The Effect of Chronic Anemia on Physical Growth and Development among Children Under Five Years

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Abstract

Background: Anemia is one of the most common hematological conditions of infancy and childhood. It has been recognized as a major health problem due to its negative impacts on mental and physical development during childhood. Anemia is the world's second leading cause of disability. Aim of the study: To assess the effect of chronic anemia on physical growth and development among children under five years. Research design: A cross sectional descriptive research design was used for this study. Setting: Pediatric Hematology Clinic at Minia University Hospital for Obstetric and Pediatric. Subjects: A purposeful sample of 100 children diagnosed with any type of chronic anemia aged from (6 - 59 months) with their caregiver. Tools of data collection: Tool I: A structured interview questionnaire, Tool II: Denver Developmental Screening Test 2nd edition (DDST II). Results: Mean age was 29.71 ± 16.02 months. It was found that children with chronic anemia had delay in all growth parameters. It was found that three fourths of studied children had abnormal development. It was found a relation between some growth parameters, Denver Developmental Screening Test 2nd edition (DDST II) and severity of disease among those children. Conclusion: Children with chronic anemia showed delayed growth and development, and also showed malnutrition. Both moderate and severe anemia was the most common among those children and both close and remote consanguinity was the most common among their parents. Recommendations: Increase awareness among mothers through educational programs on importance of follow up and care of their children with chronic anemia, regular follow up of those children with regular assessment of growth and development, nutritional counseling to parents and more efforts are still needed to increase awareness among people about importance of premarital counseling and health hazards of consanguineous marriage through mass media.

Key Words: Chronic Anemia, Physical Growth, Development, Children.

Introduction

Anemia is one of the most common hematological conditions of infancy and childhood; it is not a disease but rather a symptom of other diseases. Anemia is a decrease in the number of RBCs, the reduction in circulating RBCs decreases the oxygen-carrying capacity of the blood (Ward, et al., 2016).

The first five years of children's life is a golden period for their development, fostering their future learning skills and social and emotional abilities due to rapid gains in physical and cognitive growth and development (Butchon and Liabsuetrakul, 2017). Children are our future citizens and form an important segment of the human potential. They contribute to the vital strength of the national economy and development (Sandeep, et al., 2017).

Growth in childhood is one of the most fascinating, dynamic, complex and biological processes (Sayed, 2012). Measurement of physical growth in children is a key element in evaluating their health status. Physical growth parameters include weight, length/height, skinfold thickness, arm circumference and head circumference. Values for these growth parameters are plotted on percentile charts, and the child's measurements in percentiles are compared with those of the general population. Growth charts use a series of percentile curves to demonstrate the distribution of body measurements in children (Hockenberry and Wilson, 2015).

The Denver Developmental Screening Test II (DDST-II) is a widely used assessment of developmental progress in children from birth to 6 years of age. The test takes approximately 20 minutes to be administered and be interpreted. The test detects slow development in four functional areas of development: social/personal, fine motor function, language, and gross motor functions (Pala, et al., 2010). DDST-II consists of 125 items, and the development of a child is measured based on these 125 items (Çelikkıran, et al., 2015).

The pediatric nurse must have an understanding of factors and influences, as well as normal or expected patterns related to growth and development of the infant, child, and adolescent, to help the nurse to ask age-related questions, as well as answer the caregiver's questions regarding the child, being aware of a child's language skills and development will enable the nurse to communicate at the child's level of understanding. When working with a sick child, the nurse must be aware that the child's age and stage of growth and development can affect the way the child copes with the situation or responds to treatment (Hatfield and Kincheloe, 2018).

The role of pediatric nurse in chronic anemia is very important. The nurse explains to child and parents the nature of the disease and treatment plans, does physical examination which yields valuable evidence regarding the severity of anemia and some indication of its possible cause and also be aware of the importance of taking a thorough history to obtain pertinent information that may aid in identifying the cause of the anemia. The nurse is responsible for preparing the child and parents for the laboratory tests and assesses the child's level of tolerance for activities of daily living and play, and makes adjustments (Hockenberry and Wilson, 2015).

Significance of the study:

Worldwide, anemia affects up to one-half of children younger than five years (Wang, 2016). According to UNICEF, (2016) prevalence of any kind of anemia among children under five years in Egypt is 27.2 % and prevalence in Upper Egypt is 27.9%. Anemia is more prevalent in Rural Upper Egypt (30.2%) than in Urban Upper Egypt (22%). It is a global public health threat especially in the developing

countries. Childhood anemia has serious consequences including growth retardation, poor immune system and increased susceptibility to diseases, and has severe socio-economic consequences for families and communities (Kuziga, et al., 2017).

