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ASSESSMENT AND DETERMINANTS OF NUTRITIONAL STATUS IN A SAMPLE OF UNDER FIVE-YEAR-OLD IRAQI CHILDREN

Maysaloun Muhammed Abdulla

Assistant Professor, Community & Family Medicine Department/College of Medicine/Al-Nahrain University.

ABSTRACT: *The nutritional status of under five-year-old children is an important outcome measure of children's health. Malnutrition is one of the most important causes of children's abnormal physical and mental development. The study aims to find the prevalence and determinants of malnutrition in terms of wasting, stunting, and underweight, in addition to obesity in a sample of under five-year-old Iraqi children. A cross sectional study was conducted in three primary health care centres in Baghdad for the period from 3rd January to 31st March 2012. A sample of 606 under 5-year-old children (2-59 months) of both genders was included in the study. Data were gathered by direct interviews with the children's parents, and the weight, height, and BMI measurements of each child were taken. The prevalence of different undernutrition problems among under five-year-old children were: 5.28% for wasting, 16.17% for stunting, and 7.43% for underweight. The highest prevalence was that of being being obese; 17.5% by weight to height and 15.35% by BMI to age. Malnutrition levels were higher in rural than in urban areas. A significant association was estimated between; the age of a child and being underweight, lower levels of parental education and stunting, and between extended families and stunting. The rates of being being obese were higher than that of those of undernutrition. The factors associated with undernutrition in under five-year-old children are especially related to lower socioeconomic status such as rural residence, lower levels of maternal education, unemployed mothers, and extended larger families.*

KEYWORDS: Nutritional Status, Under 5 Children, Malnutrition.

INTRODUCTION

In the developing regions, despite population growth, a decline in under 5-year-old child mortality was estimated from 12.7 million in 1990 to almost 6 million in 2015 globally, mostly due to preventable causes (United Nations, 2015). The nutritional status of under-five children is an important outcome measure of children's health (NBS and ICF, 2010). Malnutrition is one of the most important causes of children's abnormal physical and mental development (Das and Rahman, 2011). Much research has shown that the level of resistance to infection is lower for malnourished children than other children, which causes high levels of morbidity and mortality and adverse effects on intellectual ability (Sharghi, Kamran, and Faridan 2011). Nearly half of all deaths in under 5-year-old children are attributable to undernutrition, which translates into the unnecessary loss of about three million young lives a year (Park et al 2012; UNICEF 2015).

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Poor nutrition in the first 1,000 days of a child's life can also lead to stunted growth, which is irreversible and associated with impaired cognitive ability and reduced school and work performance (UNICEF, 2015).

In April 2006, the World Health Organization (WHO) released new global growth charts for infants and children as old as 5 years to replace the existing CDC/WHO international growth charts, which were based on the 1977 NCHS growth charts (Grummer, Reinold, and Krebs 2010).

Prior to 2015, the tracking progress to the Millennium Development Goal 1 (Eradicate extreme poverty and hunger) was done through child undernutrition indicators. The target was to achieve a 50% reduction in underweight prevalence between 1990 and 2015. Another aspect of malnutrition i.e. overweight and obesity was growing at a brisk pace among children worldwide. Now, in the post-2015 development era, the world is on track to achieve the Sustainable Development Goal 2 (End hunger, achieve food security and improved nutrition, and promote sustainable agriculture) with the help of malnutrition measures (UNICEF 2015).

In the Middle East, the percentage of stunted and underweight children under the age of five decreased between 1990 and 1914 from 31% to 18% and from 14% to 7% respectively, and in 2014 the wasting rate was 8.2%. Obesity, on the other hand, continued to increase worldwide, from 7.5% in 1990 to 8.9% in 2014 (UNICEF 2016).

In general, the different prevalence of under-nutrition in various parts of the world ranged from about 5% to 40% with the different risk factors categorized as: child or family characteristics, socio-economic status, healthcare, and prevalent infectious diseases (Kavosi et al 2014).

In Iraq, the nutritional surveys carried out in 2011and 2013 showed that there exist continued nutritional problems in addition to obesity, which require a national strategy to control them. Studies showed that 61% of the deaths of children under five years old are caused by malnutrition. The multi-indicators national survey conducted in collaboration with the Ministry of Planning, the Health Organization, and UNICEF, which included 36,500 Iraqi families in 18 provinces, showed that for every (1,000) live births, in 2013 the mortality rate for infants and children under five years old was 38. In addition, the rates of underweight, stunting, and wasting were 8.4, 22.3, and 6.9 respectively, while the percentage of overweight was 12% (Nutrition Research Institute Iraq 2014, University of Baghdad 2014). The increasing prevalence of childhood obesity has become a growing matter of public health concern worldwide and is expected to reach 9.1% in 2020 (Muhihi 2013, Grieken 2013, WHO obesity and overweight 2006). New conditions, in terms of lifestyle, have been created in many developing countries due to urbanization and economic development, and which have led to the emergence of nutrition transition which is characterized by a shift to a higher caloric content in diet and to a reduction in physical activity (Rihlat 2009).

The four measures of children's nutritional status used in this study were: stunting, wasting, underweight, and overweight/obesity. Children (age 2-59 months) whose height-for-age Z-

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score (HAZ) is below minus two standard deviations (-2 SD) from the median of the WHO reference population are considered to be stunted, or chronically malnourished (NBS and ICF 2010). This means that a child who is stunted is considered short for their age, which is a measure of chronic nutritional deficiency. Wasting relates to the weight-for-height index (WHZ) which measures body mass in relation to body height or length and describes current nutritional status. Children with Z scores below minus two standard deviations (-2SD) are considered wasted, or acutely malnourished. Further, weight-for-age (WAZ) is a composite index of height-for-age (HAZ) and weight-for-height (WHZ), and it takes into account both chronic and acute malnutrition. Children with weight-for-age below minus two standard deviations (-2 SD) are classified as underweight. Height-for-age does not distinguish between chronic malnutrition (stunting) and acute malnutrition (wasting) (National Statistical Office 2011).

