Body Mass Index and Dietary Habits as Predictors of Cognitive Abilities of Preschool Children in Zagazig City, Egypt

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Abstract: **Background:** Preschool period is a crucial time for human growth and development especially the development of cognitive abilities. Nutrition is an important influencing factor of continuous growth and development that occur throughout the childhood period. BMI and dietary habits are the most useful tools for assessing the nutritional status of children. Therefore, the present study **aimed** to assess body mass index and dietary habits as predictors of cognitive abilities of preschool children in Zagazig city, Egypt. **Subjects and methods:** A cross-sectional descriptive design was used to conduct the current study where 100 child were selected by using a multistage cluster sample from three nursery schools in Zagazig city. Two tools were used to collect data they were; tool I: an interview questionnaire composed of three parts (Socio- demographic data, dietary habits questionnaire & body mass index chart), and tool II: general cognitive ability scale. **Results:** Concerning dietary habits, 65% of children had good dietary habits, while 81% of them took unbalanced diet. Considering BMI, 68% of children had normal BMI. Moreover, 57% of children had high cognitive abilities. **Conclusion:** Child's dietary habits and female sex had imposing effect on both child's cognitive abilities and BMI. Also, rural residence positively predict children's BMI. On the other hand, children's cognitive abilities inversely influenced by home crowding. Ultimately, it was proved that preschool children's BMI had no association with their cognitive abilities. **Recommendations:** Proceed school based nutrition education programs to edify preschool children about the recommended food groups, conduct educational programs for preschool children's parents to raise their awareness about children's healthy growth and development and healthy diets. Moreover, it is important to develop nursing interventions for promoting cognitive abilities of preschool children.

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Key words: Preschool children, body mass index, dietary habits, and cognitive abilities.

I. Introduction

The healthy population is the wealth of the Nation. Children are the most vital human resource a country possesses. Children hold the potential and set the limit of future development of any country. "The better the nutritional Status of the children, the higher will be the Nation rise". Today's children are tomorrow's citizen who should be healthy. Therefore their nutritional status is of great significance. Good nutrition is the basic component of healthy growth, development and for maintaining health throughout life. Malnutrition is a major public health problem that affects millions of children worldwide often leading to long lasting impairment **(Devi & Gupta, 2016).**

World Health Organization (WHO) estimates that there are 250 million people with high body mass index (BMI) in the world, among them approximately 22 million are children aged less than 5 years. Worldwide, the prevalence of children with elevated BMI increased from 4.2% in 1990 to 6.7% in 2010. The expected prevalence for 2020 is 9.1%. So that, appropriate nutrition, physical activity and behavioral modification represent important strategies for prevention of childhood malnutrition **(Munteanu et al., 2015).** In Egypt, preschool children represent 11.2% of the whole population, and 29.6% of them enrolled pre-primary education **(United Nations International Children's Emergency Fund (UNICEF) in Egypt, 2014).**

High BMI during childhood is likely to persist through adulthood, and is associated with a wide range of physical and psychological problems. Impairment of cognitive ability is one of the psychological consequences that could have a substantial impact on the future of children with elevated BMI **(Lee, 2009).** There is a growing body of evidence suggesting an association between increased body mass index and altered cognitive functioning in children. High BMI in early childhood is associated independently with impaired cognitive outcomes. It affects cognition mainly through altering the brain structures and functions **(Raji et al., 2010).** A high BMI could affect school performance in young children **(Veldwijk et al., 2011).**

In developing nations, malnourishment is viewed as a burden on a considerable proportion of population

and the most vulnerable of this proportion are the youngest of the country. More studies revealed that malnutrition at an early age affects children's physical growth and brain development. Malnutrition in early childhood impairs functional performance in adulthood and this impairment may be physical as well as cognitive. Economic losses, due to the physical and cognitive losses are substantial **(Onifade et al., 2016).**

