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Cognitive function and associated factors among school age children in Goba Town, South-East Ethiopia

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ABSTRACT

This study aimed to assess cognitive function and associated factors among school age children in Goba Town, South-Eastern Ethiopia. School based cross-sectional study was employed on 131 school children age 8–11 years. Cognitive function was assessed by Kaufman Assessment Battery for Children (KABC-II) and Ravens colored progressive matrices (Raven's CPM) test. Descriptive statistics, independent *t* test, one way ANOVA and logistic regression were used in statistical analysis. The mean (±SD) score of Raven's CPM test and triangles test was 22.02(±4.79) and 15.17 (±3.24) respectively. The mean (±SD) for short term memory measures such as word order, hand movement number recall was 15.66 (±3.03), 9.09 (±2.88) and 8.91 (±2.19) respectively. The mean score (±SD) of pattern score was 9.63 (±4.43). There was a statistically significant mean difference in hand movements and pattern score between those children who currently used iodized salt and non iodized salt($p < 0.05$). Wealth index was associated with rovers score ($P = 0.044$). Breakfast consumption was statistically associated with triangles ($P < 0.001$). Those children who had eaten breakfast less than seven days in last week had above 3 times higher odd to score RPM below average(AOR = 3.05; 95% CI: 1.07–8.68). This might implicates that promotion of iodized salt intake, improving dietary diversity, improving breakfast eating habit, and improving wealth index are important modifiable factors of cognitive function.
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1. Introduction

Cognitive impairments that resulted during preschool years were irreversible. Cognitive function of school age children can be affected by several factors such as nutritional status, demographics, and socio-economic factors (Anuar, Lim, Low, & Harun, 2005; Zalilah, Bond, & Johnson, 2000).

Globally, there were more than 200 million stunted school age children with risk of impaired physical and mental development (Grantham-McGregor et al., 2007). In poor countries, malnutrition is considered as a major problem that limits the ability of children to learn and causes them to eventually perform at a lower level (Galal & Hullet, 2003). Studies showed that children who were malnourished in early life are more likely to have lower schooling attainment and to score poorly in cognitive tests during school age as compared to well-nourished children (Alaimo, Olson, & Frongillo, 2001; Alderman

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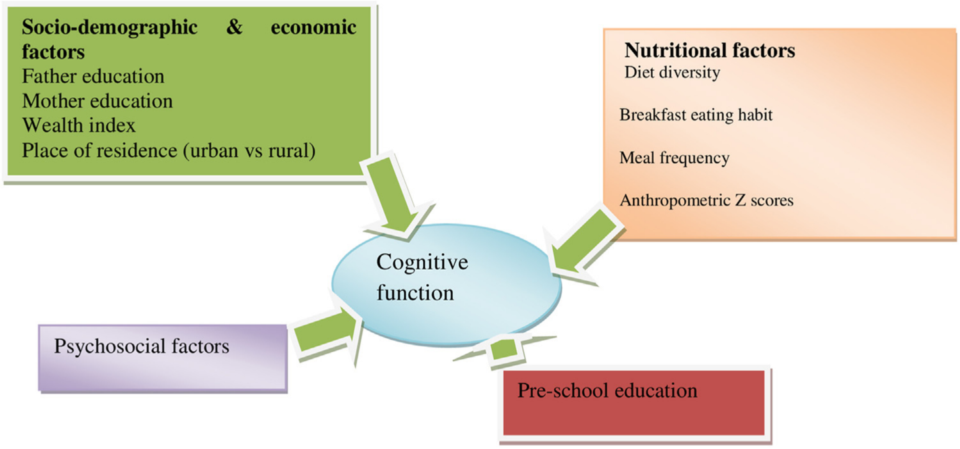

Fig. 1. Conceptual frame work that describe the association of socio-demographica factors, economic factors and nutritional status with cognitive function.

et al., 2006; Glewwe, 2005; Glow et al. 2001; Walker et al., 2000). Growth retardation in early childhood is associated with significant functional impairment in school age and adult life, and reduced work capacity, thus affecting economic productivity (DeOnis, 2000).

