NUTRITIONAL STATUS AND INTELLIGENCE QUOTIENT OF PRESCHOOL CHILDREN IN SUNSARI, NEPAL

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ABSTRACT

Introduction

Nutritional status has vital role on brain development of children during pregnancy and the first two years of life. Children who suffered from early childhood malnutrition have generally been found to have poorer IQ levels.

Objective

To find out Nutritional Status and Intelligence Quotient level of Preschool Children in Sunsari, Nepal.

Methodology

A descriptive cross-sectional study design was used in the study. Proportionately 250 preschool children were selected. Data was collected by using self-developed semi structured questionnaire for socio-demographic profiles, stadiometer and weighing scale for height and weight measurement respectively. Nutritional status was classified according to World Health Organization (WHO) standard. For an assessment of IQ, Indian Adaptation of Vineland Social Maturity Scale (VSMS) and Developmental Screening Test (DST) scale were used. These scales provide an estimate of social quotient (SQ) and development quotient (DQ) and are designed to measure social maturation of age group 'below 15 years'. Data were analyzed using Pearson chi-square statistics.

Result

Among all, 51.2% of the children were male and most (80%) of the children were from Muslim ethnicity. Mean ± SD age of the children was 51.80±12.31 months. Almost all (98.4%) of the children were delivered by normal vaginal delivery and majority (78%) of the children were delivered at home. Nearly equal proportions of children were from nuclear and non-nuclear family. Prevalence of stunting and wasting were 28.4% and 8.4% respectively. Among 250 children, 11.6% had superior IQ, 52.4% had bright normal and 36% had average IQ. Mother's education and malnutrition of children were significantly associated with IQ of children i.e., p=0.006, p=0.011 respectively.

Conclusion

Mother's education has great impact on Intelligence Quotient of children. Intelligence is strongly related to nutritional status. Poor nutrition leads to poor IQ, which results in poor academic achievements. To prevent this, priority should be given for the prevention of malnutrition which ultimately improves the intelligence of children.

KEYWORDS

Nutritional status, intelligence quotient (IQ), preschool children

INTRODUCTION

Nutrition may be defined as "the science of food and its relationship to health". It is primarily concerned with the role played by nutrients in body's physical growth, development and their maintenance. Good nutrition means "to maintain nutritional status which helps us for our growth and to enjoy good health". Most recently, the concept has been emerging that nutrition is the foundation of socioeconomic development. Nutritional problems are not only medical problems but also, the yare rooted with many other sectors of development such as education, demography, agriculture, and rural development. In the global campaign of Health for All, promotion of proper nutrition is one of the eight elements of primary health care.[1]

The relationship between nutrition and cognition or learning is very imperative. Good nutrition during the early years of a child's life is linked to best performance in later years of life. The nutrition affects the brain development since before the birth of child-with the nutrition of the mother. Under nutrition resulting negative effects on brain development during pregnancy and the first two years of life may be permanent and irreversible. Good nutrition appears to lead to higher Intelligence Quotient (IQ) resulting good cognitive development.[2]

The under nutrition has devastating and lasting effects on young children (ages 0-8). It can hold back the behavioral and cognitive development, educability, and reproductive health, thereby discouraging the future work productivity. Since growth failure occurs almost exclusively during the intrauterine period and in the first two years of life, leading stunting, anemia, and other problems, therefore calls for interventions, which focus on the very young children.[3]

In the past two decades, the world has achieved huge progress for children. Between 1990 and 2011, the numbers of children dying because of malnutrition under the age of five fell faster than ever before (from 12 million to 6.9 million).[4] Infectious diseases and under nutrition co-exist in a malignant way: under nutrition reduces immunological capacity to defend against diseases, and diseases deplete and deprive the body of essential nutrients. Therefore, the consequences of under nutrition and infectious diseases are exacerbation of poverty through lost wages, increment in health care costs, and—most insidiously—impairment in intellectual development that can significantly reduce earning potential.[5]

In developing countries, millions of young children are suffering from nutritional deficiencies and frequent infections. Recently, there are many more evidences that indicate nutrition effect son not only physical health but also children's cognitive, motor, and behavioral development. The stage of a child's development, as well as the severity and duration of the insult determines the impact of biological insult. However, most of the time, there is the co-existence of nutritional deficiencies and infection occurs together, and the consequences from anyone problem insult may be exacerbated by the presence of another, and the effects can be cumulative.[6]

In Nepal, children living in rural areas and especially those living in the Mountain zone are most likely to be malnourished. Nepal Demographic and Health Survey (NDHS 2011) found that 41% of children under age 5 are stunted, and 16% are severely stunted. Analysis by age group shows that stunting is highest (53%) in children age 36-47 months. 29 percent of children under age 5 are underweight (low weight-for-age), and eight percent are severely underweight.[7]

Childhood is the period for the development of general intelligence factor (g factor), measured by the IQ test. Both, environmental and biological factors affect the intelligence of an individual. Socio-cultural factors, socioeconomic factors, familial factors, and educational status are environmental factors. Likewise, biological influences depend on many factors for e.g., nutrition, exposure to chemical toxins, and prenatal factors. Among them, nutrition is one of the most important biological factors affecting the intelligence. Studies, in this regard have been done in other areas of the world but only few studies have been done and published in our own country Nepal. So, the objective of this study was to assess nutritional status and intelligence level of pre-school children.

