pre-schoolers as observed all over the world with a high prevalence rate in India. Several studies support the theory that iron sufficiency needs to be ensured throughout the course of brain development and for normal behavioural outcome. Preschool children with a haemoglobin concentration less than 11g/dL were considered anaemic (WHO)<sup>3</sup>. In children, anaemia affects cognitive and motor development because of the need for adequate oxygen carrying capacity during the critical first few years of life when mental and physical growth are occurring at their fastest.

Halterman et al, 2001<sup>4</sup>; Georgiff and Innis, 2005<sup>5</sup> reported deficiency of iron directly related to poor glucose metabolism leading to slower movement of impulses, reduces activity of brain cells and poor cognitive function. Iron deficiency also alters myelination, monoamine neurotransmitter synthesis, and hippocampal energy metabolism in the neonatal period that is manifested as reduced speed of processing, changes in motor and affective domain, and recognition memory, respectively. Iron deficiency during infancy may cause permanent damage to the child's brain and deficiency during the first two years of a child is associated with behavioural changes and delayed psychomotor development. Efficient memory consolidation is reported to be highly associated with proper sleep in children (Carlyle T. Smith 2004)<sup>6</sup>. Lena Hulthe'n, 2003)<sup>7</sup> also reported Iron deficiency in preschool children with manifestations of increased fatigue, short attention span, decreased work capacity, reduced resistance to infection and impaired intellectual performance.

According to Francis Galton cognition or cognitive abilities are a matter of neurological efficiency, and it could be tested by measuring reaction time and sensory acuity. Anaemic children

tend to do poor on vocabulary, reading and other tests. Many investigators found significant associations between hemoglobin concentrations and measures of cognitive development or school achievement and also motor development and behavioral aspects. Agarwal et al. 1987<sup>8</sup>, Clarke et al. 1991<sup>9</sup>, Walker et al. 1998<sup>10</sup>.

Grantham-McGregor and Ani,2001<sup>11</sup> reported anemia in infancy continue to have poorer cognition, school achievement and more behavior problems into middle childhood.

The present study was carried to identify the association between iron deficiency and cognitive performance.

## **MATERIALS AND METHODS:-**

The sample for the study comprised of 50 preschool children of 48-54 months selected randomly from the rural areas of Malappuram district, 25 children evidenced of anaemia formed the experimental group and 25 children with normal haemoglobin levels were the control group. Haemoglobin levels were identified through finger prick method. Data related to demographic socioeconomic anthropometric clinical, and were collected through interview with the mothers or caregivers. Wechsler's preschool and primary scale of intelligence fourth edition (WPPSI-iv 2012)<sup>12</sup> was modified to assess the cognitive performance. Required activities from the primary index scores were selected to obtain a total score of 50 with performance duration of 35 minutes. Ethical clearances of the study were obtained by an institutional ethical committee "Genetika" Trivandrum.

## **RESULTS AND DISCUSSION**

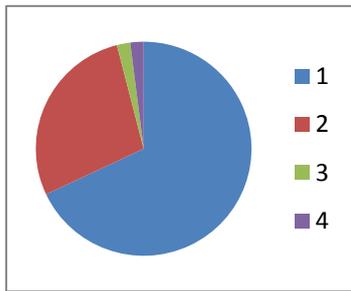
A case-control study is a type of observational study in which two existing groups differing in outcome are identified and compared on the basis of some supposed causal attribute.

In the present study identified two groups of children having homogenous socio economic demographic and other attributes which differ in their Hb level and tried to associate with their cognitive performance.

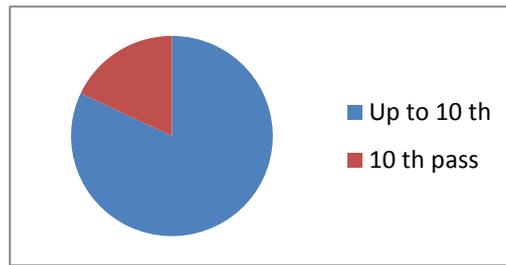
Figure A, B, C, D and E represent the social variables studied. The family size greater than 5 constitutes 68% and the educational status of father and mother, the category up to tenth which has the maximum percentage. In the case of type of family majority 92 % was in the joint family pattern. The occupation of the parent shows coolie as the majority 94%.

**Fig 1** Distribution of families on the basis of social variables

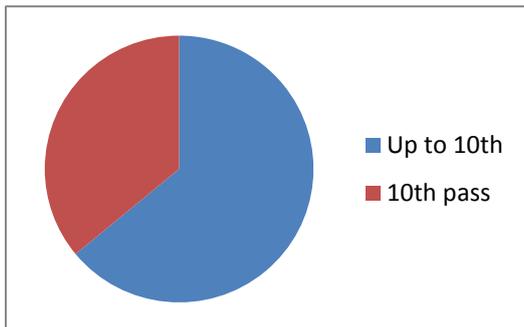
**Fig A – Family Size**



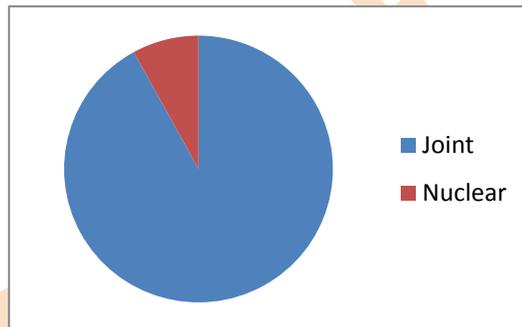
**Fig B - Educational Status of Father**