Socio-economic status is also one of the most important factors that may influence the development of children. Parental education, occupation, income, and health service facilities; would all influence the growth of children. The environment of children of higher socio-economic groups may provide opportunity for gaining knowledge and help children to be quick to learn. However in low socio-economic status groups, there may be more opportunity to master self help skills and gain independence (Aughinbaugh & Gittleman, 2003; Baum, 2003; Berger et al., 2006).

In developing countries like Ethiopia, millions of school children suffer from nutritional deficiencies and frequent infections which can have a negative effect on their cognitive, motor, and behavioral development (Lee, 2003). Because the foundation of good health and sound mind is laid during the preschool and school age periods, early age is a basic milestone in the life of an individual and is responsible for many changes that take place during later life. Children who fail to grow optimally during this crucial period may not make-up the loss in growth even if they consume an excellent diet in later life (Pollitt, 1996).

From the literature review made for this study, we have developed the conceptual frame work that describes the association of socio-demographic factors, economic factors and nutritional status with cognitive function (Fig. 1). This study hypothesized that socio-demographic, economic and nutritional factors are associated with cognitive performance of school age children. Understanding of the child's cognitive abilities and identifying the modifiable factors is critical to establishing intervention goals and to planning therapeutic activities. Screening of cognitive abilities and associated factors is essential for a comprehensive understanding of the child's abilities and limitations. This study aimed to investigate factors associated with cognitive performance among school age children in Goba Town, Southeast Ethiopia.

2. Methods

2.1. Study setting and design

Institutional based cross-sectional study design was employed among 131 school age children (6–11 years) in Goba Town, Bale zone, Oromia region, South east Ethiopia. The study was conducted from May to June 2014. School age children who have health problems (like visual impairment, hearing impairment and severe mental problems) were excluded.

The sample size (n) for this study was determined by using G power statistical software version 3.1.5 (Faul, Erdfelder, Lang, & Buchner, 2007) with the following assumptions. Assuming the effect size of 0.24, the level of significance (α), 0.05 ($Z_{\alpha/2} = 1.96$) and the power efficiency (1-β) 100% is 80% ($\beta = 0.80$). The software gives total sample size of 103 for study subjects. Considering 10% non-response rate, the total sample size (n = 121), which is the minimum sample size needed to detect difference in cognitive performance of malnourished and well nourished school age children. Actually the study was conducted on 131 school age children.

The sampling procedure was started with the stratification of the schools in to public schools and private schools by assuming there is a socioeconomic difference between strata. Five primary schools (two from public and three from private) were taken randomly. The total number and list of students were obtained from each selected school. Proportional allocation was made to determine the number of students included in the study from each school. The same procedure was followed to determine the number of students in each class of the school and finally students were selected using simple random sampling technique (i.e. computer generated random number). From randomly selected student who were absent on three consecutive days during time of data collection was substituted by the next student from the same class room.

2.2. Socio-demographic characteristics and dietary assessment

Data were collected by using a pre-tested, structured and interviewer-administered questionnaire adapted from Ethiopian Demographic and Health Survey [EDHS] (Central Statistical Agency (CSA) Ethiopia, 2011) and national nutrition program (Ethiopian Health and Nutrition Research Institute, 2009). The EDHS questionnaire was originally adapted from model survey instruments developed for the MEASURE DHS project to reflect the population and health issues relevant to Ethiopia. The questionnaire contains age, sex, education, source of water, type of toilet facilities, materials used for the floor of the house, and ownership of various consumer durable goods, dietary intake and nutritional status. The tool was pretested and translated into local languages to collect the Ethiopian demographic and health survey data (Central Statistical Agency (CSA) Ethiopia, 2012). Dietary intake was assessed by 24 h dietary recall and dietary diversity was calculated based on WHO seven food groups (WHO et al., 2008).