The WHO recommended the cut-off points for overweight and obesity based on the BMI-for-age Z –scores (BAZ). The reference curve of the Z -score = 1 was recommended to classify "overweight", while that of the Z -score > 2 classifies "obesity". The BMI-for-age Z -score < -2 and < -3 were set as the cut-off points for thinness and severe thinness, respectively (Wang and Chen 2012). Children have WHZ score above +2 were considered overweight and obese (WHO 2016).

The study aims to find the prevalence of malnutrition in a sample of under five-year-old Iraqi children in terms of wasting, stunting, and underweight, in addition to overweight and obesity, and to identify the association of some sociodemographic and lifestyle characteristics with these nutritional health problems.

METHODS

A cross-sectional study was carried out in three conveniently selected primary health care centres (PHC) in Baghdad/Alkarkh, with different catchment areas serving the population from urban and rural regions, namely Alrashid, Alshabab, and Alwashash PHC centres. Data collection was carried out for a period of three months from 3rd January to 31st March, 2012. The researcher visited each PHC centre four days a week, for 3-4 hours a day for about one month.

A convenient consecutive sample was recruited including 606 children under 5 years old (2-59 months) of both genders who were visiting health care centres for vaccination or routine care visits. Child age was determined according to the difference between a child's date of birth taken from available written records and the date of data collection. As there is no available proposed classification to define socioeconomic classes in Iraq, sociodemographic characteristics were used instead such as: residence (urban or rural), educational level, employment status, type of family (nuclear or extended), and family size. Only apparently healthy children accompanied by their parent or parents, and who had family cards, were included in the study while those with chronic diseases (endocrine, gastrointestinal, respiratory, and others), severe acute illnesses, mental illness, and those with no cards were excluded.

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Each child's parent (parents) was interviewed by the researcher, his or her verbal consent was given after a brief explanation of the nature and the aims of the study, and the data was collected using a specially structured questionnaire form designed for this study. This consisted of data regarding sociodemographic characteristics, antenatal care, and the child's mother's obstetrical history, data related to the child's feeding patterns, and the eating habits and daily physical activity that may be related to the child's nutritional status. Ethical approval was given by the Ethical Standards Council of Faculty of College of Medicine, at Alnahrain University.

Each child selected for the study underwent anthropometric measurements for weight, height and body mass index (BMI) A well-calibrated digital scale was used to measure the child's weight in kilograms (kg), and they were recorded to the nearest 0.1 kg. The scales were checked daily for accuracy and calibrated using standard known weights. All boys and girls were barefoot and wearing with minimal clothes. Children who could not stand on the scales were weighed with the respondent, then the respondent was weighed alone, and the difference was used to obtain the weight of the child. Height was measured in centimetres in a standing position for children of two years and over using tape measures fixed to the wall, and in recumbent length for those less than two years old on the examination couch. Older children (two years and above) stood with their backs against the wall with their feet parallel, and their heels, buttocks, shoulders, and the back of the head touching the wall. All anthropometric measurements were performed in duplicate. When two measurements were discrepant, a third was taken, and the two closest were selected. The presence of bilateral pitting oedema in the children was recorded if an imprint remained in both feet after pressing for 3 seconds.

Data were entered using the WHO Anthro 3.2.2 version, anthropometric indices were calculated using reference medians recommended by WHO and classified according to standard deviation units (z-scores), and based on the WHO criteria to estimate anthropometric indices (WHZ, WAZ, HAZ, and BAZ) and according to the NCHS/WHO method which assesses a child's nutritional status (WHO child growth standards 2006).

The Z-score or standard deviation (SD) is defined as the difference between the value for an individual and the median value of the reference population for the same age or height, divided by the standard deviation of the reference population. The used cut-off with Z-scores is -2 standard deviation (SD) irrespective of the indicator used. This means children with a Z-score for HAZ, WHZ or WAZ below -2 SD are considered malnourished. Wasting (weight-for-height z-score–WHZ) indicates thinness. It is usually the result of recent nutritional deficiency and is affected by seasonal shifts associated with the availability of food and the prevalence of disease. A WHZ of <-2 defines the presence of acute malnutrition (wasting). Stunting, represented by a low height-for-age z-score (HAZ), results from extended periods of inadequate food intake, poor dietary quality, increased morbidity, or a combination of these factors. A HAZ of <-2 defines chronic malnutrition (stunting). The weight-for-age z-score (WAZ) is essentially a composite of weight-for-height and height-for-age, thus a measure of both acute and chronic malnutrition. A WAZ of <-2 is used to define a child as

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being underweight. Children with a WHZ score of +1 to +2 are at risk of obesity while overweight and obese children have WHZ score above +2 (WHO 2016).

All anthropometric measurements were computed into *z*-scores; weight for age *z*-score (WAZ), height for age z-score (HAZ), weight for height *z*-score (WHZ), and BMI for age *z*-score (BAZ), using 2006 World Health Organization Growth Standards.

Malnourished children were reported when one of their anthropometric indices were abnormal (-2 z-scores below the average reference). Children were considered wasted if their weight-for-height index was below -2 z-scores below the average reference, and were considered to have growth retardation if their height for age index was below -2 z-scores below the average reference. Table (1) shows the classification of malnutrition rates as a public health problem according to WHO (B)(4).

Table -1-: Classification of malnutrition by prevalence ranges among children under 5 years of age (WHO 2016)

Index	Normal/ low	Poor/ medium	Serious/ high	Critical/ very high
Wasting	**<5%**	**5-9.9%**	**10-14.9%**	**>15%**
Stunting	**<20%**	**20-29.9%**	**30-39.9%**	**>40%**
underweight	**<10%**	**10-19.9%**	**20-29.9%**	**>30%**

Data were entered using the WHO Anthro 3.2.2 version to estimate the anthropometric indices (WHZ, WAZ, HAZ and BAZ) according to the NCHS/WHO method of assessing a child's nutritional status.

The study data was analysed using the SPSS-16 (statistical packages for social sciences) statistical computer programme to estimate mean and standard deviation (SD), the Chi-square test for the assessment of the association between the qualitative variables studied, and the student (unpaired) t-test for independent data to test the significance of the differences between the results of two means. An association or difference was considered statistically significant if the probability value (P value) was less or equal to 0.05.