Preschool period is a crucial time for human growth, development and maturation, in which changes occur in the body. Monitoring and evaluation of the process of growth and development in this period is of a particular importance. The fact that most of the risk factors associated with inadequate diet and changes in lifestyle habits in most cases begin in childhood and are passed into adolescence **(Nikolic, 2013).** Therefore, improving the dietary habits of preschool-aged children is an important public health goal **(Diab, 2015).** Nurturing healthy dietary habits is especially important in childhood as this is a critical period of growth and development. Furthermore, dietary habits are shaped from an early age with many of them forming even below the age of 5 years and these habits subsequently become more difficult to change after the age of 11–18 years. Therefore, the importance of nurturing healthy dietary habits during a child's formative years cannot be underestimated **(Shiu et al., 2012).**

Proper development of child's mind is dependent on proper nutrition particularly during early childhood. The brain is undergoing a major growth spurt during this time period, thus increasing the body's demand for nutrients. Children require a nutritionally balanced diet in order to meet the demands of their growing brain. Without the necessary intake of nutrients the brain will be stunted in its growth, which may possibly lead to mental impairment or retardation. Malnutrition impairs cognitive development because the body is attempting to survive by saving as much of its energy as it possibly can. By affecting a child's physical growth, malnutrition is affecting cognitive development in an indirect fashion **(Caviness, 2009).**

Community health nurses can educate parents, teachers and caregivers regarding the cognitive, emotional and physical health needs of the children **(Clark, 2008)**. Nutrition education in the early years of life, particularly in the preschool period, is very important for an individual's health throughout life. Additionally, nutritional experiences at a young age influence dietary habits in adulthood. For this reason, nutrition education should be continuous, effective and directed towards all family members **(Diab, 2015).**

Significance of the study

There is increasing emphasis on the importance of the pre-school period for subsequent academic outcomes. There is therefore a need to test whether, and to what extent, body mass index (BMI) is associated with cognitive function in the crucial pre-school years. The relation between childhood BMI status and cognitive functioning in a population of normal children has been the subject of limited research **(Sharif & Blank, 2010).** Malnutrition is a major problem in Egypt and affects about one-third of children under-five, which has a hazardous impact on their intellectual and physical development **(United Nations International Children's Emergency Fund (UNICEF) in Egypt, 2010).** Various studies have indicated that the most rapid period of intellectual development occurs during the first 4-5 years of life. Malnutrition during the period from 1-5 years of age results in cognitive developmental disorders **(Jalal, 2009).** Childhood malnutrition (either underweight or overweight) has a negative effect on cognitive abilities. Parents should be particularly vigilant in monitoring a child's nutritional status whatever the proximate cause of under or overweight might be **(David, 2006)**. Children suffering from malnutrition from an early age generally have difficulties facing the future and will potentially have low physical and intellectual ability and low productivity, consequently the aim of the present study was to assess body mass index and cognitive abilities among preschool children in Zagazig city.

II. Subjects & Methods

2.1.Design:

A cross-sectional descriptive design was used to conduct the current study.

2.2.Setting:

The existing study was conducted at three governmental nursery schools in Zagazig city, Egypt. These nursery schools were El-Shahid Tayar Ibrahim Ali El-Hadad, El-Nakaria El-Hadetha and Om El-Moamenen which were randomly selected from Zagazig city nursery schools.

2.3.Subjects:

The existing study enrolled 100 preschool child and their parents, who were recruited from the above mentioned nursery schools according to the following inclusion criteria:

- Age ranged from 5 to 6 years.
- Had no health problems that may affect their cognitive abilities as (attention deficit hyper activity disease, intellectual disability or taking medication affecting memory, attention,.... etc.).
- Had no health problems that may affect their body mass index as (diabetes mellitus or medication as cortisone).

Sample size:

The sample size was calculated to demonstrate an expected correlation coefficient of -0.3 or higher with 80% power and at a 95% level of confidence between

the score of cognition and BMI. Using the sample size equation for correlation in Open Epi software package, the required sample size was 85 child. This was increased to 100 to account for a non-response rate of about 10%.

2.4.Tools of data collection:

Two tools were used to carry out the present study, they were:

Tool I: An Interview questionnaire which was developed by the researcher in the light of the current related literature and composed of three parts: Socio-demographic data, child's dietary habits and body mass index chart.

