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# THE VALUE OF WAIST TO HIP CIRCUMFERENCE IN THE ASSESSMENT OF OBESITY IN CHILDREN BELOW 5 YEARS

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**ABSTRACT:**

**Background** Obese and obesity are terms commonly used in the clinic as well as street corner, often with a wide range of meaning. "Overweight" technically refers to an excess of body weight, whereas "obesity" refers to an excess of fat. The aim of study to assess the prevalence of overweight and obesity in children below five years old and identify some of their possible risk factors.

**Patients & Methods:** The current study represents an observational, cross-section study using a multistage-stratified random sampling technique, which included three hundred children (girls and boys) who aged below 5 years, selected randomly in Primary Health Center and kindergarteners in Tikrit city. The study was conducted from the first of February 2016 to the first of October 2016. Body mass index and weight for age were measured and compared to standard tables using international cut-off points. The presence of obesity is assessed by measuring the circumference of the waist (WC) and comparing it to that of the hip (HC). The relation between the two measurements is referred to as the waist-to-hip ratio (W/H).

**The Results:** Information on possible risk factors were collected by a prepared of questionnaire. The total number of cases was 300 child who aged below 5 years. The prevalence of obesity is 13% (39 cases). There was a significant association between obesity and age, residency (urban-rural), family history, social level and certain dietary practices. Modern dietary habits are an important influence in the development of childhood obesity that should be watched carefully and controlled

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## Introduction

Obesity is one of the most prevalent disorder among children and adolescents in the world. Obesity in children is a complex disorder and it's prevalence has increased in recent years that many consider it a major medical concern of the developed world. Obese children are more likely to be obese adults (1).

Many factors play a role in the development of obesity like genetics, metabolism, environment, lifestyle, eating habits, low socio-economic status and early maturation, however, more than 90% of causes are idiopathic and less than 10% are associated with other causes. Obese parents may have obese children due to shared genes and environmental factors as availability of certain energy rich food and decrease physical activities and exercise (2).

Obesity in children predisposes to insulin resistance and insulin depended diabetes, hypertension, hyperlipidemia, renal disease, liver disease, cardiac disease and reproductive dysfunction (3). The increased prevalence of pediatric obesity and it's associated morbidities demonstrates the need to determine the obesity such as body mass index (BMI), weight for age, waist to hip ratio (W/H) and skin fold thickness, but the superior one is the body mass index (4).

Body mass index is a continuous measure of body fatness but given no indication about fat distribution, calculated as weight (Kg) divided by the height square (m<sup>2</sup>). The normal values of the body mass index vary with age, sex and pubertal status. Standard curves of body mass index representing the 5th through the 95th percentiles (5).

Other method to determine body fatness is waist circumference and waist to hip ratio, although waist circumference in children had not been regarded as an important measure of adiposity, but in adult population, waist circumference measurement has been a useful tool for assessing risk for obesity related diseases such as cardiovascular diseases, and has been shown to correlate well with intra-abdominal fat mass (6).

### Definition:

In general, the overweight refer to an excess of body weight, whereas the obesity refer to an excess of fat in the body. However, the methods directly used to measure body fat are not available in daily practice, for this reason, the obesity is often assessed by means of indirect estimates of body fat (7).

According to Body Mass Index (BMI), the term " obesity " refers to children who body mass index is

>95th percentile for age and sex while the term "overweight" refers to the children who body mass index between the 85th and 95th percentile for age and sex. The National Center for Health Care Statistics Center for disease control published BMI reference standard for children between 2 – 20 years old (8).

#### **Diagnosis:**

The body mass index is the most effective and standard tool for the assessment of obesity and overweight in the children above 2 years old. The Center for Disease Control (CDC) use the term "overweight" for children with body mass index between 85th and 95th percentile for age and sex while if the body mass index above the 95th percentile, the children consider obese (9,10).

In children below 2 years old, the body mass index is not liable to assess obesity, so the evaluation depending on weight for age. If the weight is >98th percentile for age and sex, mean the child is obese (10).

In other hand, the waist circumference and waist to hip ratio are used as accepted measure to evaluate the body fat mass (central obesity) which correlate to obesity morbid as coronary heart disease and has been shown to be related to an arthrogenic lipoprotein profile (11).

#### **Epidemiology:**

Variable data regarding childhood obesity done by international studies, the prevalence rate for childhood overweight was at least 10%. The highest rates of obesity found in Malta (25.4%) and the United States (25.1%) while the lowest rates found in Latvia (5.9%) and Lithuania (5.1%) (12). In United States, the prevalence of obesity among children is doubled for preschool children (2-5 years) from 5% in 1976 to 10.3% in 1999. Obesity in children and adolescent are more common among Native Americans, non-Hispanic blacks and Mexican Americans than whites. Approximately 24% of black adolescent are obese (2).