RESULTS

A total of 606 children aged from two months up to five years were included in this study, their anthropometric measurements are shown in Table-2. Regarding the weight-for-height z scores, 5.28% of children were below -2 SD (wasting), and 17.492% were above 2 SD (overweight). The relation between the children's weight and height was statistically significant ($r = 0.910$ and $p < 0.01$) (Figure-1). By assessing the health status of children on the basis of weight-for-age it was seen that 7.43% of children were being underweight (below -2 SD) and 5.61% of children were above 2 SD. The correlation between weight and age was statistically significant ($r = 0.867$ and $p < 0.01$) (Figure-2). According to the height-for-age

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score, 16.17% of children were below -2 SD (stunting), and 6.11% children were above 2 SD. There was a statistically significant relation (r =0.905 and p<0.01) (Figure-3) between the height and the age of the children. By assessing the BMI-for-age, 6.44% of children were below a -2 SD (Z score), and 15.35% of children were above 2 SD (Figure-4), (Table-2-).

Table -2- Anthropometric measures of children 2-59 months of age according to residence

Anthropometric measures	Rural				Urban				Total
	Female N=55		Male N=68		Female N=224		Male N=259		
	No	%	No	%	No	%	No	%	No (%)
Weight for Length/Height Z score									
< -2	5	9.1	5	7.4	4	1.8	18	6.9	32(5.3)
-2 to 2	39	70.9	47	69.1	184	82.1	198	76.4	468(77.2)
>2	11	20	16	23.5	36	16.1	43	16.6	106(17.5)
Pearson Chi Square	P=0.861				P=0.023*				
Height for Age Z score									
< -2	17	30.9	20	29.4	23	10.3	38	14.7	98(16.2)
-2 to 2	32	58.2	43	63.2	189	84.4	207	79.9	471(77.7)
>2	6	10.9	5	7.4	12	5.3	14	5.4	37(6.1)
Pearson Chi Square	P=0.748				P=0.344				
Weight for Age Z score									
< -2	5	9.1	7	10.3	12	5.4	21	8.1	45(7.4)
-2 to 2	50	90.9	57	83.8	202	90.2	218	84.2	527(87)

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

Anthropometric measures	Rural				Urban				Total
	Female N=55		Male N=68		Female N=224		Male N=259		
	No	%	No	%	No	%	No	%	No (%)
Weight for Length/Height Z score									
< -2	5	9.1	5	7.4	4	1.8	18	6.9	32(5.3)
-2 to 2	39	70.9	47	69.1	184	82.1	198	76.4	468(77.2)
>2	11	20	16	23.5	36	16.1	43	16.6	106(17.5)
Pearson Chi Square	P=0.861				P=0.023*				
Height for Age Z score									
< -2	17	30.9	20	29.4	23	10.3	38	14.7	98(16.2)
-2 to 2	32	58.2	43	63.2	189	84.4	207	79.9	471(77.7)
>2	6	10.9	5	7.4	12	5.3	14	5.4	37(6.1)
Pearson Chi Square	P=0.748				P=0.344				
Weight for Age Z score									
>2	0	0	4	5.9	10	4.5	20	7.7	34(5.6)
Pearson Chi Square	P=0.178				P=0.144				
BMI for Age Z score									
< -2	5	9.1	7	10.3	6	2.7	21	8.1	39(6.4)
-2 to 2	39	70.9	44	64.7	188	83.9	203	78.4	474(78.2)
>2	11	20	17	25	30	13.4	35	13.5	93(15.3)
Pearson Chi Square	P=0.759				0.033*				

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The rates for urban and rural children were 79.7% (483 children) and 20.3% (123 children) respectively. In both residencies, although the rates for malnourished males (below -2 and above 2 Z scores) were higher than those of females for all nutritional indices, this result was only significant (P< 0.05) among urban children regarding weight for length/height and BMI for age Z scores (Table-2).

The levels of malnutrition among children under five in this study were higher in rural than urban areas as follows: wasting (8.13and 4.55), stunting (30.08 and 12.63), being underweight (9.76 and 6.83), overweight and obesity by WHZ (21.95 and16.36), and BAZ (22.76 and 13.46) for rural and urban children respectively.

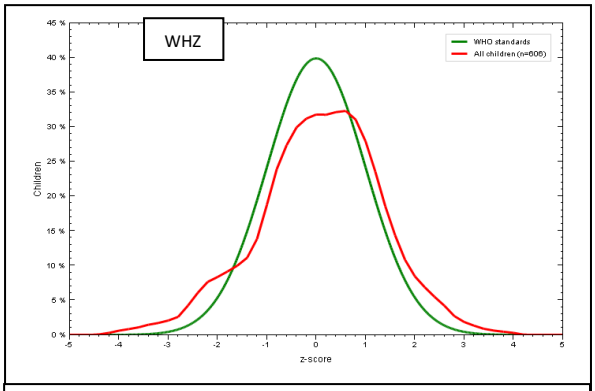

Figure 1: Weight –for-height; 5.28% of children below -2 SD, 17.492% above 2 SD. correlation between weight and height is statistically significant(r =0.910 and p<0.01).

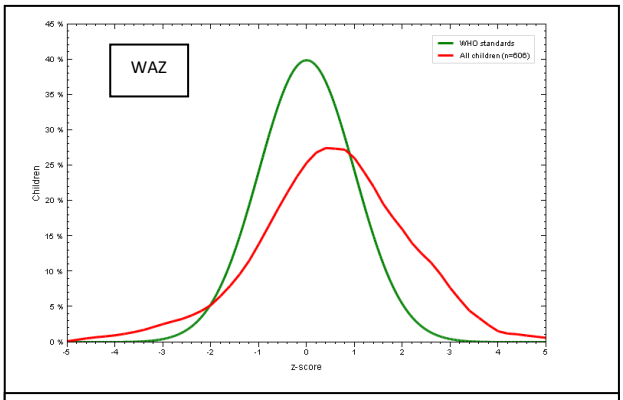

Figure 2: Weight–for–age; 7.43% of children below -2 SD , 5.61% of children above 2 SD. Correlation between weight and age is statistically significant (r =0.867 and p<0.01).