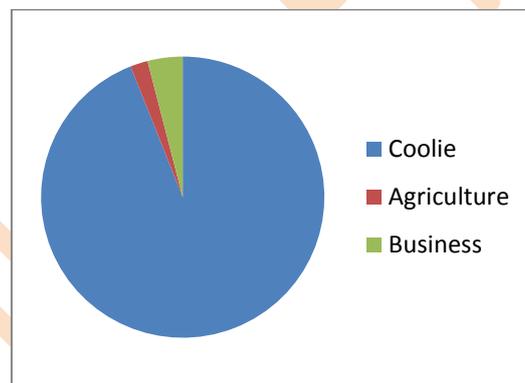
**Fig C - Educational Status of Mother**



**Fig D –Type of Family**



**Fig E –Occupation of Parent**



The Table 1 indicates monthly income of the parents with educational status.No significant difference in monthly income with respect to educational status,butper-capita income is statisticallysignificant as it depends on the total family size. As the educational status of the parents and monthly income indirectly affects the nutritional status which in turn affects the cognitive performance, and the statistical insignificance indicates these variables does not make any difference in between the groups.So these groups are homogenous in nature with respect to educational status and monthly income.

**Table 1 educational status and monthly income of parent**

Educational status of father		Monthly income	Per-capita income
Up to 10 <sup>th</sup>	Mean	21512.195	3640.878
	N	41	41
	Std. Deviation	1247.4364	540.8909
10 <sup>th</sup> pass	Mean	21777.778	4112.778
	N	9	9
	Std. Deviation	1394.4334	675.3732
Total	Mean	21560.000	3725.820
	N	50	50
	Std. Deviation	1264.2655	588.9285
F value		0.321	5.139
P value		0.574	0.028
Result		Not Significant	Significant

Table 2 shows the gender participation in the study. out of the 50 sample 27 belonged to male and 23 belonged to female category. There is no significance in between experiment group and control group related to gender, that makes the groups homogenous related to gender participation.

**Table 2 gender and groups**

		Group		
		Control group		Experiment group
Gender	male	Count	15	12
		%	60%	48%
	female	Count	10	13
		%	40%	52%
Total	Count	25	25	
	%	100%	100%	
<b>Pearson Chi-Square</b>				<b>.725<sup>a</sup></b>
P value				<b>.395</b>
Result				Not S.

**Table 3 Age**

Group	Mean	N	Std. Deviation	Variable	F value	2.646
Control group	52.000	25	2.0817	Age	P value	0.110
Experiment group	51.040	25	2.0913		Result	Not Sig.
Total	51.520	50	2.1212			

The Table 3 details the age of the study group the , the age of the control group had a mean of 52 months and experimental group 51 months. The statistical analysis through ANOVA showed that the age of the respondents in between the two groups were not significant.

**Table 4 birth weight and sleep**

Group		Birth wt	Duration of sleep/day
Control group	Mean	2.8720	9.600
	N	25	25
	Std. Deviation	.16143	.5000
Experimental group	Mean	2.8480	9.640
	N	25	25
	Std. Deviation	.15308	.4899
Total	Mean	2.8600	9.620
	N	50	50
	Std. Deviation	.15617	.4903
F value	0.291	F value	0.82
P value	0.592	P value	0.776

The birth weight of a child also determines the intellectual abilities of children. The table 4 shows the birth weight of both the groups, and were found to have an average mean wt of 2.84 and 2.86 respectively.

The p value 0.592 indicated no significance so the groups are homogenous with respect to birth weight of the children. The proper sleep were reported to be associated with memory (Carlyle T. Smith,2004)<sup>7</sup>. The average sleep hours of the groups were noted which indicated no significance in between the groups. Both the groups had a mean value of 9.6 hours of sleep that makes the groups homogenous with respect to sleep pattern also.

**Table 5 Nutritional profile of the children**

Group		Height	Weight	BMI	Head .C	Chest.C	MUAC	Hb level
Control group	Mean	102.120	14.956	14.3940	49.560	51.800	16.660	12.048
	N	25	25	25	25	25	25	25
	Std. Deviation	5.1585	1.3232	1.20176	1.4742	2.2730	7.1846	.2257
Experiment group	Mean	95.480	12.172	13.4280	47.800	49.240	14.520	10.596
	N	25	25	25	25	25	25	25
	Std. Deviation	3.6069	.5412	1.11450	1.2247	1.8321	.4890	.2071
Total	Mean	98.800	13.564	13.9110	48.680	50.520	15.590	11.322
	N	50	50	50	50	50	50	50
	Std. Deviation	5.5365	1.7258	1.24652	1.6092	2.4180	5.1544	.7641
F Value		27.820	94.805	8.684	21.082	19.223	2.208	561.715
P Value		0.00	0.00	0.05	0.00	0.00	0.144	0.00
Result		**	**		**	**		**
Standard antropometric values		110-115 cm	16-20kg	>14.3	50-52cm	52-56cm	>13.5	>11g/dl

Table 5 details the anthropometric and Hb levels of the study group. The control group children were in the normal nutritional status as per IAP standards, while the experimental group children were found to be in the mild grades of malnutrition.