Obese parent increase the risk of obesity among offspring by two-three fold, about 80% of obese children between 10-14 years had one obese parent. In addition, the amount of time, which spent in watching television, is directly related risk of obesity in children and adolescent. In addition, displacement of physical activity and depression of metabolic rate have adverse effect on diet quality then effect on risk of obesity (8).

Girls are more common than boys to develop persistent obesity during adolescent, this is related to physical changes in the body composition that happen puberty, when the body fat

decrease in boys while increase in girls. Approximately 70% of obese adolescent girls remain obese, whereas about 28% of obese adolescent male do so (7).

**Aim:**

To monitor child health by early detection of obesity among children under 5 years old.

**Objective:**

The objective of this study are:

- 1) Clarify the sociodemographic factors of study cases include age, sex, residence and died.
- 2) Recognize the health problems among the samples as cardiac, metabolic and endocrine diseases.
- 3) Recognize the number of children having obesity in the samples.
- 4) Outline the waist circumference and hip circumference of children below 5 years old attending Primary Health Care Center (PHCC) and kindergarten in Tikrit city.
- 5) Assess the benefit of waist to hip ratio in determining the obesity in children below 5 years old.

**Patient and methods:**

**1. Design of study:**

This current work represented a descriptive cross-sectional randomized study which was conducted during the period extending from the first of February 2016 to the first of October 2016,

with regular working hours on children with obesity.

**2. Socio-Demographic characteristic:**

This study has been included children aged below 5 years old who attending Primary Health Care Center (PHCC) and kindergartens in Tikrit city from different residency (urban and rural areas)

**3. Development of questionnaire:**

The questionnaire was developed to collect all data relevant to socio-demographic factors contributing in obesity.

**4. Ethical considerations:**

Official permission to perform this study was obtained from the manager of PHCC in Tikrit city and from the family then explained the purpose of data collection before starting the study.

**5. Data collection:**

This study perform over 300 child who aged below 5 years old selected randomly, and include two components: the first one is interviewer administration of questionnaire and the second one is anthropometric measurement (weight, height, waist circumference and hip circumference).

**6. Data interpretation:**

**1) Weight for age:**

After taken the weight of children below 24 months old, their weights were plotted to chart of weight for

age(growth charts of CDC) then classified the result into three groups (obesity, normal weight and underweight). The term of obesity referred to the children whose weights were above the 98 percentile for age and sex while the children whose weights were between the 2 and 98 percentile for age and sex, followed to group of normal weight (13).

## **2) Body mass index:**

The body mass index (BMI) was calculated by the weight in (Kilograms) divided by the height squared (meters).Then classified the nutritional statuses of children who aged above 2 years old into groups (underweight, normal, overweight and obesity) according to the recommendation cut-off point of WhO (3).The term of obesity referred to the children whose BMI is above of 95 percentile for age and sex, while the children who's BMI between the 85-95 percentiles for age and sex, followed the group of overweight according to CDC of growth charts (14).

## **3) Waist to hip ratio:**

The waist to hip ratio is the ratio of waist circumference to hip circumference (W/H), but there is no deference ranges in children till now.

## **8. Statistical analysis:**

Data collection and analysis were performed using chi square, p-value of less than 0.05 was considered as statistically significant and p-value less than 0.01 as highly significant and less than 0.001 as extremely significant.

## **Results:**

### **1.Demographic characteristics of study:**

The total sample studied in this research was (300) of children, the age group was taken below 5 years of age. The prevalence of obesity was (13%).

### **2. Distribution the prevalence of obesity according to total samples:**

Figure (1) show distribution of the prevalence of obesity according to total samples. The prevalence of obesity were 39 (13%) and non-obese were 261 (87%).

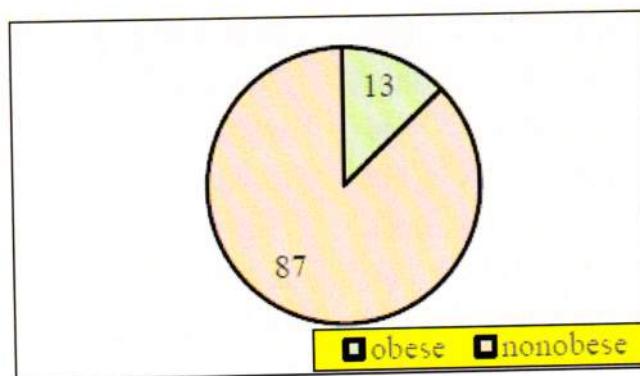


Figure (1) Distribution the prevalence of obesity according to study cases

### 3. Distribution of obese samples according to sex:

Regarding to sex, Most of obese samples were females 21 (53.9%) while males were 18 (46.1%).