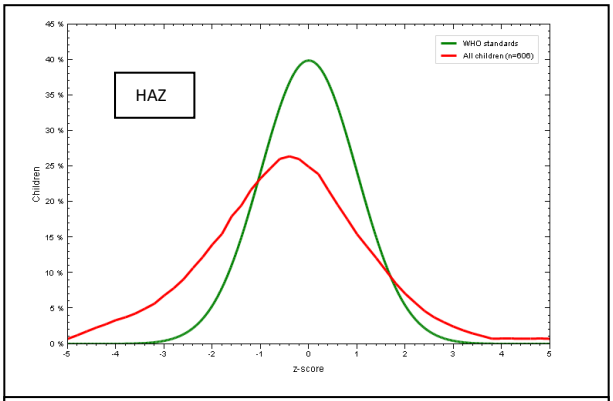

Figure 3 : Height–for-age; 16.17% of children below -2 SD, 6.11% of children above 2 SD. The height and age of the children had statistically significant correlation (r =0.905 and p<0.01).

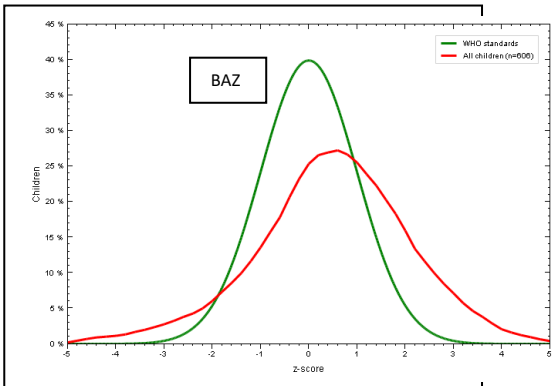

Figure 4: BMI-for –age;6.44% of children below -2 SD , 15.35% of children above 2 SD

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The sociodemographic characteristics of the children were studied and it was found the highest rate of children (46.5%) were aged from three months up to one year while the lowest was for those aged from four to five years old (3.96%). Parents with primary and secondary education represented 34.6% and 50.2% for fathers and mothers respectively, the illiterate or those with a limited ability to read and write were 29.7% and 29.5%, while college and higher education constituted 26.7% and 20.35% , for fathers and mothers respectively. The children's fathers were all employed (self-employed 60.1% and governmental employed 39.65) and about two- thirds of mothers were housewives and the remaining 35.5% of them were employed. Regarding family structure, 461(76.1%) of children had nuclear families while 145 (23.9%) were from extended families. The family size of approximately 80% of the sample was less than five, and 20% (122) consisted of five people or more (Table-3).

Table -3- Anthropometric measures of children 2-59 months of age according to sociodemographic characteristics

Variables		WHZ			HAZ			WAZ			BAZ		
		<-2	-2 to 2	>2	<-2	-2 to 2	>2	<-2	-2 to 2	>2	<-2	-2 to 2	>2
	N	N %	N %	N %	N %	N %	N %	N %	N %	N %	N %	N %	N %
Age in months													
2-11	282	18 6.4	209 74.1	55 19.5	55 19.5	210 74.5	17 6.0	31 11.0	240 85.1	11 3.9	21 7.4	223 79.1	38 13.5
12-23	178	10 5.6	140 78.7	28 15.7	23 12.9	140 78.7	15 8.4	3 1.7	160 89.9	15 8.4	13 7.3	135 75.8	30 16.9
24-35	76	2 2.6	62 81.6	12 15.8	11 14.5	61 80.3	4 5.3	7 9.2	63 82.9	6 7.9	2 2.6	60 78.9	14 18.4
36-47	46	1 2.2	36 78.3	9 19.6	6 13.0	40 87.0	0.0 0.0	3 6.5	42 91.3	1 2.2	2 4.3	35 76.1	9 19.6
48-60	24	1 4.2	21 87.5	2 8.3%	3 12.5	20 83.3	1 4.2	1 4.2	22 91.7	1 4.2	1 4.2	21 87.5	2 8.3
Pearson Chi square		P=0.661			P=0.310			P=0.011*			P=0.647		
Educational level of father													

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

Illetrate or only read & write	180	13 7.2	133 73.9	34 18.9	36 20.0	132 73.3	12 6.7	17 9.4	157 87.2	6 3.3	17 9.4	134 74.4	29 16.1
Primary or secondary	264	10 3.8	207 78.4	47 17.8	39 14.8	209 79.2	16 6.1	20 7.6	229 86.7	15 5.7	14 5.3	204 77.3	46 17.4
college & above	162	9 5.6	128 79.0	25 15.4	23 14.2	130 80.2	9 5.6	8 4.9	141 87.0	13 8.0	8 4.9	136 84.0	18 11.1
Pearson Chi square		P=0.492			P=0.531			P=0.223			P=0.118		
Educational level of mother													
Illetrate or only read & write	179	12 6.7	129 72.1	38 21.2	43 24.0	122 68.2	14 7.8	16 8.9	157 87.7	6 3.4	14 7.8	131 73.2	34 19.0
Primary or secondary	304	14 4.6	240 78.9	50 16.4	42 13.8	245 80.6	17 5.6	25 8.2	258 84.9	21 6.9	17 5.6	242 79.6	45 14.8
college & above	123	6 4.9	99 80.5	18 14.6	13 10.6	104 84.6	6 4.9	4 3.3	112 91.1	7 5.7	8 6.5	101 82.1	14 11.4
Pearson Chi square		P=395			P=0.005*			P=0.156			P=0.327		
Occupation of father													
Self employed	364	17 4.7	277 76.1	70 19.2	70 19.2	274 75.3	20 5.5	28 7.7	320 87.9	16 4.4	22 6.0	277 76.1	65 17.9
Government employed	242	15 6.2	191 78.9	36 14.9	28 11.6	197 81.4	17 7.0	17 7.0	207 85.5	18 7.4	17 7.0	197 81.4	28 11.6
Pearson Chi square		P=0.306			P=0.038*			P=0.275			P=0.106		
Occupation of mother													
Unemployed	391	21 5.4	302 77.2	68 17.4	72 18.4	295 75.4	24 6.1	30 7.7	345 88.2	16 4.1	26 6.6	304 77.7	61 15.6
employed	215	11 5.1	166 77.2	38 17.7	26 12.1	176 81.9	13 6.0	15 7.0	182 84.7	18 8.4	13 6.0	170 79.1	32 14.9