2.3. Anthropometric assessment

Anthropometric measurements (height and weight) were taken for all children included in the study. Body weight was recorded to the nearest 0.1 kg using the UNICEF SECA weighing scale. Instruments were checked against a standard weight for accuracy daily. Calibration of the indicator against zero reading was checked before weighing every child. Children were weighed with light clothing and without shoes. Height was measured to the nearest 0.1 cm using the shorr measuring board without shoes in a standing position. The age of children in completed year was obtained from school and confirmed from the parents.

2.4. Cognitive assessment

The cognitive function of the students was assessed by selected tests from the Kaufman Assessment Battery for Children (KABC-II) (Kaufman & Kaufman, 2004). From the tests which measure sequential processing (short term memory), Number Recall, Word Order and Hand Movement were used. The maximum scores for these tests are 22, 31 and 23 respectively. For measuring simultaneous processing Rover and Triangles were used. The maximum score for these tests are 44 and 29 respectively. Planning (fluid reasoning) was measured by using Pattern Reasoning. The maximum score for the test is 36. Tests measuring learning and knowledge did not used for this study because they were not used previously in similar cultural settings. Core subsets for planning and conceptual thinking, were not administered because; in previous studies done in similar settings, most of the pictures in the subsets were not familiar to the child (Alemtsehay et al., 2011; Girma, Loha, & Stoecker, 2009). Raven's Colored Progressive Matrices (RCPM) made up of three sets of twelve problems which measures the ability to solve problems and reasoning by analogy and has been used extensively as a culturally fair test of intelligence(Raven, 2000). Each of the cognitive tests was administered by different well trained data collectors. One data collector administered only one cognitive test for all study subjects to reduce inter individual differences.

2.5. Data entry, processing and analysis

Data were checked for completeness, cleaned, coded and entered into SPSS version 20 and WHO anthroplus Version 1.0.4 for analysis. The nutritional indicators; height-for-age, weight-for-age, and weight-for-height were calculated from measurements using WHO Anthro plus and compared with reference data according to WHO 2006 population. Those children who have a Z score below-2 standard deviation (-2SD) of the WHO median for weight-for-age, height-for-age and weight-for-height were considered under-weight, stunted or wasted, respectively. Normal was defined as Z-scores greater than or equal to -2SD, because obesity and over weight is null in the area as we examined from the collected data Data from questionnaires were checked by running summary descriptive statistics for all variables. For categorical variables, entered values were cross checked against pre-defined values. For continuous variables, range checks were done by setting plausible lower and upper limit values for a specific variable. Values that fall outside of the specified range were checked and corrected; by went back to questionnaires or omitted. Scatter plots were used to identify outliers. Histograms were used to see the variability and distribution of continuous data. Data were checked for normality of distributions by using Kolmogorov–Smirnov test.

A descriptive analysis was conducted to summarize the variables in summary statistics such as frequencies, means and standard deviations. Independent sample *t*-test and one way ANOVA were used to compare mean differences in cognitive test scores. Pearson correlation was used to check the relationship between nutritional status and cognitive performance. For Ravens CPM, bivariate and multivariable logistic regression analyses were performed to identify the associated factors with Ravens CPM (dependent variable). The dependent variable (Ravens CPM score) was dichotomized to below average Ravens CPM scores and average and above average scores. Strengths of association were determined by odds ratio (OR) and 95% confidence interval. A P-value less than 0.05 was accepted as being statistically significant

Table 1
Mean score of the cognitive function tests among school age children in Goba Town, South East Ethiopia, 2014.

Cognitive function test	Minimum	Maximum	Mean	Std. D
Raven's CPM	13	33	22.02	4.79
Triangles test score	9	28	15.17	3.24
Word Order score	2	26	15.66	3.03
Pattern score	1	31	9.63	4.43
Hand Movement score	4	17	9.09	2.88
Rovers score	4	36	14.25	6.93
Number Recall score	5	16	8.91	2.19

2.6. Ethical consideration

The ethical clearance was obtained from the institutional review board of Madawalabu University. Letter of permission was also obtained from Goba woreda education office. Study objectives, study period and measurement procedures were explained and informed written consents were obtained from parents (mothers/caregivers). The students and parents (mothers/caregivers) of study subjects were assured that the information they provide kept confidential.