METHODOLOGY

It is a descriptive cross-sectional study done in Bhutaha, Harinagar Rural Municipality, Sunsari. Ethical clearance was obtained from the institutional review committee, B.P. Koirala Institute of Health Sciences, Dharan. Data was collected from 250 preschool children residing in Bhutaha. As per Rural Municipality record of 2068, total number of preschool children was 2250 who were residing in Bhutaha. Taking represents of 10% population as well as 10% additional non response sample was taken. Here with:
10% of Population of 2250=225
10% non-response rate of 225=22.5
Addition of both numbers 225+22.5=247.5 (250). Thus, the sample size for this study was 250.

Sampling was done in two phases. In first phase, three wards were selected by using simple random technique (lottery without replacement). In second phase, house-to-house survey was done and systematic random sampling technique was used. Every alternate house was enrolled and was selected as a sample unit. In house, that has more than one preschool child, eldest one was taken as a sample for this study.

Semi-structured questionnaire was used to collect socio-demographic data like age, sex, ethnicity, religion, birthplace, mode of delivery, birth order, immunization status, occupation of parents, education of parents etc. Wooden stadiometer and standard weighing scale were used to measure height and weight of the child respectively. Nutritional status was classified according to WHO classification.[8] Children's IQ was measured with Vineland Social Maturity Scale (VSMS) for social quotient (SQ) and Developmental Screening Test (DST) for developmental quotient (DQ). Both were Indian Adaptation. For both tools,

face-to-face interview of the primary care giver (mother) and child was done as well as researcher herself asked child to demonstrate activities like buttoning and unbuttoning clothes and uses pencils for writing etc. SQ and DQ were scored separately and an average of both was taken as IQ. SQ obtained from following formula-(Social Age/Chronological Age)*100, similarly DQ obtained from- (Developmental Age/Chronogical Age)*100. Finally, IQ was calculated in this way-(SQ+DQ)/2 as average IQ score. Social age was estimated from obtained score and was given in standard chart and developmental age calculated from DST tool.

Data entry and analysis

The completeness of the data was checked on the same day of data collection. Data was entered in Microsoft Excel 2007 and export into SPSS (statistical package for social science) 11.0 version for statistical analysis. Univariate and bivariate analysis (Chi Square ($\chi 2$)) was done. For all statistical tests, probability of significance was set at 5% level ($p< 0.05$. The descriptive statistics, frequencies, percentage, proportion, mean and standard deviation were calculated. As the part of inferential statistics, Chi Square ($\chi 2$) test was applied to find the association of IQ and selected variables (The findings of the study are presented in tables below.

RESULTS

Out of 250 preschool children included in the study, most of the children (49.6%) were of age 36-48 months and mean age of the study subjects was 51.80 ± 12.31. More than half (51.2%) of the children were male and 80% of the children were Muslim in religion. Almost all (98.4%) children were delivered normally and 78% of the children were born at home. Among them, 63.6% family have 5-9 members at their home and 8.0% have more than 13 members and only 10.4%have four members in their family at their home. Almost half (50.4%) children belong to nuclear family and remaining (49.6%) were from non-nuclear family. Most (43%) of the parents have 3-4 children, followed by 31.2% have up to two and 25.6% have more than four children. Majority (33.1%) children were first child and 0.8% children were eighth in birth order.

More than half (57.6%) fathers of study children were literate, whereas majority (82.4%) of their mothers were illiterate. More than half (59%) fathers of children were working as a labor (national and international setting) and the least percentage (6.4%) were working as teacher/ service. Almost all (99.6%) mother were homemakers. Most (86.6%) of the families were living below poverty line and only 13.6% family were living above poverty line.

Regarding nutritional status of children, majority (71.6%) of the children have normal height according to their age followed by 20.8% children were moderately stunted and 7.6% children were found severely stunted. Likewise, 91.6% have normal weight according to their height and only 8.4% were found moderately wasted. More than half i.e., 52.4% children have bright normal IQ, followed by average 36% and superior 11.6%.

