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"EFFECT OF MALNUTRITION ON THE COGNITIVE DEVELOPMENT AMONG CHILDREN POPULATION"

Tanvi Twara[1*], Sanskriti Upasna[2], Mamta Tiwari[3], Aruna Agrawal[4],G.P Dubey[5].

[1]Junior Research fellow, Dept. of kriya Sharir, Faculty of Ayurveda Institute of medical Sciences, Banaras Hindu University, Varanasi UP, India
[2]Junior Research fellow, Dept. of kriya Sharir, Faculty of Ayurveda Institute of medical Sciences, Banaras Hindu University, Varanasi UP, India
[3]PHD Scholar, Dept. of kriya Sharir, Faculty of Ayurveda Institute of medical Sciences, Banaras Hindu University, Varanasi UP, India
[4]Professor, Dept. of kriya Sharir, Faculty of Ayurveda, IMS, BHU, Varanasi UP, India
[5]Distinguished Professor, Dept. of kriya Sharir, Faculty of Ayurveda, IMS, BHU, Varanasi UP, India

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***Correspondence for Author**
Dr. Tanvi Twara
Junior Research fellow, Dept. of kriya Sharir, Faculty of Ayurveda Institute of medical Sciences, Banaras Hindu University, Varanasi UP, India.

ABSTRACT

The present study was designed to investigate the effect of malnutrition on cognitive development. Out of total 900 children 441 undernourished children were selected for this study. These 441 undernourished children of 5 to 12 years of age groups of both the gender were selected from various school of Varanasi district. Various anthropometric indices have been measured to identify undernourished children. These children were classified in mild, moderate and severe malnourished category based on Gomez classification. Total protein, albumin and globulin were estimated in selected children as these are important indicator of severity of malnutrition. Long-term and short term memory and attention span were determined in undernourished children to assess the cognitive impairment. It was observed that under nutrition exert profound influence on cognitive development of children. A significant poor memory and attention span was recorded in malnourished children suggested poor scholastic performance. At biochemical level low values of serum total protein and altered albumin globulin levels were estimated and the results indicated that protein energy malnutrition play a major role in the cognitive impairment of children.

KEYWORDS: Malnutrition, Protein Energy, Cognitive Function,

INTRODUCTION

Malnutrition is defined as "the lack of sufficient quantity or quality of nutrients to maintain the body system at some definable level of functioning". Malnutrition is a board term commonly used as an alternative to under nutrition but technically it also refers to over nutrition. Children are malnourished if their diet doesn't provide adequate calories and protein for growth and maintenance or they are unable to fully utilize the food they eat due to illness (under nutrition) and they are also malnourished if they consume too much calories(**UNICEF).**

A strong correlation has been established between malnutrition and cognitive impairment. Several studies have indicated that malnourished children are more prone to develop cognitive impairment in early childhood. Recent report provided by **UNICEF** pointed out that in India about 46 percent of children below the age of three years have shown poor growth for their age, 47 per cent are underweight and at least 16 percent are wasted. It is estimated that Madhya Pradesh has highest number of malnutrition in India while lowest in Kerala .

According to Richardson et al 1972; Cherkin A 1987; Connolly KJ 1993; Uauy et al; 2001 protein energy malnutrition(PEM) among children affects brain growth, attention span, short–term memory and overall mental development. Malnourished children are more prone to develop various infectious diseases and poor cognitive function. When they reach school age, they have very poor learning ability as compared to well-nourished peers. Micro-nutrients deficiencies like zinc, iodine, iron and vitamin A in children results in poor attention span (decreased ability to concentrate) and memory. Anemia resulting from deficiency of iron is known to have a severe impact on the cognitive development of children (Grantham-McGregor, 1995). Lindsey M. King (2012) described the relationship between nutrition and cognitive function and emphasized its multifaceted and complex nature. Various neuropsychophysiological factors are also found to be associated with malnutrition. The contributing factors like depressed mood (Kemps, triggerman and Marshall ,2005), preoccupying cognitions (Vreugdenburg, Bryan and Kemps, 2003), decreased ability for processing capacity, decreased attention span, (Widenhorn-muller, Hiller, Klank and weiland, 2007), slower reaction time (Green, Roger, Elliman and Gatenby, 1992) and decreased listening ability (Morris and Sarll, 2001) are associated with malnutrition.