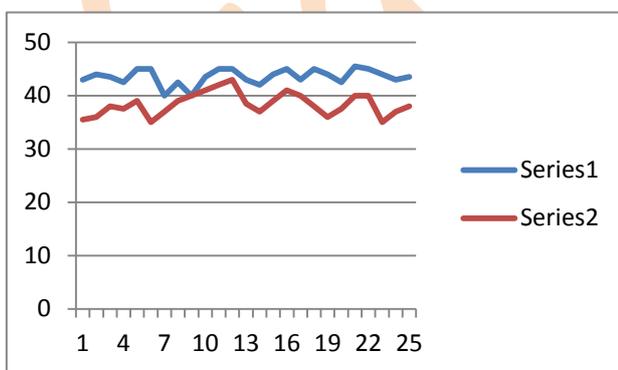
The Anthropometric and Hb level of the groups by ANOVA revealed that significant difference was there with respect to height weight head circumference ,chest circumference andHb level in between the groups .Reports says that anaemia in children always associated with malnutrition.Shibili.R.M(2016) <sup>3</sup>the study among 400 childrenunder five years of age in Kerala reported 41% of the underweight children had anaemia,46.1% of thestunted children had anaemia and 37% of the children having wasting also had anaemia.

**Table 6Cognitive performance**

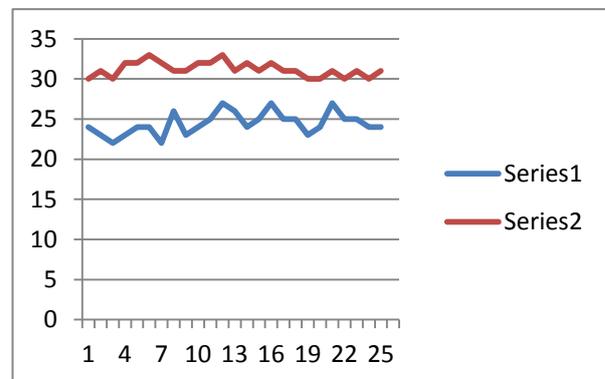
Group		Score	Time taken	
Control group	Mean	43.540	24.440	F value 98.178 P value 0.00
	N	25	25	
	Std. Deviation	1.4643	1.4166	
Experimental group	Mean	38.400	31.200	F value402.268 P value 0.00
	N	25	25	
	Std. Deviation	2.1409	.9129	
Total	Mean	40.970	27.820	
	N	50	50	
	Std. Deviation	3.1678	3.6123	

Table 6 explains ANOVA with the score and time taken by the controlgroup and experimental group and the test indicated that the control group had a mean score of 43.54/50 and experimental group 38.40/50 that was statistically significant with p value 0.00. The time taken for the test indicated that the control group had a mean value. 24.44 minutes and experimental group it was 31.2 minutes. It was again statistically significant with p value 0.00.

**Fig 1 Cognitive Performance score**



**Fig 2 Cognitive Performance Time**



**Table 7 correlation between Hb, cognitive performance**

Correlations between Hb and Cognitive Performance				
		Hb level	Score	Time taken
Hb level	Pearson Correlation	1	.757**	-.923**
	Sig. (2-tailed)		.000	.000
	N	50	50	50
	Mean and SD	11.322 ± 0.7641		
Score	Pearson Correlation	.757**	1	-.700**
	Sig. (2-tailed)	.000		.000
	N	50	50	50
	Mean and SD	40.970±3.1678		
Time taken	Pearson Correlation	-.923**	-.700**	1
	Sig. (2-tailed)	.000	.000	
	N	50	50	50
	Mean and SD	27.820±3.6123		

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Table 7 shows the statistical correlation between Hb cognitive performance score and time taken by the groups. The statistical correlations at 1% level indicate that Hb level and score was highly correlated with the chi square value 0.757 and p value 0.00. The Hb level and time taken for the test also had a high correlation as the Hb level is 92.3% negatively correlated, with a mean and SD 27.820±3.6123. This result revealed that Hb level is highly correlated with cognitive performances in preschool children. The processing speed, concentration and attention span of children is closely associated with Hb level. Halterman et al, 2001<sup>5</sup>; Georgiff and Innis, 2005<sup>6</sup> reported reduced speed of processing, changes in motor and affective domain, and recognition memory in anaemic children.

## CONCLUSION

The present study indicated that haemoglobin level in children have significant role in cognitive performance. The present research paper also concluded that there is significant association between Hb level and cognitive performance in preschool children. Iron deficiency in preschool children lay the ground for problems in cognitive functioning, then a large, unrecognized population of children could be at risk owing to iron deficiency, so this nutritional problem that needs to be prevented and treated very seriously.

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