Table 1: Classification of Nutritional Status of the Children (n=250)

Characteristics	Category	N (%)
Height per Age	Normal	179 (71.6)
	Moderate Stunting	52 (20.8)
	Severe Stunting	19 (7.6)
Weight per Height	Normal weight	229 (91.6)
	Moderate wasting	21 (8.4)

Table 2: Gender Wise Distribution of Nutritional Status of Children(n=250)

Characteristics	Categories	Male	Female
		Frequency (%)	Frequency (%)
Height for Age	Normal Height	87 (68.0)	92 (75.4)
	Moderate Stunting	28 (21.9)	24(19.7)
	Severe Stunting	13 (10.1)	6(4.9)
Weight for Height	Normal Weight	116 (90.6)	113(92.6)
	Moderate Wasting	12 (9.4)	9 (7.4)

Table 3: Classification of Intelligence Quotient of Children (n=250)

Characteristics	Category	Frequency	Percentage
Intelligence Quotient	Superior	29	11.6
	Bright normal	131	52.4
	Average	90	36

Table 4: Association between IQ and Selected Socio-Demographic Variables of Children (Pearson Chi Square Test (n=250)

Characteristics	Categories	IQ			p value.
		Superior (%) (120-129)	Bright normal (%) (110-119)	Average (%) (85-109)	
Age in Months	36-48	11 (8.9)	69 (55.6)	44 (35.5)	0.535
	49-60	8 (13.1)	28 (45.9)	25 (41.0)	
	61-72	10 (15.4)	34 (52.3)	21 (32.3)	
Sex	Male	15(11.2)	68 (53.1)	45 (35.7)	0.960
	Female	14 (11.5)	63 (51.6)	45 (36.9)	
Religion	Hindu	7 (14.0)	27 (54.0)	16 (32.0)	0.734
	Islam	22 (11.0)	104 (52.0)	74 (37.0)	
Ethnicity	Muslim	22 (11.0)	104 (52.0)	74 (37.0)	0.734
	Others	7 (14.0)	27 (54.0)	16 (32.0)	
Birth Place	Home	18 (9.2)	109 (55.9)	68 (34.9)	0.036
	Hospital	11 (20.0)	22 (40.0)	22 (40.0)	
Type of Family	Nuclear	14 (11.1)	65 (51.6)	47 (37.3)	0.903
	Joint/Extended	15 (12.1)	66 (53.2)	43 (34.7)	
Number of Children	0-2	10 (12.8)	40 (51.3)	28 (35.9)	0.975
	3-4	13 (12.0)	56 (51.9)	39 (36.1)	
	>4	6 (9.4)	35 (54.7)	23 (35.9)	
Birth Order	First	11(13.3)	44 (53.0)	28 (33.7)	
	Second	8 (16.0)	24 (48.0)	18 (36.0)	
	Third	1 (2.4)	23 (56.1)	17 (41.5)	0.575
	Forth and Above	9 (11.8)	40 (52.6)	27 (35.6)	
Household Size	Up to 4	1 (3.8)	13 (50.0)	12 (46.2)	
	5-9	19 (11.9)	85 (53.5)	55 (34.6)	0.855
	10-13	6 (13.3)	23 (51.1)	16 (35.6)	
	More than 13	3 (15.0)	10 (50.0)	7 (35.0)	

Table 5: Association between IQ and Characteristics of Parents

Characteristics	Categories	IQ			Total	p-value
		Superior (%) (120-129)	Bright normal (%) (110-119)	Average (%) (85-109)		
Income of Family	Below Poverty	27 (12.5)	110 (50.9)	79 (36.6)	216	0.384
	Above Poverty	2 (5.9)	21 (61.8)	11 (32.3)	34	
Father's Education	Illiterate	4 (6.6)	33 (54.0)	24 (39.4)	61	
	Literate	25 (13.2)	98 (51.9)	66 (34.9)	189	0.350
Mother's Education	Illiterate	25 (12.1)	116 (56.3)	65 (31.6)	206	
	Literate	4 (9.1)	15 (34.1)	25 (57.8)	44	0.006
Father's Occupation	Labour	15 (10.1)	71 (48.0)	62 (41.9)	148	
	Farmer	8 (13.8)	37 (63.8)	13 (22.4)	58	0.130
	Others	6 (13.6)	23 (52.3)	15 (34.1)	44	

Table 6: Association between IQ and Nutritional Status of Children

Characteristics	Category	IQ			Total	p-value
		Superior (%) (120-129)	Bright normal (%) (110-119)	Average (%) (85-109)		
Height for Age	Normal Height	27 (15.1)	95 (53.1)	57 (31.8)	179	
	Stunting	2 (2.8)	36 (50.7)	33 (46.6)	71	0.008
Weight for Height	Normal weight	24 (10.5)	122 (53.3)	83 (36.2)	229	
	Moderate wasting	5 (23.8)	9 (42.9)	7 (33.3)	21	0.184

DISCUSSION

Regarding nutritional status, majority (71.6%) of the children had normal height according to their age followed by 20.8% moderately stunted and 7.6% severely stunted. Likewise, 91.6% had normal weight according to their height and only 8.4% were found moderately wasted. Similar study finding of Ghazi HF et al. reported that nutritional status of respondents was good as 87.9% were normal as compared to malnourished.[9]The finding contradicts NDHS report which showed that 29% children were underweight. Among them 41% were stunted and 11% were wasted.