According to the WHO, (2015) the percentage of children aged 6-59 months with blood Hb concentration < 11 g/dl in Egypt is 45%. WHO has issued criteria to define public health significance of a problem according to prevalence of it so 5–19.9 % is mild, 20–39.9 % is moderate and ≥ 40 % is regarded as a severe public health problem and as a result of this anemia ranks as a severe public health problem in Egypt (WHO, 2011).

Aim of the study:

The aim of this study was to assess the effect of chronic anemia on physical growth and development among children under five years.

Research questions:

- What is the relationship between chronic anemia with physical growth and development among children under five years?
- Is there a relationship between chronic anemia and malnutrition effect on physical growth and development among children less than five years?

Subjects and method:

Research design:

A cross sectional descriptive research design was used for this study.

Subjects:

A purposeful sample of 100 children diagnosed with any type of chronic anemia aged from (6 - 59 months) with their caregivers.

Setting of the study:

This study was conducted in the Pediatric Hematology Clinic at Minia University Hospital for Obstetric and Pediatric.

Tools of data collection:

Two tools were used to collect the required data for the study:

Tool I: A structured interview questionnaire designed by the researcher included three parts:

Part 1: Bio-demographic data of children and their parents include:

Data related to children such as age, gender, birth order and residence and data related to parents such as education and occupation of children's parents.

Part 2: Medical history for children with emphasis on child's diagnosis, the onset, duration, Hb level and grading, number of hospitalization during the previous 6 months, complications from disease if present, the presence of relevant family history and degree of consanguinity between parents.

Part 3: Anthropometric measurements was used according to the WHO growth charts to measure weight, length/height, head circumference, mid-arm circumference and body mass index and plotted on the chart appropriate for age and sex (WHO, 2006).

Tool II: Denver Developmental Screening Test 2nd edition (DDST II) (Ricci, et al., 2013). The test consists of up to 125 items, divided into four parts:

Part 1: Personal/Social: aspects of socialization inside and outside the home.

Part 2: Fine motor adaptive: eye/hand coordination, and manipulation of small objects.

Part 3: Language: production of sounds, ability to recognize, understand, and use of language.

Part 4: Gross motor functions: motor control, sitting, walking, jumping, and other movements.

Scoring system for Tool II was done as follows:

P: Pass-child successfully performs item or caregiver reports the child can do the item.

F: Fail-child does not successfully perform the item and/or the caregiver reports the child cannot do the item.

N.O.: No Opportunity-the child has not had the opportunity to perform the task due to restrictions.

R: Refusal-the child refuses to attempt and the parent cannot report.

Tools Validity:

Tool one was tested for content validity by a panel of five experts in the field of the study from Minia and Assuit University, Faculty of Nursing, Pediatric Nursing Department and necessary modifications were done and its result was 95%. These modifications were education and occupation of children's parents and interpretations of DDSTII.

Tools Reliability:

Reliability of tool one was performed to confirm its consistency by using Cronbach's alpha test and the result was 0.72. Tool two is valid and reliable.

Pilot study:

A pilot study was conducted on 10 % of sample which equal 10 children who met the inclusion criteria for selection to test clarity, completeness, adequacy, objectivity, applicability, content validity and internal consistency of the study tools and to determine possible problems in the tool. According to the results of pilot study, the needed omissions, and/or additions were done. Children involved in the pilot study were excluded from the main study sample. Pilot testing helped the researcher plan for data collection.

Ethical considerations:

A written initial approval was obtained from the Research Ethical Committee of the Faculty of Nursing, Minia University. Oral consent was obtained from all the caregivers of children who met the criteria of selection and accepted to be included in the study. The purpose and nature of the study was explained by the researcher through direct personal communication prior to starting their participation in the study and the caregivers were assured that they could withdraw at any time from the study. Confidentiality was assured through coding the data. Each assessment sheet was coded anonymous

Procedure:

Administrative approval was obtained from the Dean of Faculty of Nursing, Minia University to the director of Minia University Hospital for Obstetric and Pediatric and the director of outpatient clinics before implementation of the study. The researcher interviewed each child and his

caregiver individually after introducing herself and explaining the purpose and nature of the study. Caregiver's consent to participate in the study was secured orally.

The interview was conducted in the hematology clinic at Minia University Hospital for Obstetric and Pediatric. Demographic and health history data was obtained from the caregiver. Hb level and grade was recorded in the sheet according to WHO grading of anemia depending upon Hb level, anemia is graded: mild when Hb level between 10-10.9 g/dl. Hb level between 7-9.9 g/dl indicates moderate anemia and severe anemia when Hb level below 7g/dl (WHO, 2011).