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

Pearson Chi square		P=0.988			P=0.125			P=0.090			P=0.925		
Type of family													
Nuclear	461	21 4.6	363 78.7	77 16.7	68 14.8	372 80.7	21 4.6	33 7.2	398 86.3	30 6.5	27 5.9	369 80.0	65 14.1
extended	145	11 7.6	105 72.4	29 20.0	30 20.7	99 68.3	16 11.0	12 8.3	129 89.0	4 2.8	12 8.3	105 72.4	28 19.3
Pearson Chi square		P=0.204			P=0.002*			P=0.219			P=0.151		
Family size													
<5	484	26 5.4	372 76.9	86 17.8	76 15.7	383 79.1	25 5.2	34 7.0	419 86.6	31 6.4	31 6.4	378 78.1	75 15.5
5+	122	6 4.9	96 78.7	20 16.4	22 18.0	88 72.1	12 9.8	11 9.0	108 88.5	3 2.5	8 6.6	96 78.7	18 14.8
Pearson Chi square		P=0.911			P=0.110			P=0.195			P=0.979		

The highest rates of children with low Z scores (< -2) were among infants of 2-11 months (less than one year-old) for all anthropometric measures (WHZ 6.4%, HAZ 19.5%, WAZ 11% and BAZ 7.4%). The lowest rates were as follows: 2.2% for WHZ of children within their fourth year of age, 12.5% for HAZ among the 48-60 months age group, 1.7% for WAZ within the second year of life, and 2.6% for BAZ among children aged 24-35 months. On the other hand, Z score rates above two were highest among children who were less than one year old for the WAZ index (19.5%), one to less than two years old for the HAZ and WAZ indices (8.4% for each), in the 36-47 months age group for BAZ (19.6%). The lowest rates were among the age group 36-47 months for HAZ and WAZ (0.0% and 2.2% respectively) , 8.3% for WHZ in children of 48-60 months of age, and 13.5% were less than one year old for BAZ .

Children of parents (fathers and mothers) with the lowest educational level (illiterate or with a limited ability to read and write) had the highest percentages of malnourishment (below -2 and above 2 Z scores) for almost all the anthropometric measures studied: for fathers, WHZ 7.2% and 18.9%, HAZ 20% and 6.7% , BAZ 9.4% and 16.1% respectively, and WAZ 9.4% (for below -2 SD) and the rates according to mothers' education were, WHZ 6.7% and 21.2%, HAZ 24% and 7.8% , BAZ 7.8% and 19.0% respectively, and WAZ 8.9% (for below -2 SD). The lowest rates were found among children with parents of higher educational levels .

Undernutrition (below -2 Z score) had higher rates among children of unemployed mothers (housewives) for all the indices (WHZ 5.4%, HAZ 18.4%, WAZ 7.7% and BAZ 6.6%) while

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

those with >2 SD were estimated to have higher rates among employed mothers for WHZ and WAS (17.7% and 8.4% respectively).

A significant association was found between the HAZ of the children and their fathers' occupations and those of HAZ <-2 SD represented 19.2% among the self-employed while >2 SD accounted for 7.0% among governmental employed fathers.

For almost all anthropometric measures studied, children from extended families were found to have higher rates of malnutrition (below -2 and above 2 SD): WHZ (7.6% and 20.0%), HAZ (20.7% and 11.0%), and BAZ (8.3% and 19.3%) respectively, and the rate of children with <-2 SD for WAZ was 8.3% , with a significant association between family structure and WAZ indicator (P=0.002) .

Children from larger families had higher rates of undernutrition (<-2 SD), HAZ was 18.0% , WAZ 9.0% , and BAZ 6.6%, while those from smaller families had higher percentages of >2 Z scores for WHZ (17.8%) , WAZ (6.4%) , and BAZ (15.5%).

Children of more than two years of age constituted 24.1% of the sample , and Table-4 shows the mean Z scores of anthropometric measures (WHZ , HAZ , WAZ and BAZ) of those children according to some nutritional and life style variables. Although not significant, the means of all the four indices were higher among children who, were breast fed during the first year of life, started solid food at or after six months of age, ate sweet food or fruit and vegetables three times or more per day, drank water three times or more per day, slept for nine hours or more per day, and did not watch TV.

Table-4- Mean anthropometric measurements of children 2 years up to 5 years of age according to feeding patterns and lifestyle characteristics.

	N	WHZ Mean SD	p-value	HAZ Mean SD	p-value	WAZ Mean SD	p-value	BAZ Mean SD	p-value
BF during 1st year									
No	122	.4758 1.4622	0.24	-.6742 -1.4310	0.38	-.0217 -1.1882	0.13	.5675 1.5469	0.33
Yes	24	.9513 1.1932		-.2387 -1.2901		.5096 1.1166		.9848 1.1454	
*** Age of starting added food**									
<6 months	124	.4855 1.4017	0.25	-.6060 -1.3950	0.94	.0201 1.2389	0.35	.5689 1.4521	0.28
≥ 6	22	.8673 1.5649		-.5809 -1.5256		.2768 .81681		.9418 1.7101	
Eat night meal*									