3. Results

3.1. Cognitive function test scores among school age children

Frequency, mean, and standard deviation were the descriptive statistics used to summarize the scores of school age children on cognitive tests. About 18.6% of the school age children scored Raven's CPM below 18 (half of the maximum score). The mean (±SD) score of the Raven's Colored Progressive Matrices test was 22.02(±4.79) while the mean (±SD) score for the triangles test was 15.17 (±3.24). The mean (±SD) for short term memory measures; word order, hand movement and number recall were 15.66 (±3.03), 9.09 (±2.88) and 8.91 (±2.19) respectively. The mean score (±SD) of Patten score (fluid reasoning or solving problems by using induction deduction reasoning) was 9.63 (±4.43) (Table 1).

Reliability among the different cognitive tests were measured by cronbach's α value. A cronbach's α value > 0.7 indicating a high level of internal consistency between the tests (Tavakol & Dennick, 2011). In this study the cronbach's alpha value between the cognitive tests was 0.79 (95% CI: 0.73–0.84). All the cognitive test scores have statistically significant correlation between each other. The correlation between word order and number recall was 0.60. Similarly the correlation between Raven's CPM and pattern reasoning was 0.61. Raven's CPM and triangles have a correlation of 0.64 which is relatively stronger as compared to the other correlations (Table 2).

We have used Pearson correlation analysis to determine if there was a statistically significant association between anthropometric Z scores and cognitive function test scores. Our correlation analysis showed that anthropometric z scores and the cognitive function test scores were not statistically correlated ($p > 0.05$) (Table 3).

3.2. Factors associated with cognitive function test scores

Factors associated with different cognitive function test scores were identified by Pearson correlation, independent *t*-test and one way analysis of variance (one way ANOVA) (Table 4). Mean comparison based on independent *t*-test analysis showed that those children who were using iodized salt have statistically significant higher scores for hand movements ($p < 0.001$), pattern score ($p < 0.02$) and Ravens CPM ($p < 0.02$) as compared to those children who did not used iodized salt. Similarly, independent *t*-test result revealed that the mean Ravens CPM score was significantly higher in those children who had consumed four and more food groups in the last 24 h as compared to their counter parts (p =0.007). One way analysis of variance showed that the mean rovers score was significantly higher in those children who were from the medium and good wealth index tertile as compared to those children who were from the poor wealth index ($p = 0.044$).

Table 2
Correlation between cognitive function test scores among school age children in Goba Town, South east Ethiopian, May 2014.

	Raven's CPM	Triangles	Word order	Pattern reasoning	Hand movement	Rovers	Number recall
Raven's CPM	1						
Triangles	0.64	1					
Word order	0.35	0.31	1				
Pattern reasoning	0.61	0.48	0.29	1			
Hand movement	0.46	0.34	0.33	0.47	1		
Rovers	0.51	0.45	0.24	0.38	0.30	1	
Number recall	0.32	0.29	0.60	0.30	0.41	0.33	1

All correlation coefficients are statistically significant at *p*-value 0.05.

Table 3
Correlations between cognitive function test scores and anthropometric z-scores among school age children in Goba Town, South east Ethiopia, 2014.