The anthropometric measurements were carried out once to children, recorded immediately in the sheet and plotted on WHO growth chart appropriate for gender and age. The time taken for filling each sheet ranged from 40- 50 minutes depending on the response of the child and the caregiver to questions. Data collection was conducted in the period from the beginning of April to the end of September 2017 by interviewing the caregivers & children on Wednesday every week.

A digital scale was used to measure weight. Infants and children were weighed without shoes and minimal clothing, the average weight of clothing material was then determined and subtracted from the reading. The child placed in the center of the scale. Weight was measured and recorded immediately (Bowden and Greenberg, 2016 and Gupta, et al., 2017).

Length was measured by placing the infant laid flat in supine position on a hard table, any hair ornament or hats were removed and straighten the infant's legs together. The head was positioned in Frankfort plane vertically with the help of the caregiver; the knees were extended by a firm pressure applied by the researcher to straighten the legs and prevent knees from flexing. Then, marking the end points of the vertex and the heels of the feet and measuring between these two points. Length was measured and recorded immediately and approximated to the nearest 0.1cm (Gupta, et al., 2017).

Height was measured through standing the child bare feet on the foot plate of the mechanical dial scale/wall with the calves, heels, buttocks, scapula and back of head touching the vertical board of the scale/wall, the head was positioned in Frankfort plane horizontally. The child was asked to maintain a fully erect position and slightly apart feet at a 60o angle and weight distributed on both feet. Then, moving the sliding headpiece tell it touched the top of the child's head compressing the hair. The vertical distance is measured by placing a firm, flat surface against the vertex or crown of the head, Height was measured and recorded immediately and approximated to the nearest 0.1cm (Gupta, 2011).

Head circumference was measured by using a non-stretchable measuring tape. The tape measure was placed around forehead just above the eyebrows anteriorly and around the occipital posterior. The tape was pulled snugly to compress hair and the measurements were approximated to the nearest 0.1 cm and recorded (Correia, 2017).

Mid-arm circumference was measured by using a non-stretchable measuring tape, placed on the acromion process and the olecranon and made a horizontal mark at the midpoint, then encircled the tape around the arm over the marked midpoint without compressing the skin or underlying tissue. The measurements were approximated to the nearest 0.1 cm and recorded (Gupta, 2011).

Body mass index is given by the following formula "weight in kilogram divided by height in square meter". The value of BMI was plotted on age and sex specific BMI chart (Kavitha, 2015).

Developmental assessment was done according to DDST II by the researcher in the presence of the caregiver. The test was performed before any painful or frightening procedures, the researcher started by put one or two test materials in front of the child while taking history from the caregiver. The first few test items that was below the child's age level were administered first to assure him/her on initial successful experience. Items requiring less active participation were administered first.

A vertical line was drawn through the four sectors of the test form at the child's chronological age. The date of the test was written at the top of the age line. In each sector, the items to be administered were those below the age of the child, the items through which the child's chronological age line passes and the items to the right until the child has 3 items failures in the sector being tested.

Statistical analysis:

Data entry was done using compatible personal computer. The collected data were coded, categorized, tabulated, analyzed and summarized by using Statistical Package for Social Science (SPSS version 20) and Excel 2010 has been used to generate figures. Data was presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations for quantitative variables. Chi-square test was used. Statistical significance was considered at p-value < 0.05. WHO growth charts was used for this study. Health resources administration standard at < 3rd percentile; 3rd - 97th percentile and > 97th percentile was used to compare growth parameters of children.

Scoring of development was done by the researcher using Denver Developmental Screening Test score.

Limitations of the study:

The environment was not ideal for interviewing because of overcrowding and noise in clinic related to a big number of children, it was better to be present a separate room other than diagnosis room for applying DDST.

Results:

Table (1): Distribution of Studied Children with Chronic Anemia according to their Personal Characteristics

Characteristics	Group (N= 100)	
	No.	%
Age of children:		
6 months - < 1 year	17	17.0
1 year - < 2 years	23	23.0
2 years - < 3 years	26	26.0
3 years - < 4 years	15	15.0

Characteristics	Group (N= 100)	
	No.	%
4 years - < 5 years	19	19.0
Mean ± SD	2.71±16.02	
Sex of children:		
Male	58	58.0
Female	42	42.0
Residence:		
Urban	8	8.0
Rural	92	92.0
Birth Order:		
First child	22	22.0
Second child	27	27.0
Third child	19	19.0
Fourth child or more	32	32.0

Table (1): Illustrates the personal characteristics of the studied children. It was found that children aged from 2 < 3 years were more frequent (26%) with a mean age of 2.71 ± 16.02 months. Males were higher (58%). The majority of our studied sample was living in rural areas (92%). The fourth or more birth order was more frequent represented (32%).