Part 1: Socio- demographic data:

It involved two parts; **child data:** such as; child's age, sex, siblings, birth order, etc., and **family data:** such as; parents' age, educational level, occupation, family size, family income, residence, etc.

Part 2: Child's dietary habits:

It was developed by the researcher based on the current related literature, to assess the dietary habits of the children, role of parents in these habits, children's recommended dietary intake and their daily life activities. It included questions as type of food, breakfast, number of servings per day, chewing, etc. This part was filled out by parents.

Scoring system:

The child was considered as having a balanced diet if the intake of all essential food groups in recommended servings was reported.

- **Good** (60%+)
- **Bad** (< 60%)

Part 3: Body Mass Index (BMI):

Measuring BMI was calculated through measuring the height of the children by using measuring tape, whereas, their weight by using portable scale with a capacity of 120 Kg. **The same scale and measuring tape were used to measure all children's weight and height**. After that, the researcher used **BMI chart developed by Centers for Disease Control and Prevention (CDC, 2000).** This chart was used to assess BMI of children between 2 and 20 years old, BMI is interpreted relative to a child's age and sex, because the amount of body fat changes with age and varies by sex. Percentiles specific to age and sex was used to classify BMI.

Scoring system:

Body Mass Index (BMI) was calculated according to ***Castillo-Martinez et al (2012)*** by dividing the body weight in Kg by the squared height in meters. The BMI was then categorized according to percentile charts. Body mass index-for-age categories and corresponding percentiles were:

- **Underweight:** Less than 5th percentile.
- **Healthy weight:** 5th percentile up to the 85th percentile.
- **Overweight:** 85th to less than the 95th percentile.
- **Obese:** Equal to or greater than the 95th percentile.

Tool II:

General cognitive ability scale:

It was used to assess general mental ability, scholastic aptitude and reasoning ability for age 5 to 7 years. This scale was developed by **Otis and Lennon (1969)** and translated into Arabic by **Kamel (1987)**. The scale is a sample of verbal, symbolic and formal paragraphs which represent a wide range of cognitive abilities (55 items). It is designed to measure the g factor (general cognitive ability factor). It depends mainly on pictures.

Scoring system:

The scoring was done following the instructions of the tool manual ***(Kamel, 1987)***.

2.5.Pilot study:

The pilot study was carried out on a sample of 10 children representing 10% of the calculated total sample size. The aim was to test clarity of the questions, the format of the questionnaire, comprehensiveness of the items and to estimate the exact time required for filling out the questionnaire sheet. The children involved in the pilot study were included in the main study sample, since there was no modification in the tools of data collection.

2.6.Field work:

Once permission was granted to proceed with the study, the researcher met with each director of the selected nursery schools, explained the study aim and procedures, as well as the data collection forms. The researcher asked the directors to seek the permission of the parents of the selected children to participate in the study. Then, the researcher set a schedule for data collection in collaboration with the director of each nursery school. The researcher spent some time with children before the actual data collection procedure to be familiar with the children. After that, the researcher measured children's height and weight Then, the researcher divided those children into small groups on rounded tables, asked the children to listen carefully to her to follow the instructions which enable them to answer the test and she ensured that each child should have his/her own answer, and no matter if they don't know the answer, they can skip it.

At the end of the day, at leaving time, the researcher met with the children's parents at the nursery school director's office and asked them to fill out the socio-demographic data part and the dietary habits questionnaire sheets under her guidance. The researcher stayed with the parents to answer any specific questions that arose during completing the questionnaire. The needed time for tools of data collection for each child was about 45 minutes. The

researcher went to the nursery schools 3 days per week from 8 AM to 12 PM. The field work was carried out within the period of around two months, starting from the mid of February 2018 to the beginning of April 2018.

2.7.Validity

It was ascertained by a panel of three experts in the field of community health nursing and community medicine who reviewed the content of the tools for clarity, relevance, comprehensiveness and understandability.