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

Yes	31	.7803 1.3283	0.29	-.9171 -1.2311	0.16	-.0087 -1.0552	0.72	.8487 1.3440	0.35
No	115	.4790 1.4530		-.5173 -1.4475		.0770 1.2228		.5648 1.5310	
Eat sweet*									
<3 times	38	.3247 1.3489	0.28	-.7118 -1.2835	0.58	-.0955 -1.1837	0.35	.4363 1.3831	0.37
3+	108	.6198 1.4535		-.5636 -1.4555		.1131 1.1878		.6915 1.5308	
Eating fruits or Vegetables *									
<3 times	36	.3189 1.3651	0.28	-.7397 -1.2929	0.50	-.1150 -1.2133	0.31	.4328 1.3957	0.38
3+	110	.6164 1.4469		-.5572 -1.4489		.1156 1.1773		.6880 1.5248	
Drinking water*									
<3 times	33	.2767 1.3683	0.23	-.7745 -1.2444	0.43	-.1591 -1.1329	0.23	.3927 1.4174	0.31
3+	113	.6208 1.4420		-.5519 -1.4560		.1224 1.1988		.6929 1.5142	
Sleeping hours*									
<=8	91	.5152 1.4666	0.76	-.6432 -1.4730	0.65	-.0032 -1.1059	0.42	.5918 1.5706	0.73
9+	55	.5891 1.3748		-.5344 -1.3093		.1613 1.3126		.6802 1.3683	
Watching TV**									
No	17	.6406 1.34054	0.73	-.3388 -1.6854	0.68	.2935 1.2397	0.53	.7212 1.4241	0.82
≤ 3 hours	52	.4156 1.3536		-.6885 -1.1893		-.0646 -1.2909		.5206 1.3599	
4+	77	.6075 1.5058		-.6021 -1.4917		.0903 1.1042		.6744 1.6046	

*student t-test

** ANOVA

Anthropometric measures of children below two years of age, who represented 75.9% of the total children,were studied in relation to certain nutritional and maternal variables (Table-5-).

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

Although not significant, it is worth noting the mean values of the four nutritional indices (WHZ, HAZ, WAZ, BAZ) among children who were bottle or mixed fed during the first six months of their lives were higher than those of breast fed children for the same period. On the other hand, the means were significantly higher among children who ate solid food before six months of age, than those who started after six months of age or who never started yet. The difference in the means was highly significant for the WAZ and BAZ scores.

The weight for the age Z score means of children who eat sweet food, fruit or vegetables were significantly higher than those who do not, although the means of other indices (WHZ, WAZ, and BAZ) were also higher but the difference was not significant.

In spite of no significant difference in the Z score means regarding sleeping hours, the ranking of the child in the family, the history of the children's mothers antenatal care, complications during pregnancy, and the type of delivery, the results of this study revealed that for all the anthropometric measures studied the Z score means were higher among children ranking less than 3, and if their mothers had complications during pregnancy or the child was delivered by caesarean section.

Table -5- Mean anthropometric measurements of under 2 year children in relation to nutritional and maternal factors

	N	WHZ Mean SD	P-value	HAZ Mean SD	P-value	WAZ Mean SD	P-value	BAZ Mean SD	P-value
Feeding during 1st Six months**									
Breast feeding	133	.4651 1.5981	0.63	-.4179 1.7606	0.59	-.0266 1.2418	0.42	.3041 1.5278	0.42
Bottle feeding	160	.4928 1.6003		-.2822 1.6524		.1633 1.3513		.4534 1.6751	
Mixed feeding	167	.6271 1.5449		-.4757 1.8006		.1118 1.1672		.5466 1.5694	
Started added food*									
Yes	366	.6116 1.4293	0.04	-.2959 1.6103	0.02	.2605 1.0968	<0.01	.5973 1.5091	<0.01
No	94	.2298 2.0380		-.7647 2.1296		-.5752 1.5777		-.1522 1.7788	
Age Started									

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

added food**									
None	94	.2357 2.0279	0.04	-.7817 2.1247	0.04	-.5747 1.5693	<0.01	-.1377 1.7749	<0.01
<6 months	296	.6682 1.3371		-.2987 1.5179		.3042 1.0962		.6603 1.3990	
>= 6	70	.3661 1.7702		-.2535 1.9639		.0845 1.0933		.3177 1.9055	
Eat sweet*									
Yes	161	.5042 1.4246	0.77	-.1957 1.4588	0.08	.2937 1.0938	0.01	.5650 1.5494	0.23
No	299	.5493 1.6567		-.4972 1.8634		-.0201 1.3223		.3790 1.6176	
Eating fruits or Vegetables *									
Yes	169	.5386 1.4592	0.96	-.2579 1.5056	0.21	.2771 1.0921	0.01	.5931 1.5681	0.13
No	291	.5306 1.6454		-.4694 1.8561		-.0191 1.3301		.3576 1.6065	
Sleeping hours**									
<=8	52	.4413 1.4621	0.88	-.0637 1.8522	0.26	.2958 .9316	0.25	.4633 1.6645	**0.83**
9-12	364	.5522 1.5123		-.4103 1.7063		.0870 1.2442		.4584 1.5166	
13+	44	.4882 2.1727		-.6252 1.8348		-.1314 1.6155		.3030 2.1036	
Rank of Child*									
<3	403	.5457 1.5568	0.66	-.3771 1.6686	0.63	.1206 1.2507	0.16	.4733 1.5771	0.29
3+	57	.4474 1.7323		-.4949 2.1740		-.1288 1.2742		.2377 1.7159	
Antenatal care*									

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

Yes	19	.0095 2.0305	0.14	-.2826 2.1623	0.78	-.1289 1.0375	0.44	.0805 2.1029	0.31
No	441	.5561 1.5545		-.3964 1.7191		.0991 1.2636		.4598 1.5705	
Complications during Pregnancy *									
Yes	26	.8131 1.5551	0.35	-.1069 2.0813	0.39	.4004 1.1037	0.194	.6527 1.5194	0.49
No	434	.5168 1.5795		-.4088 1.7154		.0711 1.2621		.4316 1.6001	
Type of Delivery*									
Vaginal delivery	428	.5083 1.5904	0.21	-.4007 1.7328	0.69	.0681 1.2628	0.18	.4215 1.6098	0.27
Cesarean section	32	.8716 1.3782		-.2712 1.8147		.3791 1.1211		.7469 1.3653	

*student t-test
** ANOVA

DISCUSSION

According to the WHO malnutrition classification (Table-1), the rates of wasting, stunting and being underweight in the current study are within the poor/medium category. Data from the Central Organization of Statistics regarding the multiple indicator cluster survey (MICS) in Iraq showed that the rates of wasting and being underweight in children under five year for the years 1991, 2000, 2003, 2004, and 2006 are comparable to this study (5.28% and 7.43% respectively) but the rate of wasting in MICS 2011(7.4%) was higher. The stunting rate among children in the current study (16.17%) was lower than the MICS national figures (range 20-33.7%). Being overweight and obesity in this study showed higher rates (17.49% for WHZ and 15.35% for BAZ) than Iraqi national figures (WHO 2014).