Table (2): Distribution of Families of Children with Chronic Anemia according to their Personal Characteristics

Characteristics	Group (N= 100)	
	No.	%
Father's Education:		
Illiterate	37	37.0
Read & write	9	9.0
Primary school	10	10.0
Secondary school	39	39.0
University	5	5.0
Father's Occupation :		
Not work	4	4.0
Farmer	54	54.0
Worker	33	33.0
Employee	9	9.0
Mother's Education :		
Illiterate	56	56.0
Read & write	6	6.0
Primary school	9	9.0
Secondary school	26	26.0
University	3	3.0
Mother's Occupation:		
Housewife	97	97.0
Worker	3	3.0

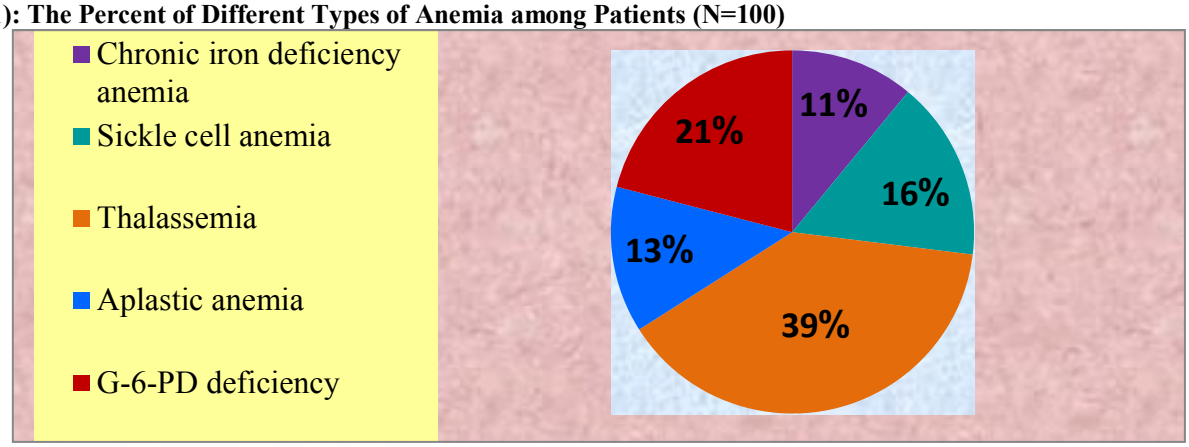
Table (2): Illustrates the personal characteristics of parents of children with chronic anemia. It was found that secondary school educated fathers were more frequent (39%), while regarding mother's education it was found that illiteracy was higher (56%). As regards father's occupation it was found that farmer fathers were more frequent (54%). Regarding mother's occupation it was found that the majority of mothers were housewives (97%).

Table (3): Presence and Degree of Consanguinity between Parents (N=100)

Consanguinity	Distribution percent	
	No.	%
No consanguinity	25	25.0
Remote consanguinity	28	28.0
Close consanguinity	47	47.0

Table (3): Presents degree of consanguinity between parents. It was found that close consanguinity between parents represented (47%), remote consanguinity between parents was (28%) and no consanguinity was found in one fourth of parents (25%).

Figure (1): The Percent of Different Types of Anemia among Patients (N=100)



G-6-PD: Glucose-6- phosphate dehydrogenase

Figure (1): Shows the frequency distribution of different types of anemia among patients. Studied sample included 100 of children with chronic anemia. They were 39 patients with thalassemia (39%), 21 patients with G-6-PD deficiency (21%), 16 patients with sickle cell anemia (16%), 13 patients with aplastic anemia (13%) and 11 patients with iron deficiency anemia (11%).