Brain development is regulated by intake of various nutrients and growth factors during fetal and earlier postnatal life. Brain development occurs largely in between 24 and 42 week of gestation. Poor nutritional status during this period impairs the development and also rapidly obstructs several neurological processes, including synapse formation and myelination (Georgieff 2001, Dopping 1990, Rao 2000, Thompson 2001, Kretchmer 1996). Malnutrition not only harms the body but leaves an ill effect on the mind of those who survive with it. As a consequence lower IQ, poor scholastic performance and behavioral problem are associated with children (Mcgregor 1995, Lui et al 2005). Sharma et al (2009) also pointed out that PEM increase susceptibility to infection, low general immunity resulting in cognitive decline among school going children. Early malnutrition significantly alters the learning capability of the children in both male and female. These workers further pointed out that PEM is an important causative factor for poor cognitive function including poor attention span. Thus it is concluded that both genetic as well as environmental factor play vital role in the development of malnutrition mediated cognitive impairment.

In view of the above fact a field study was planned to investigate the effect of malnutrition on brain development with special reference to cognitive development particularly memory and attention span among children population.

MATERIAL AND METHOD

The present study has been designed to investigate the effect of under nutrition on cognitive function. The main objective of the present study is to evaluate the prevalence of cognitive deficit disorder among undernourished children of both sexes between the age group of 5 to 12 years. Another objective is to assess overall scholastic performance among the selected school children population of the Varanasi district. After randomization 900 school going children were selected for further classification. Out of 900, 441 cases were identified as undernourished. The total numbers of student were further randomized to measure various anthropometric indices for the measurement of degree of under nutrition. The BMI was measured by using the formula already mentioned by WHO. The undernourished children were further classified as per Gomez classification and categories into three major group i.e mild, moderate and severe. The skin-fold thickness particularly sub-scapular, triceps and mid-auxiliary were measured by Harpendou's skin-fold caliper. The total and differential protein was measured as per standard laboratory method. Short- term memory and long-term memory were measured by specially designed electronic device (Medicaid system). The

attention span was determined by using attention span apparatus. The total number of 441 school going children were finally studied and the various parameter mentioned earlier were measured and calculated by using ANOVA and 95% confidence interval of the limit of mean.

RESULT AND DISCUSSION

Out of total 441 undernourished children 250 were males and remaining 190 were females. When we measured the degree of undernourishment, 158 cases were grouped under the category of mild, 178 under moderate and remaining 105 under severe group. Moderate degree of malnutrition exhibited the higher percentage (40.36%) of prevalence of malnutrition as compared to mild and severe group of malnourished children.

Table 1. Classification of under nutrition in terms of mild, moderate and severe in children.

Classification	Percent of reference weight for age	Total number	Percentage (%)
Mild	75-89%	158	35.82
Moderate	60-74%	178	40.36
Severe	<60%	105	23.80

Table 2. Total protein content of blood serum as one of the indices of determination of degree of malnutrition among children belonging to rural localities.

Classification	Gender/ sample size	Sample size	Total protein(g/dl)	95% confidence interval of the limit of mean
Mild	Male	94	5.40±0.94	5.21-5.59
	Female	64	5.09±1.20	4.8-5.38
Moderate	Male	104	5.20±1.20	4.97-5.43
	Female	74	4.90±0.95	4.68-5.12
Severe	Male	52	4.60±0.75	4.4-4.8
	Female	53	4.30±1.02	4.03-4.57

Normal level of total protein = 6 -7.5 g/dl.

Comparison	**Mild Vs Moderate**	**Mild Vs Severe**
Male	**p>0.05***	**p<0.0001*****
Female	**p>0.05***	**p<0.0001*****

When total protein measured in malnourished children, categorized in mild, moderate and severe a significant difference was noticed in mean value of all three groups. When mild degree of malnutrition was compared with severe degree of malnutrition a significant difference was noticed in the average value of total protein. Female group showed low protein level as compaired to male group.

Table 3. Albumin and Globulin content of blood serum as an important determinate of malnutrition.

Classification	Gender / sample size	Albumin (gm)	95% confidence interval of the limit of mean	Globulin (gm)	95% confidence interval of the limit of mean
Mild	Male (n=94)	3.2±0.95	3.01 - 3.39	2.6±0.42	2.52 - 2.68
	Female (n=64)	2.4±0.66	2.24 - 2.56	2.8±0.32	2.72 - 2.88
Moderate	Male (n=104)	2.4±0.68	2.25 - 2.55	3.0±0.64	2.85 - 3.15
	Female (n=74)	2.0±0.42	1.92 - 2.08	2.9±0.09	2.88 - 2.92
Severe	Male (n=52)	2.4±0.36	2.3 - 2.5	2.4±0.63	2.23 - 2.57
	Female (n=53)	2.2±0.80	1.98 – 2.42	2.4±0.36	2.3 - 2.5

Normal level of Albumin =3.5 to 5.0g/dl and globulin = 2.5 to 3.5 g/dl

Albumin was found significantly low in severe cases of malnutrition than moderate and mild. Females showed low level of albumin in all the three group. 95% confidence interval of the limit of the mean showed distinct patterns in all groups. The globulin didn't exhibit much difference in mild to moderate and mild to severe cases. 95% confidence interval of the limit of mean (table.3) also overlap with each group indicating insignificant variation in all the three groups.