2.8.Reliability:

Internal consistency of activities of daily living (ADL) scale was assessed by calculating Cronbach Alpha Coefficient. Its reliability proved to be satisfactory as shown by the value of Cronbach Alpha Coefficient in the following table:

Scale	No. of Items	Cronbach's Alpha
ADL scale	6	0.60

2.9.Ethical consideration:

Firstly, the research protocol was approved by the Research Ethics Committee (REC) in faculty of Nursing, Zagazig University, Egypt. The agreement of participants was taken from parents after full explanation of the aim of the study. Participants were given the opportunity to refuse participation and they were notified that they could withdraw at any time of the data collection interviews; also they were assured that the information would be confidential and used for the research purpose only. The researcher assured maintaining anonymity and confidentiality of the children's data.

2.10.Administrative design:

Official permission was obtained from the Education Directorate at Zagazig city, Egypt based on letters issued from the Faculty of Nursing, Zagazig University explaining the aim and procedures of the study. Then, the director of West administration referred the researcher to the directors of the selected nursery schools with approval letters. Then the researcher met with each of them and explained the aim of the study and the nature of tool used for data collection. The researcher gave the director of each nursery school a copy of the tool and the formal letters.

2.11.Statistical design:

Data entry and statistical analysis were done using SPSS 20.0 statistical software package. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations and medians and interquartile ranges for quantitative variables. Cronbach alpha coefficient was calculated to assess the reliability of the scales through their internal consistency. Spearman rank correlation was used for assessment of the inter-relationships among quantitative variables and ranked ones. In order to identify the independent predictors of cognitive ability score, multiple linear regression analysis was used and analysis of variance for the full regression models done. To identify the independent predictors of normal BMI (percentile), multiple logistic regression analysis was used. Statistical significance was considered at p-value <0.05.

III.Results

As to personal characteristics of children in the study sample, 52 % of children aged >5 to 6 years, 51% of them were males, 94% had siblings, and 74% of them were not the first child. Moreover, 56% of children got health care at nursery. Regarding the demographic characteristics of children parents, 82% of the respondents in the current study were mothers. Regarding mothers' demographic characteristics, 75% of them aged 30 years or more, 46% had university education, and 65% of them were housewives. As for fathers, 68% of them aged 35 years or more, 44% had secondary education, and 55% of them were employees. As to family characteristics of children in the study sample, 97% of parents were married, 60% of them belonged to nuclear families, and 88% of families had sufficient income. Concerning residence, 54% of them belonged to rural areas, and their homes were mainly not crowded (<2 /room) as reported by 62% of parents.

Table 1 describes dietary habits of children in the study sample as reported by parents. As the table reveals, higher percentage of children ate breakfast, took 3 regular meals, took one main meal with family daily, didn't eat while playing, didn't eat frequently between main meals, didn't eat in hurry, masticated well, and wasn't forced to stop eating (58%, 76%, 95%, 73%, 91%, 68%, 80%, & 97%) respectively. Regarding having outside snacks, 41% of children ate outside snacks mainly taken from home (53.7%). Ultimately, 65% of children had good dietary habits.

Table 2 explains the recommended dietary intake of children as reported by parents. As the table displays, higher percentage of children consumed the recommended intake of fruits, vegetables, dairies, animal proteins, and cereals (67%, 60%, 62%, 68%, & 83%) respectively. Meanwhile, totally 81% of children took unbalanced diet.

Table 3 describes independence in the performance of the various activities of daily living among children in the study sample. As the table reveals, higher percentage of children were partially dependent in daily activities as eating/drinking, clothing, personal hygiene, help in housekeeping, and shopping (42%, 62%, 55%, 55%, & 49%) respectively. Totally, 45% of children were independent.

As to body mass index (BMI) percentiles among children in the study sample, **figure 1** depicts 68% of children had normal BMI. Regarding cognitive abilities among children in the study sample, **figure 2** illustrates that 57% of children had high cognitive abilities.