Figure (2): The Percent of Severity of Anemia among Children with Chronic Anemia (N=100)

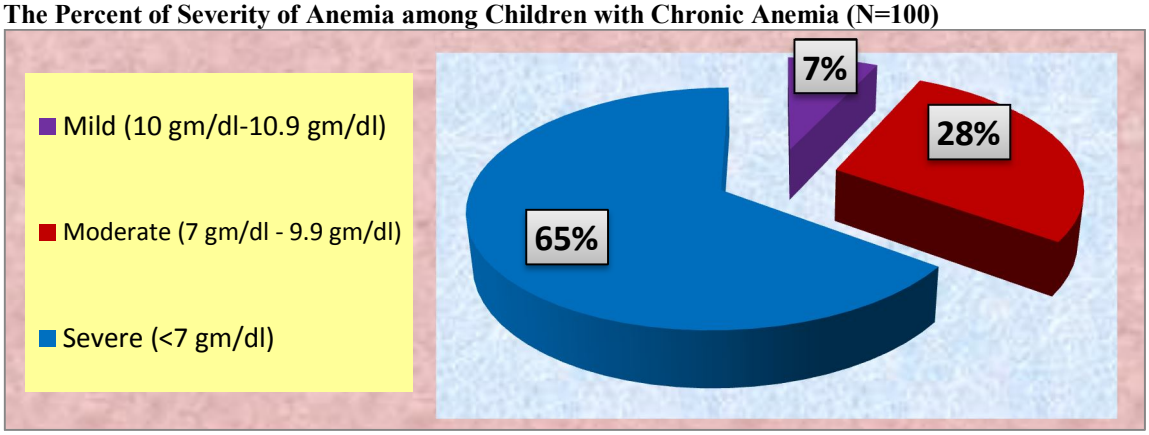


Figure (2): Illustrates the frequency distribution of severity of anemia among studied children. It was found that severe anemia represented 65% and moderate anemia represented 28% while mild anemia represented 7%.

Table (4): The Growth Parameters of Children with Chronic Anemia

Anthropometric indices	Group (N=100)	
	No.	%
Weight for age percentile:		
Below 3rd percentile	78	78.0
3rd – 97th percentile	22	22.0
Length/Height for age percentile:		
Below 3rd percentile	69	69.0
3rd – 97th percentile	29	29.0
Over 97th percentile	2	2.0
Weight for length / height percentile:		
Below 3rd percentile	47	47.0
3rd – 97th percentile	53	53.0
Head circumference for age percentile:		
Below 3rd percentile	67	67.0
3rd – 97th percentile	33	33.0
Mid-arm circumference for age percentile:		
Below 3rd percentile	75	75.0

3rd – 97th percentile	25	25.0	
Body mass index for age percentile:			
Below 3rd percentile	42	42.0	
3rd – 97th percentile	58	58.0	

Table (4): Describes the growth parameters of children with chronic anemia. As regards weight for age percentile, it was found that high percentage of children (78%) were below 3rd percentile category. As regards length/height for age percentile, it was found that 69% of patients were below 3rd percentile category, while 53% of patients regarding weight for length / height percentile were between 3rd and 97th percentile category.

Concerning head circumference for age percentile, it was found that two thirds of patients were < 3rd percentile category (67%). As regards mid-arm circumference for age percentile, it was found that three fourths of patients were < 3rd percentile category (75%). Regarding body mass index for age percentile, 42% of patients were falling below 3rd percentile category.

Table (5): The Distribution Percent of Children with Chronic Anemia according to Pattern of Development using DDST II (N=100)

Denver Developmental Screening Test 2nd edition	Group (N= 100)	
	No.	%
Normal DDST II	6	6.0
Abnormal DDST II	75	75.0
Questionable DDST II	18	18.0
Untestable DDST II	1	1.0

Table (5): Explains the pattern of development of children with chronic anemia. It was found that three fourths of studied children had abnormal DDST II, 18% had questionable DDST II and there is one untestable DDST II.

Table (6): The Relationship between Anthropometric Indices and DDST II among Children with Chronic Anemia (N=100)

Anthropometric indices	Denver Developmental Screening Test 2nd edition (DDST II)								X2 test P-value
	Normal DDSTII (N= 6)		Abnormal DDSTII (N=75)		Questionable DDSTII (N=18)		Untestable DDSTII (N=1)		
	No.	%	No.	%	No.	%	No.	%	
Weight for age percentile:									
Below 3rd percentile	2	33.3	62	82.7	13	72.2	1	100.0	X2=8.56
3rd – 97th percentile	4	66.7	13	17.3	5	27.8	0	0.0	P=0.03*
Length/Height for age percentile:									
Below 3rd percentile	3	50.0	54	72.0	11	61.1	1	100.0	X2=3.53
3rd – 97th percentile	3	50.0	19	25.3	7	38.9	0	0.0	P=0.73
Over 97th percentile	0	0.0	2	2.7	0	0.0	0	0.0	
Weight for length / height percentile:									
Below 3rd percentile	1	16.7	38	50.7	8	44.4	0	0.0	X2=3.55
3rd – 97th percentile	5	83.3	37	49.3	10	55.6	1	100.0	P=0.31
Head circumference for age percentile:									
Below 3rd percentile	4	66.7	50	66.7	12	66.7	1	100.0	X2=0.49
3rd – 97th percentile	2	33.3	25	33.3	6	33.3	0	0.0	P=0.91
Mid-arm circumference for age percentile:									
Below 3rd percentile	4	66.7	56	74.7	14	77.8	1	100.0	X2=0.634
3rd – 97th percentile	2	33.3	19	25.3	4	22.2	0	0.0	P=0.88
Body mass index for age percentile:									
Below 3rd percentile	1	16.7	34	45.3	7	38.9	0	0.0	X2=2.71
3rd – 97th percentile	5	83.3	41	54.7	11	61.1	1	100.0	P=0.43