Regarding IQ of children, more than half (52.4%) of the children scored in between 110-119 (Bright Normal), 36% children had IQ in between 85-109 (Average) and 11.6% children had IQ in between 120-129 (Superior). Similar study finding of Ghazi HF et al. reported that 77.7% of the respondents had high intelligence level.[9] But the finding contradicts book report of Morgan CT et al. wrote that majority (59.1%) of people have average IQ.[10]

This study showed that there was no association between ethnicity and IQ of children that both Muslim and Non-Muslim children had equal IQ. In contrary to this finding, the study done by Templer DI, to compare the IQ of Muslim and Non-Muslim population revealed that mean IQ score (100±15) of Non-Muslim population was significantly higher than Muslim population (85±15).[11] Another study result showed that White children's IQ was significantly higher than either African American or Hispanic children.[12]

In this study, result showed that 100% children were exclusively breast fed up to 6 months of age and in relation to this majority of children had bright normal IQ. This finding was supported by the study of Angelsen NK et al. that a shorter duration of breast-feeding was associated with lower scores on mental developmental tests.[13]

There was no significant association between socioeconomic status of family and IQ of children. In contrary to this finding, study conducted by Johnston FE et al. found that there was higher levels of SES, increasing levels of nutritional status (i.e., height) are associated with higher IQ.[14]

The study finding suggests that there was no significant relationship between family size and IQ of children. This result contradicts with the finding of Black SE et al. which revealed that family size has a negative effect on IQ, suggesting that random shocks to family size have a negative effect on existing children.[15]

Mother's education was significantly associated with IQ of children. Educated mothers' children had more IQ than those of who were uneducated. This finding was supported by the study finding done in Pakistan by Shahzada G. The finding showed that there was a significant correlation between mother's education and students' verbal/linguistic intelligence.[16] Similar finding was found in the study done by Rahu K et al. It showed that mother's education had an independent positive correlation with offspring intelligence.[50] Study of Meador KJ et al, found the same finding that maternal IQ and education were independently related to cognitive outcome of the child.[17]

Present study revealed that those children who were delivered at home had significantly low IQ score (p =.036)

and it was also found that home delivery was significantly more in illiterate mothers (p=0.011). Thus, the study finding might have showed low IQ in children because of illiterate mothers who delivered at home.

The study finding showed that there was significant association between nutritional status (height for age) and IQ of children. Webb KE et al supported this finding. They found that severely stunted children had significantly lower IQ scores than mild to moderately stunted children.[18] Similar result was found by Upadhyay SK, and Agrawal DK that the stunted children had lower IQ scores as compared to those who were wasted.[19] Same finding was showed in a study done by Suvarna and Itagi S. K. It was noted that the nutritional status was positively and significantly correlated with level of intelligence. [20]

CONCLUSION

Mother's education has great impact on Intelligence Quotient of children. Intelligence is strongly related to nutritional status. Enhanced nutritional status offer good intelligence and chronic malnutrition leads to poor intelligence. Poor nutrition leads to poor IQ, which results in poor academic achievements, that further causes deprivation from better job opportunities, finally that result in poor socioeconomic status and the consequence is poor nutrition. Again another vicious cycle begins. To break this vicious cycle, priority should be given to the prevention of severe acute malnutrition (wasting) and chronic malnutrition (stunting) that they affect the developing brain and compromise long-term cognitive, motor, and socio-emotional development.

RECOMMENDATIONS

Similar type of study can be carried out in large sample size in larger area and comparing different ethnic groups and different ecological areas. An integrated comprehensive system for assessment of nutritional status and growth monitoring should be followed to detect malnutrition early to avoid the irreversible effect on intellectual development and adverse reaction on scholastic achievement. Educational sensitization programme through audio visual aids can be conducted for Mothers Group regarding importance of nutrients in physical and mental health especially during infancy and early childhood period

LIMITATIONS OF THE STUDY

Since study was conducted in only one VDC of Terai so findings cannot be generalized to all population of Nepal.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

FINANCIAL DISCLOSURE

None

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