Table 1: Dietary habits of children in the study sample as reported by parents (n=100)

Dietary habits	Frequency	Percent
Child eats breakfast:		
No	42	42.0
Yes	58	58.0
Reasons for no (n=42):@		
No time	4	9.5
Not a habit	3	7.1
No appetite	28	66.7
Prefers to take it with friends	20	47.6
Other	2	4.8
Child:		
Takes 3 regular meals	76	76.0
Takes one main meal with family daily	95	95.0
Eats in front of TV	20	20.0
Does not eat while playing	73	73.0
Does not eat outside home	24	24.0
Does not eat frequently between main meals	91	91.0
Does not eat in hurry	68	68.0
Masticates well	80	80.0
Is not forced to eat	36	36.0
Is not forced to stop eating	97	97.0
Child eats outside snacks	41	41.0
Sources (n=41):@		
Home	22	53.7
Nursery canteen	10	24.4
Buy from outside	13	31.7
Total dietary habits:		
• Good	65	65%
• Bad	35	35%

(@) Not mutually exclusive

Considering correlation matrix of BMI and cognitive abilities scores, **table 4** indicates that there was no correlation between child's BMI and cognitive abilities. **Table 5** clarifies correlation matrix of BMI and cognitive abilities scores and child characteristics. The table indicates statistically significant negative correlation between child's cognitive ability and number of siblings (r= -0.219), birth order (r= -0.262) and crowding index (r= -0.250). While, there was a statistically significant positive correlation between cognitive abilities and child's dietary habits score (r= 0.201). As regard BMI, the same table points to a statistically significant positive correlation between BMI and number of siblings (r= 0.197) and child's dietary habits score (r=0.279). As well, there was a statistically significant positive correlation between BMI percentile and child's dietary habits score (r=0.297).

Table 2: The recommended dietary intake of children as reported by parents (n=100)

Food groups intake as recommended	Frequency	Percent
Fruits	67	67.0
Vegetables	60	60.0
Dairies	62	62.0
Animal proteins	68	68.0
Legumes	42	42.0
Cereals	83	83.0
Fried food	6	6.0
High sugar drinks	31	31.0
High sugar food	17	17.0
High salt food	38	38.0
High fat food	22	22.0
Balanced diet:		
Yes (all main groups as recommended)	19	19.0
No	81	81.0

Concerning best fitting multiple linear regression model for the cognitive abilities score, **table 6** reveals that female gender was a statistically significant independent positive predictor of children's cognitive abilities score (p=0.000). Conversely, the crowding index was a statistically significant independent negative predictor of cognitive abilities (p=0.001). The model explains 19% of the variation in this score as the value of r- square indicates.

Table 3: Independence in the performance of the various Activities of Daily Living among children in the study sample (n=100)

Activities of Daily Living (ADL)	Dependent		Partial dependent		Independent	
	No.	%	No.	%	No.	%
Eating/drinking	29	29.0	42	42.0	29	29.0
Clothing	27	27.0	62	62.0	11	11.0
Personal hygiene	32	32.0	55	55.0	13	13.0
Elimination	18	18.0	21	21.0	61	61.0
Help in housekeeping	31	31.0	55	55.0	14	14.0
Shopping	27	27.0	49	49.0	24	24.0
Total	21	21.0	34	34.0	45	45.0

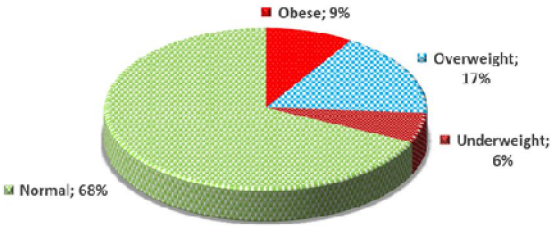

Figure 1: Body mass index (BMI) percentiles among children in the study sample (n=100)

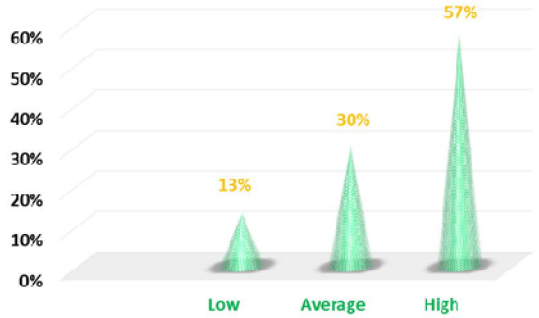

Figure 2: Cognitive abilities among children in the study sample (n=100)