Anthropometric z score		Cognitive function test scores						
		number Recall score	rovers score	hand Movement score	pattern score	Word Order score	Triangles test score	Ravens CPM
HAZ[a]	r	−0.11	−0.09	0.13	0.013	−0.04	0.002	0.06
	P-value	0.22	0.33	0.15	0.88	0.63	0.98	0.52
	N	128	128	128	128	128	128	126
WAZ[b]	r	−0.001	−0.05	0.15	0.003	0.021	0.08	0.09
	P-value	0.99	0.56	0.10	0.98	0.82	0.39	0.34
	N	127	127	127	127	127	127	125
BAZ[c]	r	0.078	−0.01	0.05	−0.02	0.05	0.10	0.041
	p-value	0.38	0.94	0.57	0.83	0.56	0.26	0.65
	N	127	127	127	127	127	127	125

The total number of N is not equal because of missing values and out layers.
[a] Height for age Z score.
[b] Weight for age Z score.
[c] Body mass index for age Z score.

Table 4
Factors associated with different scores of cognitive test among school age children in Goba Town, South east Ethiopia, 2014.

Variables		Number recall	Rovers	Hand movements	Patten score	Word order	Triangle	Ravens CPM
Iodized salt utilization	No	8.72	14.08	8.41	8.98	15.66	15.02	21.14
	Yes	9.32	14.68	10.89	10.89	15.68	15.43	23.84
	P value	0.143	0.64	<0.001	0.02	0.97	0.50	0.02
Wealth index	Poor	9.07	13.98	8.80	9.17	15.39	14.50	21.39
	Medium	9.11	14.37	8.83	9.91	15.77	15.66	22.03
	Good	8.70	14.70	9.41	9.66	15.86	15.52	22.74
	p-value	0.428	0.044	0.39	0.47	0.28	0.11	0.28
Dietary diversity	<3	8.79	14.21	8.83	9.04	15.54	14.96	20.96
	≥4	8.98	14.09	9.21	10.21	15.71	15.36	23.25
	P-value	0.603	0.92	0.46	0.14	0.76	0.49	0.007
Family size	≤3	9.72	17.12	9.69	11.38	16.00	15.69	22.94
	4–5	8.97	13.23	9.13	9.66	15.67	15.34	21.92
	≥6	8.14	13.14	8.38	7.92	15.27	14.35	21.14
	p-value	0.011	0.018	0.16	0.004	0.608	0.189	0.297
School type	Private schools	9.43	16.33	10.19	11.37	16.30	16.43	24.03
	Public schools	8.36	12.08	7.94	7.81	14.98	13.84	19.85
	P-Value	0.005	<0.001	<0.001	<0.001	0.013	<0.001	<0.001
Sex	Male	9.24	15.99	9.29	9.88	16.05	15.53	22.65
	Female	8.33	11.25	8.75	9.21	14.98	14.54	20.89
	P-value	0.022	<0.001	0.304	0.405	0.05	0.045	0.093
Place of residence	Urban	8.97	13.98	9.20	9.60	15.65	15.16	21.90
	Rural	8.11	17.89	7.67	10.11	15.78	15.33	23.67
	p-value	0.261	0.103	0.125	0.739	0.902	0.875	0.287
Educational status of the father	illiterate	8.50	14.42	9.42	9.67	15.50	16.50	22.36
	Primary (1–8)	8.42	12.88	7.88	8.17	15.00	13.38	20.21
	Secondary (9–12)	8.67	13.96	9.16	9.69	15.46	14.98	21.63
	Tertiary (>12)	9.35	14.54	9.65	10.12	16.04	15.92	23.58
	P-value	0.401	0.831	0.132	0.323	0.689	0.008	0.083
Educational status of mother	illiterate	7.92	11.85	8.62	8.31	14.08	13.92	19.62
	primary(1–8)	8.51	15.58	8.12	8.67	15.61	14.84	21.74
	secondary(9–12)	9.08	13.42	9.58	9.87	15.79	15.73	22.16
	Tertiary (>12)	9.59	15.18	10.59	10.94	16.06	15.41	24.44
	P-value	0.120	0.242	0.010	0.145	0.27	0.280	0.055
Meal frequency	r	0.085	−0.044	0.208	0.106	0.08	0.001	0.036
	P-value	0.335	0.618	0.017	0.228	0.394	0.989	0.685
Number of days breakfast consumed	r	0.100	0.108	0.183	0.21*	0.112	0.335**	0.325**
	P-value	0.260	0.223	0.037	0.016	0.204	<0.001	<0.001

*Significant at p-value <0.05, **significance at p-value <0.001.