* Statistically significant difference (P < 0.05)

DDST II: Denver Developmental Screening Test 2nd edition

Table (6): Presents the relationship between anthropometric indices and DDST II. No statistically significant difference was found between anthropometric indices and DDST II except weight for age percentile and DDST II (p=0.03).

Table (7): The Relationship between Grading of Hemoglobin and Anthropometric Indices among Children with Chronic Anemia (N=100).

Anthropometric indices	Grading of hemoglobin						X2 test P-value
	Mild (N=7)		Moderate (N=28)		Severe (N=65)		
	No.	%	No.	%	No.	%	
Weight for age percentile:							
Below 3rd percentile	1	14.3	221	75.0	56	86.2	X2=19.22 P=0.000*
3rd – 97th percentile	6	85.7	7	25.0	9	13.8	
Length/Height for age percentile:							
Below 3rd percentile	1	14.3	17	60.7	51	78.5	X2=18.40 P=0.001*
3rd – 97th percentile	6	85.7	9	32.1	14	21.5	
Over 97th percentile	0	0.0	2	7.1	0	0.0	
Weight for length / height percentile:							
Below 3rd percentile	0	0.0	13	46.4	34	52.3	X2=6.94 P=0.03*
3rd – 97th percentile	7	100.0	15	53.6	31	47.7	
Head circumference for age percentile:							
Below 3rd percentile	6	85.7	17	60.7	44	67.7	X2=1.62 P=0.44
3rd – 97th percentile	1	14.3	11	39.3	21	32.3	
Mid-arm circumference for age percentile:							
Below 3rd percentile	0	0.0	22	78.6	53	81.5	X2=22.67 P=0.000*
3rd – 97th percentile	7	100.0	6	21.4	12	18.5	
Body mass index for age percentile:							
Below 3rd percentile	0	0.0	12	42.9	30	46.2	X2=5.53 P=0.06
3rd – 97th percentile	7	100.0	16	57.1	35	53.8	

*statistically significant difference (P < 0.05)

Table (7): Presents the relationship between grading of hemoglobin and anthropometric indices. It was found that a very highly statistical significant difference was found between weight for age, mid-arm circumference for age percentiles and grading of hemoglobin (p=0.000). It was found a highly statistical significance difference between length/height for age and grading of hemoglobin (p=0.001) and a statistical significance difference was found between weight for length/height percentile and grading of hemoglobin (p=0.03). However no statistically significant difference was found regarding head circumference for age, BMI for age percentiles and grading of hemoglobin.

Table (8): The Relationship between Grading of Hemoglobin and Pattern of Development using DDST II among Children with Chronic Anemia (N=100).

Denver Developmental Screening Test 2nd edition	Grading of hemoglobin						X2 test P-value
	Mild (N=7)		Moderate (N=28)		Severe (N= 65)		
	No.	%	No.	%	No.	%	
Normal DDST II	0	0.0	6	21.4	0	0.0	X2=33.39 P=0.000*
Abnormal DDST II	4	57.1	12	42.9	59	90.8	
Questionable DDST II	3	42.9	10	35.7	5	7.7	
Untestable DDST II	0	0.0	0	0.0	1	1.5	

* Statistical significant difference (p<0.05)

Table (8): Shows the relationship between grading of hemoglobin and DDST II. It illustrates that a very highly statistical significance difference was found between DDST II and grading of hemoglobin (p=0.000). It was found that high percentage (90.8%) of studied patients with severe grade of hemoglobin were abnormal DDST II.

Discussion:

Before going through discussing our results, it appears important to explain why WHO growth charts used, to have an international standard growth chart which allows comparison of children in different settings around the world. The aim of the present study was to assess the effect of chronic anemia on physical growth and development among children under five years.