Two studies in Iran, a neighboring country, conducted in 2013 and 2014, showed lower rates in stunting (12.5% and 9.53%). The first Iranian study showed a similar rate of being underweight (7.5%) and lower rate of wasting (4.4%), while the second showed higher rates of being underweight (9.66%) and wasting (8.19%) (Kavosi et al 2014, Abolfazl 2013).

Regarding the three indicator rates of wasting , stunting and being underweight in other neighboring countries, in 2014 lower rates were registered in Turkey and Kuwait (1.7%, 9.5%, 1.9% and 2.4%, 5.8%, and 3% respectively), and in 2012 the rates in Jordan were (2.4%, 7.8%, 3%). The prevalence in Saudi Arabia was higher for wasting (11.8%) but lower for stunting (9.3%) and being underweight (5.3%), while in Syria all the indicators of

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

undernutrition in 2009 were higher than in this study (11.5%, 27.5%, and 10.1% respectively) . In Egypt the prevalence of those indicators, according to WHO statistics, were higher for wasting (9.5%) and stunting (22.3%) but similar for being underweight (7.0%) (WHO 2014).

The rates of being underweight and stunting in the current study are lower than countries of the Far East except Thailand, which had slightly lower rates (being underweight 7% and stunting 15.7%) (WHO 2015).

The rates of being underweight and stunting in this study were lower than those of studies in Cameroon in 2014 and Kenya in 2011, except for wasting which was higher than in those studies (Nolla 2014, Olack 2011). A study in Bangladesh (2011) showed higher rates than in the current study regarding the three indicators of undernutrition (Siddiqi, Haque and Goni 2011).

Male children had higher rates of malnutrition than females for all anthropometric indices in both urban and rural areas. The lower Z scores prevalence for BAZ and WHZ (wasting) were significantly higher among males than females in urban residences, and similar results were seen in another study in Cameroon in 2014 (Nolla 2014). A study in Kenya (2011) also concluded that under-five male children are more likely to become stunted than their female counterparts (14). Different studies have suggested that boys are more influenced by environmental stress than girls (15) and that male children are more vulnerable to early childhood disease and health problems. This is in addition to the supportive findings of male gender as a risk factor of malnutrition (Kavosi et al 2014, Olack 2011, Makoka 2013).

A study in India in 2003 showed a higher proportion of female children had normal weight/age and weight/height ratios than their male counterparts. This is in accordance with the reports from the South Asian countries, which have shown that there was no sex difference in the nutritional status of preschool children 9 (Lakshmi et al 2003).

The current study showed rates of malnutrition among children from rural areas were higher than those of urban children. This finding was similar to that of a study on malnutrition in children under-five in Bangladesh (Siddiqi, Haque and Goni 2011). Several studies reported that a high prevalence of under-nutrition in rural areas may be the result of low education levels, low social ranking, poor water supply, and a high incidence of infectious disease (Kavosi et al 2014). Women in urban areas had better access to nutritional information and are more educated than mothers in rural areas, are more aware of the benefits of immunizing children against diseases, the importance of taking children to health clinics, feeding children at the appropriate times and in the right quantities (Kavosi et al 2014, Siddiqi, Haque and Goni 2011, Makoka 2013).

The highest rates of children with below -2 Z scores were among those aged 2-11 months. Similar to findings by Olack B et al. in which moderate wasting was most prevalent among children aged 6-11 months (Olack 2011). A small rise in the prevalence of undernutrition in children aged between three and six months is seen with the early introduction of milk substitutes and there is higher morbidity in the 3-6 months age group. A further rise in the

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

undernutrition rate between six and twelve months is seen if there is too late an introduction or an inadequate amount of complementary feeds for children (WHO 2015, Olack 2011).

The current study found children with poorly educated mothers and fathers to suffer more from malnutrition than those with parents with a higher level of education, which is in agreement with the findings of Siddiqi et al. Another result reported by this study is that the rates of all types of undernutrition were higher among housewives (unemployed mothers) which may be explained by their lower educational level than employed mothers. Educated parents have a major contributing role to the better health and nutritional status of their children. Illiterate or poorly educated mothers are less aware that child feeding, care giving practices, and health seeking are important for the development of child nutritional status. A father's education may also affect a child's nutritional status since he is responsible for the family resources such as income and food. Therefore, improving socio-economic conditions along with mothers' literacy and preventing infections through personal hygiene might help to improve the nutritional status of children (Kavosi et al 2014, Siddiqi, Haque and Goni 2011, Makoka 2013, Meshram et al 2012).

Childhood malnutrition rates were higher among extended families with a larger family size especially being underweight, which was significantly associated with family type and this finding was similar to previous studies (Meshram et al 2012, Mahyar et al 2010). In a larger family the susceptibility of children to malnutrition may increase as a result of a decrease in food intake and accessibility to health care (Kavosi et al 2014, Meshram et al 2012, Mahyar et al 2010, Jayant et al 2010).

The rates of anthropometric indices of >2 SD like overweight and obesity were higher among children from smaller families.

Children in this study were studied in relation to some nutritional and lifestyle factors after they were divided into two groups; below two years and from two up to five years because of the growth and developmental differences between these two age groups. Physical growth and bodily changes are rapid and profound in the first two years as infants (birth to age one) and toddlers (ages one to two) grow quickly (Cliffsnotes 2016). Over 800,000 children's lives could be saved every year among children under five, if all children aged 0-23 months were optimally breastfed (WHO. Infant and young child feeding 2016) (ref2).