As evaluated by independent *t*-test, those children who had consumed four and above food groups has significantly higher score of Ravens CPM ($p = 0.007$). One way analysis of variance showed that those children who were from smaller family size (≤ 3) had higher mean score in number recall ($p = 0.01$), rovers ($p = 0.018$), and pattern score ($p = 0.004$). Pearson correlation analysis revealed that number of days of breakfast consumption in the previous week was statistically positively correlated with triangles ($r = 0.335$, $p < 0.001$) and Ravens CPM ($r = 0.325$, $p < 0.001$). Similarly, Pearson correlation analysis showed that twenty four hour meal frequency was positively correlated with hand movement ($r = 0.21$, $p = 0.017$) (Table 4).

3.3. Logistic regression analysis

In the bivariate logistic regression analysis only school type (Governmental vs non- governmental) and breakfast habit were found statistically significant associated with Ravens CPM. The other variables were not found statistically significant in the bivariate analysis at $P < 0.2$ in the logistic regression analysis. Therefore variables others than school type (Governmental vs non- governmental) and breakfast habit were not included in the final multivariable logistic regression.

To demonstrate the independent effect of school type (Governmental vs non- governmental) and breakfast habit, we performed a multivariable logistic regression with type of schools and breakfast habit as independent variables while RPM scores as a dependent variable. The multivariable logistic regression model analysis showed that, those children who had eating breakfast less than seven days in last week had above 3 times higher odds of having RPM scores below average (AOR = 3.05; 95% CI: 1.07–8.68), $p < 0.001$.

4. Discussion

This study hypothesized that there are socio-demographic, socioeconomic and nutritional factors which affect cognitive performance of children. We have demonstrated that there are factors significantly associated with cognitive performance of school age children measured by Kaufman Assessment Battery for Children (KABC-II) (Kaufman & Kaufman, 2004) and Raven's Colored Progressive Matrices (RCPM) (Raven, 2000). However the factors associated with cognitive performance of school age children were not the same for all the tests. This study did not find a statistically significant association between anthropometric z score and cognitive performance tests. This finding contradicts with a study from South Africa which revealed that under-nutrition on school children was also associated with poor cognitive scores (Taljaard, Covic, & Graan, 2007). A cross-sectional study conducted on nutritional status and cognitive performance of women and their five years old children in Sidama Zone, Southern Ethiopia, also showed that height-for-age z-score was correlated with scores for short-term memory and visual processing indices and weight-for-age z-score was also correlated with scores of short-term memory and visual processing indices which implies performance on memory and visual processing tasks was significantly lower in children with growth deficits (Alemtsehay et al., 2011). A study of Fernstrom and his colleagues also indicated that malnourished children with poor physical growth perform poorly in intelligence tests (Fernstrom, Uauy, & Arroya, 2001). Similar study conducted by Khalifa et al. on nutritional status and cognitive performance of primary school children at Giza, India, showed that chronic malnutrition (low height/age and low head circumference/age) had significant influence on cognitive performance of children (Khalifa, Hasaballa, Tawfik, & Mansour, 2004). The absence of association between nutritional status and cognitive function test in this study might be explained by the power of the sample size to detect the difference. In this study the prevalence of stunting, underweight and wasting was found low. Therefore the mean difference in cognitive test score might not be significant because of the small number of students who were malnourished. This might imply that the association between cognitive function and nutritional status is better detected in a community where malnutrition is widespread.

This study found that cognitive function tests were significantly associated with iodine salt intake. There was a statistically significant difference in hand movement, pattern, and Ravens CPM test scores among those children who used iodized salt and their counter parts. This could be due to the fact that iodine deficiency results poor cognition in school children (Fernald, 1998; Feyrer, Politi, & Weil, 2013; Gordon et al., 2009; Maberly, Haxton, & Haar, 2003).