Table 4.Short term memory scores in mild, moderate and severe malnourished children.

Classification	Gender	Sample size	Short–term score	95% confidence interval of the limit of mean
Mild	Male	94	7.2±2.98	6.6-7.8
	Female	64	6.8±2.78	6.12-7.48
Moderate	Male	104	4.2±0.98	4.01-4.39
	Female	74	4.8±1.16	4.54-5.06
Severe	Male	52	3.2±1.76	2.72-3.68
	Female	53	2.8±1.25	2.46-3.14

Normal Range =10

Comparison	**Mild Vs Moderate**	**Mild Vs Severe**
Male	**p<0.0001*** **	**p<0.0001*** **
Female	**P<0.0001*** **	**p<0.0001*** **

Short- term memory was found low in severe cases than mild and moderate degree of malnourished children. When short term memory of mild cases were compared with

moderate and severe highly significant difference was noticed. A similar pattern was observed in female also.(Table 4)

Table 5.Long-term memory scores in mild, moderate and severe malnourished children.

Classification	Gender	Sample size	Long-term score	95% confidence interval of the limit of mean
Mild	Male	94	4.6±1.05	4.39-4.81
	Female	64	3.2±1.87	2.74-3.66
Moderate	Male	104	4.1±1.75	3.76-4.44
	Female	74	3.0±1.25	2.72-3.28
Severe	Male	52	2.5±1.02	2.22-2.78
	Female	53	2.6±0.85	2.37-2.83

Normal range = 10

Comparison	**Mild Vs Moderate**	**Mild Vs Severe**
Male	**p<0.05***	**p<0.0001*****
Female	**p>0.05***	**p<0.01****

Long-term memory was also found very low in severe cases than mild and moderate. Females have shown low scores of long term memory as compared to male.

Table 6.Level of attention span in different degree of under nutrition like mild, moderate and severe malnourished children.

Classification	Gender	Sample size	Attention span (per/sec)	95% confidence interval of the limit of mean
Mild	Male	94	5.5±1.40	5.22-5.78
	Female	64	4.8±1.92	4.33-5.27
Moderate	Male	104	3.4±1.96	3.02-3.78
	Female	74	3.0±1.58	2.64-3.36
Severe	Male	52	1.2±0.82	0.98-1.42
	Female	53	0.9±0.17	0.85-0.95

Normal Range = 10

Comparison	**Mild Vs Moderate**	**Mild Vs Severe**
Male	**p<0.0001*****	**p<0.0001*****
Female	**P<0.0001*****	**p<0.0001*****

Low scores of Attention span (Table 6) is an index of poor scholastic performance. The score of attention span was found significantly less in severely undernourished children in comparison to moderate and severe. 95% confidence interval of the limit of mean did not overlap each other.

Ample evidence has been accumulated in the recent past indicating the significance of nutrition in cognitive development including behavior. Several epidemiological studies have demonstrated that the protein energy malnutrition is an important health related issue in developing countries. Childhood mortality is significantly higher in tribal and rural locality due to poor hygiene and low body immunity in undernourished children. Poor intellectual development is an outcome of undernourishment. Though the problem of malnourishment is a global issue but it is more dominant in third world countries. Grantham-McGregor (1995) reviewed the effect of severe malnutrition on mental development. He enumerates several factors responsible for poor cognitive development in undernourished children. He further observed that a poor socio-culture background play an important role in mental development. Kar et al (2008) emphasized that once brain is affected by severe undernourishment for a considerable long phase, inspite of improving socio-economic condition no improvement can be obtained. Indian Council of Medical Research (ICMR) and National Institute of Nutrition (NIN) both organization have widely surveyed the various parameters for determination of nutritional status. These organizations have considered different ethnic group and noticed that dietary habit and absence of balanced diet is main cause of malnutrition. While in tribal locality poor calorie intake particularly severe deficiencies of protein and vitamins are the major cause of infection and high prevalence of mortality among tribal children.

As shown in result maximum cognitive impairment was noticed in severe cases of malnutrition. Poor attention span was noticed in severe cases in comparison to mild and moderate. It indicates that low protein intake significantly affect the cognitive development resulting in poor memory span. Such children exhibit poor scholastic performance and learning abilities particularly associated with severely malnourished children. Poor performance in mathematics and science is a consequence of under nutrition.

CONCLUSION

A very high percentage of malnourished children were identified in selected population who have shown varying degree of under nutrition. The poor scholastic performance of selected malnourished children is the outcome of economically deprived class of Varanasi district. However, a larger sample size may provide the definite etiology of malnutrition responsible for cognitive development.

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