The results regarding children from two up to five years revealed that those who were breast fed for the first year of life and those who started solid food at six months or later, have a better nutritional status with a higher Z score means of all anthropometric measurements in the current study. Early introduction to complementary feeding was associated with a lower weight-for-age and increased risk of respiratory infection in a study carried out in Zambia (Katepa-Bwalya 2015). Breastfeeding and the weaning of an infant are not only crucial for optimal growth and development but also are important determinants of future physical and mental well being because of rapid growth spurts and the development of organs and tissues during the first year of life**.** Malnutrition is often associated with inappropriate feeding practices occurring during the first year of life (Jayant et al 2010, Katepa-Bwalya 2015).

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

Rapid growth and development takes place during the preschool years, from age two to five. At this age a child grows about two to three inches and gains four to five pounds each year. Proper nutrition and opportunities to play and be physically active are critical to ensuring a child grows properly (Serrano 2013). The results of our study revealed no significant association between TV watching hours and the nutritional status of children over two years of age, although higher Z score means were estimated among those who did not watch TV which is similar to a finding in another study which suggested that among preschool-aged children, TV viewing reduced energy intake during meals and snacks for some children. The results also showed that although recent studies found that eating while watching TV is linked to increased weight status in children, they did not find any significant association with weight status (Serrano 2013, Francis and Birch 2006) .

Preschool children (from two up to five years) in our study who consumed fruit and vegetables more frequently had a higher mean of anthropometric indices which may reflect a higher dietary diversity with a greater likelihood of meeting the Recommended Dietary Allowances (RDA) for all nutrients. In addition, low food variety in preschool children's diets may translate into poor nutritional status (Walingo and Ekesa 2013). This study showed that more frequent sweet food intake (such as chocolate, sweet food or drinks) was associated with increased anthropometric means. Consumption of sweet foods may be one factor, which contributes to being overweight (Valmórbida and Vitolo 2014).

The other group of under two year children showed a reversed result from older children regarding the age of starting solid food as higher Z score means were found among those who were fed complementary food earlier than the age of six months. This may be due to the fact that nutritional aspects and growth patterns among younger children differ from those for older ones so giving them solid food earlier than recommended may also have a different effect on their nutritional status, and in addition they need to continue breast feeding until age two (UNICEF Data 2016). Findings related to other feeding patterns like eating sweet food, fruit, or vegetables were similar to those for children aged over two years. First and second rank children were found to have a higher Z score mean as they may be from a smaller family be fed and cared for more by their families and have better access to health services (Kavosi et al). The higher means among children delivered by caesarean section (C/S) match the results of an international prospective cohort study conducted in four developing countries which suggested that children born by C/S have a higher probability of developing obesity than those who were not. The risk of being obese among those born by caesarean delivery was over twofold in early childhood, and 57% higher in late-childhood which suggests that risk magnitudes wane over time (Carrillo et al 2015). (ref3) The relation between the nutritional status of children under two years and maternal complications during pregnancy could not be determined accurately in the current study because a wide range of these complications were included i.e. diabetes, pre-eclampsia, anemia, and other medical problems, and each of them may have a different adverse effect on a child's nutritional status.

For BMI-for-age (BAZ) and WHZ, the results from this research found that the prevalence of being overweight and obesity was higher among the rural children. This finding was

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

comparable to that by Davis et al. (2010), who explained that this might be due to the fact that rural children do not engage in physical activity as much as urban children (Davis et al 2010).

A concomitant presence of both over and undernutrition were estimated at higher rates among children aged under five with low-educated parents (illiterate or with a limited ability to read and write) in our study. Stunting and being overweight rates were both higher among rural children. These results are comparable to those of a study by Rihlat et al. who found that low socioeconomic level is associated with the coexistence of overweight and stunting. They also found that lower maternal education is an independent risk factor for a child to be overweight-stunted (Rihlat 2009).

In general this study showed the rates of being overweight and obesity were higher than that of undernutrition – a finding which may be comparable to the current global situation as the prevalence of stunting in children before the age of five years has decreased over the last decade. During the same period a steady rise in preschool being overweight has been reported, which may indicate that stunting and being overweight are found at the same time (Black et al 2013, de Onis , Blossner and Borghi 2010).

Being overweight and underweight among under five year-old children in the current study may be considered as evidence to indicate that the Double Burden of Malnutrition (DBM) is already a concern. A concept first presented just over a decade ago, the DBM is the coexistence of the undernutrition and overnutrition of macronutrients and micronutrients across the life course of the same population, community, family, and even individual. Of particular concern is the life course dimension of the DBM, or the link between maternal and fetal undernutrition, and an increased susceptibility to overnutrition and diet-related non communicable diseases later in life (The World Bank 2013).

The highest rates of both stunting and being overweight were found among infants below one year of age in the current study. The foetal and neonatal development of children could be affected by early maternal biological changes, even if the mother lives in a healthy environment, which may predispose the child to a higher risk of being overweight later. The intergenerational effect hypothesis is a complementary way to understand the coexistence of being overweight and stunting in children and should be explored to gain a better understanding of the individual dual burden in children (Said-Mohamed et al 2012).

CONCLUSIONS

Prevalence of wasting, stunting and being underweight in the current study are within the poor/medium level according to WHO classification. The rates of being overweight and obesity were higher than that of undernutrition, a finding which may be comparable to the current global prevalence. The progress of being overweight may reveal the beginning of the nutritional transition process.

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

Factors associated with undernutrition in under five year-old children are especially related to lower socio-economic status such as rural residence, lower maternal education, an unemployed mother, and an extended family with a larger family size. Other factors are male gender and infants below one year. Higher Z score means were found among older children (above two years) who were breast fed for the first year of life, those who started solid food at six months or later, and those who consumed fruit, vegetables and sweet food more frequently. The findings in the first two years of life were different concerning complementary food but similar for the other factors.

The coexistence of both being overweight and undernutrition were estimated at higher rates among under five year-old children with poorly educated parents and rural families, and the highest rates of both stunting and being overweight were found among infants below one year of age. The concomitant presence of these two nutritional problems (stunting and being overweight) may be considered as evidence to indicate that the Double Burden of Malnutrition (DBM) is already a concern.

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