In this study wealth index was significantly associated with Rovers (Visual processing Perceiving, storing). Longitudinal studies also revealed that greater wealth is associated with higher cognitive performance (Crookston, Forste, McClellan, Georgiadis, & Heaton, 2014; Escueta, Whetten, Ostermann, O'Donnell, & The Positive Outcomes for Orphans (POFO) Research Team, 2014).

Child diet diversity was also a significant contributor to cognitive performance (Ravens CPM). Children who had higher dietary diversities scored higher mean score for Ravens CPM. A study from Southern Ethiopia revealed that children who consumed meat, poultry or eggs had significantly higher scores for Number recall, Word order, Triangles and the sequential scale (Girma et al., 2009). A study done in Kenya also showed that improved dietary diversity had a direct impact on the cognitive ability of children (Whaley et al., 2003). Number of day's breakfast consumed had a statistically significant correlation with cognitive test scores such as Raven's CPM, triangles, pattern score and hand movement. In the multivariable model those children who had eating breakfast less than seven days in last week had above 3 times higher odds of having RPM scores below average. Many studies revealed that regular breakfast consumption improves cognition (Defeyter & Russo, 2013; Liu, Hwang, Dickerman, & Compher, 2013; Mahoney, Taylor, Kanarek, & Samuel, 2005).

In this study those children who attended public schools had lowered cognitive score as compared to the private schools. The difference in mean cognitive test scores between public and private schools could be explained by the socio economic difference between school age children attended private and public schools. Socio-economic status is an environmental factor that may influence the cognitive development of the children (Brito & Noble, 2014). The mean score for number recall, rovers and pattern score was different across the different family size. This might be also associated with socio-economic status. When the family size increases, usually the socioeconomic status of the household decreases. Besides this fact the care provider might not able to provide adequate breakfast for children due to shortage of food and increased burden from high number of family members.

This study also found that mother educational status was significantly associated with hand movement while educational status of father was associated with triangles. Some differences in development of children who come from different socio-economic status are expected (Brito & Noble, 2014; Raizada & Kishiyama, 2010). Children who were from higher socio-economic groups might provide with opportunity for gaining knowledge and help children to be quick to learn (Aughinbaugh & Gittleman, 2003; Baum, 2003; Berger et al., 2006). Many consistent findings were reported from different studies. Those children who had illiterate caregiver is associated with lower performance on cognitive development tests (Escueta et al., 2014). Another study done in four low and middle income countries showed that parents schooling is a determinative factor of children's cognitive scores (Crookston et al., 2014). The other justification could be those educated mothers might be provided a care such as regular breakfast which stimulates cognitive development.

This study has its own limitations. The first limitation was its small sample size and includes children mostly from urban area where malnutrition is not distributed widely as rural. This study did not assess micronutrients status of those school age children which are actually the most determinant for cognitive development. This study also did not use standard scores for measuring the different dimension of cognitive function using scale.

This study implicates there is a need to institute programs to improve school age children cognitive development through various mechanisms. The importance of integrated child care and psychological intervention might be considered in school among different stakeholders towards the initiation of some sort of focus, for designing effective child care interventions. In fact additional researches should be conducted in other parts of the country too, but this study gives a clue about some of the factors that the education, economic and health sector to act upon in child development.

5. Conclusion

There was no statistically significant association between nutritional status (HAZ, WAZ and BAZ) and cognitive test scores (Number recall, Rovers, Hand movement, pattern reasoning, Word order, Triangles, Ravens CPM). Factors such as iodized salt intake, parent education, dietary diversity score, wealth index and family size associated with the cognitive function of school age children who attended in Goba Town. Promotion of Iodized salt intake, improving dietary diversity, breakfast eating habit, and improving wealth index were the recalled interventions.

Competing interest

The authors declare that we have no competing interests.

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