The current study included 100 children with chronic anemia. The present study showed that there was a high frequency about one fourth of children aged 2 to less than 3 years. This finding is compatible with Kuziga, et al., (2017) who found that prevalence of anemia in Uganda was highest among children aged 12 to 23 months (68.5%). While UNICEF, (2016) stated that high frequency (49.2%) of anemia in Egypt is among children aged 9 to 11 months.

The present study showed that male patients were higher 58%. This is in accordance with Kuziga, et al., (2017) who found that the prevalence of anemia was high among male children (61.3%). This result is not in agreement with Abdel-Rasoul, et al., (2017) who studied iron deficiency anemia among preschool children (2–6 years) in a slum area (Alexandria, Egypt) found that female children represented (51.1%). However, UNICEF, (2016) mentioned that male patients were nearly (27.2%) the same percent of female patients (27.3%).

Regarding residence, the majority of our studied children (92%) lived in rural areas. This result goes in harmony with Ncogo, et al., (2017) who studied prevalence of anemia in children living in urban and rural settings from Guinea, and found that the prevalence of anemia was higher in children living in rural sites. Also, UNICEF, (2016) stated that prevalence of anemia in Egypt is higher in rural areas than in urban areas, also mentioned that prevalence of any kind of anemia is more prevalent in rural Upper Egypt than in urban Upper Egypt. As regards birth order, our study found that fourth or more birth order represented (32%). Abdel-Rasoul, et al., (2017) found that birth order more than two represented 31.9%.

Regarding father's education, the present study found that secondary educated fathers represented 39% and illiterate fathers represented 37%. This result is in contrary with Abdel-Rasoul, et al., (2017) who found that secondary educated fathers represented 25.5% while illiterate fathers represented 53.2%.

Regarding father's occupation, our study reported that more than one-half of fathers were farmers. Abdel-Rasoul, et al., (2017) found that more than one-half of fathers had seasonal work.

As regards mother's education, the present study revealed that illiteracy was higher than one-half. This is in accordance with Abdel-Rasoul, et al., (2017) who found that 44.7% were illiterate mothers. This finding is compatible with UNICEF, (2016) which stated that 29.9 % of mothers had complete primary and some secondary education while children of illiterate mothers represented 27.8%. This result goes in harmony with that of Austin, et al., (2012) who studied anemia among Egyptian children and found that prevalence of anemia was high (51%) among children of illiterate mothers.

Regarding mother's occupation, the study revealed that the majority of mothers (97%) were housewives. This result is in the same line with that of Abdel-Rasoul, et al., (2017) who stated that 91.5% of mothers were housewives.

Concerning consanguinity between parents, the present study showed that close consanguinity among parents represented (47%), while remote consanguinity among parents was (28%). This is because in our community there is a high incidence of consanguineous marriage.

Anwar, et al., (2014) stated that close consanguinity accounts for 22% of the total marriage in Egypt and is higher in rural areas. Sherief, et al., (2014) found in a study carried on 108 Egyptian children and adolescents aged (2-17 years) with β-thalassemia-major recruited from Zagazig University Hospital that positive consanguinity found in 62.05% of patients.

Regarding frequency distribution of different types of anemia among patients, more than one third of children under five years have thalassemia. Sheikh, et al., (2017) stated that about 1.5% population of the world are carriers of β thalassemia. Also, Elsayed and Abd El-Gawad, (2015) stated that β- thalassemia is the most common chronic hemolytic anemia in Egypt (85.1%) from a study carried out in different geographical areas of Egypt. Yamamah, et al., (2015) stated that the prevalence of iron deficiency anemia in children aged 2.7- 17.8 years living at South Sinai, Egypt is 37.9%. Souganidis, et al., (2012) stated that iron deficiency anemia is the leading cause of anemia worldwide, accounting for approximately 50% of the total prevalence. Mansour, et al., (2014) stated that aplastic anemia is a bone marrow failure syndrome with an incidence of two per million in Western countries and 4–6 per million in Asia. Aplastic anemia is a rare disease.

The current study reported that severe anemia represented 65%; moderate anemia represented 28% while mild anemia represented 7%. This finding is not in agreement with Kuziga, et al., (2017) who stated that the proportion of children who had severe anemia (Hb□<□7 g.dl) was 1.3%, while those with moderate anemia were 27.7%, and mild anemia was found in 29.8% among children aged 6 to 59 months in Uganda. Moreover, Zuffo, et al., (2016) found that prevalence of anemia among children aged 6-36 months in Colombo in Curitiba was 56.9%, 42.2%, 0.9% for mild, moderate and severe anemia, respectively.