Table 4: Correlation matrix of BMI and cognitive abilities scores

	Spearman's rank correlation coefficient	
	Cognitive abilities	**BMI**
Cognitive abilities		
BMI	0.04	

(**) Statistically significant at p<0.01

Table 5: Correlation matrix of BMI and cognitive abilities scores and child characteristics

Item	Spearman's rank correlation coefficient		
	Cognitive abilities	**BMI**	**BMI (percentile)**
Age	-0.15	-0.05	-0.01
No. siblings	**-.219***	**.197***	0.18
Birth order	**-.262****	0.09	0.07
Mother age	-0.09	0.11	0.11
Mother education	0.14	0.12	0.11
Father age	-0.19	0.03	0.04
Father education	0.09	0.09	0.08
Crowding index	**-.250***	0.03	0.01
Dietary habits score	**.201***	**.279****	**.297****
Balanced diet score	0.13	0.06	0.08
ADL score	0.00	0.07	0.05

(*) Statistically significant at p<0.05 (**) Statistically significant at p<0.01

Table 6: Best fitting multiple linear regression model for the cognitive abilities score

Item	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Constant	125.76	12.85		9.789	0.000	100.26	151.26
Female sex	26.88	6.51	0.38	4.129	**0.000**	13.96	39.80
Crowding index	-23.22	6.70	-0.32	-3.464	**0.001**	-36.53	-9.92

r-square=0.19 Model ANOVA: F=12.78, p<0.001

Variables entered and excluded: age, siblings, birth order, parents education, food habits, balanced diet, BMI (percentile)

Table 7: Best fitting multiple logistic regression model for normal BMI (percentile)

Item	Wald	Df	P	OR	95.0% CI for OR	
					Upper	Lower
Constant	0.09	1	0.761	1.33		
Female sex	2.76	1	**0.097**	0.44	0.17	1.16
Rural residence	7.15	1	**0.008**	3.75	1.42	9.87
Nagelkerke R Square: 0.13						
Hosmer and Lemeshow Test: p=0.840						
Omnibus Tests of Model Coefficients: p<0.001						

Variables entered and excluded: age, siblings, birth order, parents education, food habits, balanced diet, Cognitive abilities

Table 7 demonstrates best fitting multiple logistic regression model for normal BMI (percentile). As shown in this table, female gender and rural residence were statistically significant independent positive predictors of normal BMI [percentile] (p=0.097 & p=0.008) respectively. The model explains 13% of the variation in this score as the value of r-square indicates.

IV. Discussion

Preschool period is a crucial time for human growth and development, also it is a time when children develop many habits likely to continue in adulthood. It is important that children not only acquire knowledge about appropriate and balanced nutrition, but also develop good dietary habits **(Diab, 2015).** Nutrition of the preschool children is of paramount importance because the foundation for life time, health, strength and intellectual vitality is laid during that period **(Devi & Gupta, 2016).**

Regarding dietary habits of preschool children, the current study results revealed that totally around two thirds of the study sample had good dietary habits, where more than half of children ate breakfast, more than three quarters took 3 regular meals, most of them didn't eat frequently between main meals and the majority masticated well. Possible explanation of such result is that around two thirds of mothers were housewives, consequently they had more time to give big attention for their children's dietary habits. In the same vein, a study conducted in Germany by **Alexy et al. (2010)** found that more than three quarters of the study sample ate breakfast. Also, **Abdul Aziz and Devi (2012)** in Malaysia indicated that three fifths of preschool children ate breakfast every day. Totally, a contrary result reported by **Natekar and Mhaske (2015)** in India indicated that most of preschool children had average dietary habits**.**

Considering recommended dietary intake of preschool children, the existing study results clarified that the majority of children consumed unbalanced diet. This result might be due to that children in this age might prefer picky eating so that their diet did not contain all main food groups (fruits, vegetables, dairies, animal proteins, legumes and cereals) as recommended. In the same context, a study carried out by **Huybrechts et al. (2008)** in Belgium revealed that the overall diet of most of children in the sample was not compatible with the recommended dietary intake. Furthermore**, Panova et al. (2017)** in Macedonia found unbalanced dietary intake of most of preschool children. Conversely, a study conducted in Malaysia **(Poh et al., 2013)** clarified that dietary intake of around two thirds of children was compatible with the recommended dietary intake. This discrepancy between results might be attributed to that the later study sample included sample of children aged 6 months to 12 years old, where the wide variation of age might be the cause.