Also, Al Ghwass, et al., (2015) who studied iron deficiency anemia in an Egyptian pediatric population found that mild anemia was found in 20% of total study population while 41.7% had moderate anemia and only 2.3% had severe anemia. This is because the studied children in our study had chronic anemia. Isaac, et al., (2013) found that G-6-PD-deficient children, had 70.2% were moderately deficient, while 29.4% were severely deficient.

Regarding weight for age, the current study found that more than three fourths (78%) of studied children below 3rd percentile. This result comes in agreement of El Kishawi, et al., (2015) who studied anemia among children aged 2–5 years in the Gaza Strip Palestinian found that the majority of children 74.8% were categorized under normal

weight. Ughasoro, et al., (2015) found that 5.9% were < 3rd percentile of WHO charts.

Concerning length/height for age, our study found that about two thirds of studied children were below 3rd percentile. This goes in harmony with that of El Kishawi, et al., (2015) who stated that approximately half of children (52.4%) were stunted. Ughasoro, et al., (2015) stated that 15.7% (n= 45) were < 3rd percentile. Zhao, et al., (2012) who studied prevalence of anemia and its risk factors among children 6–36 months old in Burma found that 55.2% were stunted.

As regards weight for length/height, the present study found that 47% of studied children falling < 3rd percentile. This agrees with El Kishawi, et al., (2015) who found that 8.4% were wasted. Ughasoro, et al., (2015) reported that 6.3 % (n= 18) were <3rd percentile. Zhao et al., (2012) demonstrated that 13.2% were wasted.

Concerning head circumference for age, it was found that two thirds of patients were < 3rd percentile category. Zhao, et al., (2012) found that 13.5% of the children had a small head circumference.

As regards mid-arm circumference for age, the present study found that three fourths of patients were < 3rd percentile category. Ughasoro, et al., (2015) found that 7 % (n= 20) were < 12.5 cm. Zhao, et al., (2012) stated that mid-arm circumference for age under the 15th percentile of the data from children in the United States was considered as wasting. They found that 29.2% of children were under the 15th percentile level of United States children.

It was found that three fourths of studied children had abnormal DDST II, 18% had questionable DDST II and there is one untestable DDST II. This is because a high percentage of patients had severe and moderate anemia. Nandanwar & Kamdi, (2013) stated that sickle cell anemia affects almost all systems of the human body. It retards the growth and development, thus sickle cell anemia acts as a great retarder of human body.

This result agrees with that of Pala, et al., (2010) who found that DDST-II scores were abnormal in 67.3% of subjects with iron deficiency anemia. Iron deficiency anemia impaired psychomotor development during childhood. Moreover, Ahmed, (2004) found in a study of growth and development of children with chronic hemolytic anemia aged 1-6 years in Assuit city that 74.2% of children had abnormal DDST II, 14.5% had questionable DDST II and 3.2 % were untestable.

Regarding the relation between growth indices and DDST, the present study showed no statistically significant difference between all growth parameters and DDST II except weight for age percentile (p=0.03). Ahmed, (2004) found that no statistically significance difference was found between DDST II and all growth percentiles except chest circumference for age (p<0.01).

It was found a statistical significance difference between some growth parameters, DDST II and grading of hemoglobin. Severe chronic anemia in infants and young children may lead to delayed growth and long term effects on neurodevelopment and behavior; chronic anemia has a negative effect on linear growth during all stages of growth (infancy, childhood and adolescence) (Soliman, et al., 2014).

Anemia has important consequences for human health and the social and economic development of each nation. Anemia influencing children's health, their cognitive and physical development, and immunity, increase the risk of infections and infant mortality, and causing effects that last for a lifetime (Zuffo, et al., 2016).

Conclusion:

Based on the results of the present study, it was concluded that children with chronic anemia showed delayed growth and development. Using the three indices of malnutrition; weight for age, length/height for age and mid-arm circumference for age children with chronic anemia showed malnutrition. Both close and remote consanguinity were the most common among parents of children with chronic anemia. Both moderate and severe anemia was the most common among children with chronic anemia. There was a relationship between chronic anemia and malnutrition effect on physical growth and development among children under five years.

Recommendations

Based on the findings of the present study the following is recommended:

- Increase awareness among mothers through educational programs on importance of follow up and care of their children with chronic anemia.
- Regular follow up of children with chronic anemia should be maintained with regular assessment of growth and development.
- Nutritional counseling to parents of children with chronic anemia because malnutrition was evident among those children.
- More efforts are still needed to increase awareness among people about importance of premarital counseling and health hazards of consanguineous marriage through mass media.
- Encourage further researches to study the prevalence of chronic anemia in Minia to realize the size of the problem.

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