As regards BMI (percentile) of preschool children, the present study results clarified that more than two thirds of the study sample had normal BMI

(percentile). This result might be attributed to that around two thirds of children had good dietary habits. Also, their highly educated parents can pick up any abnormality of lating their children's growth and development and seek health care. Similarly, a study conducted in Iran revealed that around two thirds of preschool children had normal BMI **(Tabriz et al., 2015).** As well, **Okoye and Hart (2015)** carried out a study in Nigeria and clarified that about two thirds of preschool children had normal BMI. In contrast, **Rodríguez et al. (2017)** in Chile found that more than three fifths of preschool children had abnormal BMI. Also, a study conducted in Thailand by **Pongcharoen et al. (2017)** revealed that about two thirds of preschool children had abnormal BMI. Such variation might be due to differences in the dietary habits and standard of living in these countries.

Concerning cognitive abilities of preschool children, the current study results illustrated that more than half of children had high cognitive abilities. Possible explanation of such result is that better education of parents will enable them to help their children with their preschool work and learning. Also, adequate family income might affect cognitive level of the child because it plays an important role in the developmental ability of a child, as they are likely to have access for learning in a conducive environment with adequate learning facilities and modern academic equipment that will facilitate learning. In the same stream, higher percentage reported in a study carried out in Nigeria by **Onifade et al. (2016)** who revealed that most of preschool children had good cognitive abilities. On the contrary, **Warsito et al. (2012)** in Indonesia found that around half of preschool children had average cognitive abilities. This difference might be attributed to using different cognitive ability scale.

The present study results demonstrated a statistically significant positive correlation between BMI of children and their dietary habits. This result might be due to that adequate dietary habits as eating breakfast, taking 3 regular meals, not eating while playing, masticating well etc., would positively improve children's weight in relation to age and in turn affect their BMI. This finding is in the same line with, **Abdul Aziz and Devi (2012)** in Malaysia who emphasized that there was a statistically significant positive correlation between BMI and child's dietary practices. Likewise, **Natekar and Mhaske (2015)** in India indicated a perfect positive correlation between children's dietary habits and BMI.

A statistically significant positive correlation between dietary habits of children and their cognitive abilities was confirmed in the present study. This result might be attributed to that dietary habits mainly affect the nutritional status of children. This, in turn, positively impact their growth and development including cognitive abilities. In the same context, a study conducted in United States of America by **Tandon et al. (2016)** indicated a positive association between healthy dietary habits and children's cognitive outcomes. Also, **Leventakou et al. (2016)** in Greece indicated a weak but important association between dietary habits and cognitive ability of preschoolers.

The present study results demonstrated statistically significant negative correlations between children's cognitive abilities and number of siblings and birth order. Possible explanation of such result is that the more the number of siblings, the lower the attention and care of parents directed to each child. Additionally, increasing the number of children in a family might limit the amount of resources available and also limit the range of interactions with the adults. Consequently, this might affect the development of children's cognitive abilities. As regards birth order, children who aren't the first child could learn new and creative things and gain experience from their older siblings. This opportunity is not available for the first child and in turn negatively impacted cognitive abilities of child.

This result is in agreement with **Avan, Rahbar and Raza (2007)** in Pakistan who demonstrated an inverse relation between number of siblings and cognitive development. As well, similar findings was found in a study carried out in Brazil by **Dos Santos et al. (2008)** who demonstrated that birth order was a statistically significant independent negative predictor of children's cognitive abilities. Conversely, **Freijo et al. (2006)** conducted a study in Spain and found no statistically significant correlation between birth order or sibling number and cognitive development. This might be due to differences in family system, social, and educational systems among the countries.

The current study results revealed a statistically significant positive correlation between number of siblings and child's BMI. Such result might attributed to that older siblings could be role models for younger children, encourage the little children for eating, and teach them the dietary habits, consequently this might have an effect on their BMI. In the same stream**, Al-Agha et al. (2015)** in Kingdom of Saudi Arabia found that the more the siblings number was, the more BMI increased. Dislike, **Natekar and Mhaske (2015)** in India found no statistically significant association between number of siblings and BMI of children. This might be attributed to the difference of standard of living and the range of number of siblings which might too wide in same countries like India.

The existing study demonstrated that female gender was a statistically significant independent positive predictor of both children's cognitive abilities and their normal BMI (percentile). Possible explanation of such result is that females usually are

more attentive, obey orders, and conscientious than males. As to BMI, this result might be due to physiological composition of females at this age where the effects of hormones don't appear in this early age. Dislike, the results of a study conducted by **Onifade et al. (2016)** in Nigeria revealed no statistically significant relationship between children female gender and their cognitive abilities. Also, **Natekar and Mhaske (2015)** in India found no statistically significant association between sex and BMI. Furthermore, **Ranabhat et al. (2016)** carried out a study in Nepal and indicated no statistically significant relation between female gender and BMI. This discrepancy between results might be attributed to differences in the culture and traditions among these countries.

The current study results indicated that crowding index was a statistically significant independent negative predictor of children's cognitive abilities. This result might be due to that children need safe and comfortable environment for optimum growth and development. Similar result was found in a study conducted in Brazil which indicated that crowding index (home density) was a statistically significant independent negative predictor of children's cognitive abilities **(Dos Santos et al., 2008).** As well, studies carried out in Indonesia by **Hastuti (2008) and Warsito et al. (2012)** found that inadequate physical environment such as a small house resulted in a greater risk for impaired cognitive maturation.

According to the present study results, rural residence was a statistically significant independent positive predictor of normal BMI (percentile). Such result might be attributed to that the rural community is still hold on to homely diets and healthy dietary habits with less availability of junk food, whereas the urban community is more prone towards the junk food, fast foods, sedentary life (television watching hours & physical inactivity). In the same vein, **Opara et al. (2010)** in Nigeria found that most of the urban children had higher prevalence of abnormal BMI. In addition, a study conducted in India by **John et al. (2016)** revealed that the prevalence of abnormal BMI was significantly higher in urban children compared to rural children. On the other hand, **Devi and Gupta (2016)** carried out a study in India and clarified that there was no significant difference between rural and urban preschool children with respect to BMI. However, the rural girls are certainly better than urban ones.

Ultimately, the present study results revealed no statistically significant correlation between children's BMI (percentile) and their cognitive abilities. This result might be due to the small sample size or that the cognitive abilities might be affected by innate characteristics, and also **Guxens et al. (2009)** stated that higher cognitive function at age four is associated with decreased risk of being overweight at age six. Similar findings have been indicated by **Veldwijk et al. (2011)** in Netherlands who found no significant association between BMI and cognitive ability of young children.

V.Conclusion

The current study results bring about the conclusion that:

Children participating in the present study were mainly not the first child, their parents had particularly secondary or higher education and sufficient income. Additionally, although the children mostly didn't consume a balanced diet, they had foremost good dietary habits and normal BMI. Meanwhile, children's cognitive abilities tended to be high. Ultimately, child's dietary habits and female sex had imposing effect on both child's cognitive abilities and BMI. Also, rural residence positively predict children's BMI. On the other hand, children's cognitive abilities inversely influenced by home crowding. Moreover, it was proved that preschool children's BMI had no association with their cognitive abilities.

VI.Recommendations

On the basis of the current study findings, the following recommendations are suggested; proceed school based nutrition education programs to edify preschool children about the recommended food groups and build sustainable healthy dietary habits among preschool children. Also, conduct educational programs for preschool children's parents to raise their awareness about children's healthy growth and development, indicators of BMI percentiles, healthy diets of preschool children, and cognitive abilities of preschool children. Moreover, it is important to develop nursing interventions for promoting cognitive abilities of preschool children. Ultimately, replicate the study on larger number of children in other settings to permit for generalization of results.

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