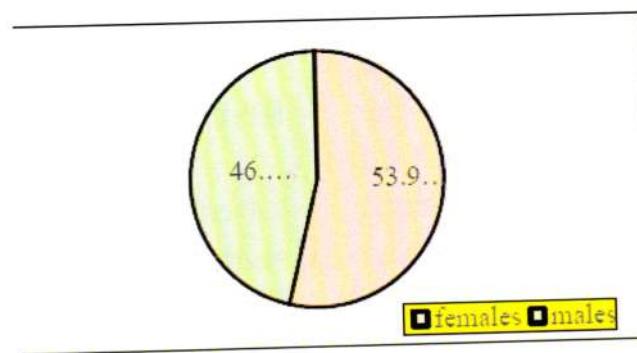


Figure (2) Distribution of obese samples according to sex

### 4. Distribution of obese samples according to family history:

Figure (3) shows the distribution of obese samples according to the family history of obesity. Most of the samples had no family history of obesity (negative) 33cases (84.6%) while 6 samples (15.4%) had a family history (positive).

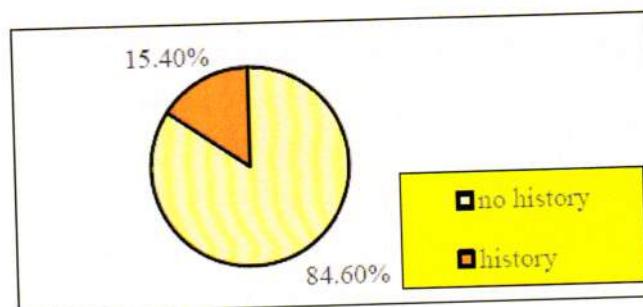


Figure (3) Distribution of obese samples according to the family history of obesity

### 5. Relation of obesity and sex:

Regarding to the sex of children, the obese females (21 cases) were more prevalent than obese males (18 cases).

**Table (1) Relation of obesity and sex**

Sex	Obese	Non-obese	Total
Males	18	131	149
Females	21	130	151
<b>Total</b>	<b>39</b>	<b>261</b>	<b>300</b>

df=1 , p>0.05 not significant

**6. Relation between the obesity and residence:**

Regarding to the residence, obese children were more prevalent at urban area (15.2%) than obese children at rural area (10.2%).

**Table (2) Relation between the obesity and residence**

Obesity	Urban		Rural		Total	
	NO	%	NO.	%	NO.	%
Obese	26	15.2%	13	10.2%	39	13%
Non-obese	146	84.8%	115	98.8%	261	87%
<b>Total</b>	<b>172</b>	<b>100%</b>	<b>128</b>	<b>100%</b>	<b>300</b>	<b>100%</b>

df=1 , p>0.05 not significant

**7. Relation between the obesity and social class:**

Regarding to social class and it's relation with obesity, the following table show that the obese children are more common in high social level 20 cases (51.2%).

**Table(3) Relation between the obesity and social class.**

Obesity	Low		Middle		High		Total	
	No.	%	No.	%	No.	%	No.	%
Obese	6	9	13	6.7	20	47.7	39	13
Non obese	60	91	179	93.3	22	52.3	261	87
<b>Total</b>	<b>66</b>	<b>100</b>	<b>192</b>	<b>100</b>	<b>42</b>	<b>100</b>	<b>300</b>	<b>100</b>

df=1 p>0.05 not significant

**8. Mean of waist to hip ratio among obese children below 2 years in regard to sex:**

Regarding to the mean of waist to hip ratio for obese children, the mean of W/H ratio for males of 0-1 year was 1.035 and of 1-2 years was 0.995 while the mean for females of 0-1 year was 0.995 and of 1-2 years was 0.97. 8

Table(4) Mean of waist to hip ratio among obese children below 2 years in regard to sex.

Age	Males		Females		Total	
	Year	NO.	Mean	NO.	Mean	
0-1	2	1.035	1	0.995	3	
1-2	2	0.995	3	0.97	5	
Total		4		4		8

**9. Mean of waist to hip ratio among obese children between 2-5 years in regard to sex:**

Regarding to the mean of waist to hip ratio of obese children, the mean for males were 1.035, 1.015, 0.97 of age groups 2-3, 3-4, 4-5 respectively while the mean for females were 1.005, 1.005, 0.97 of age groups 2-3, 3-4, 4-5 respectively.

Table (5) Mean of waist to hip ratio among obese children between 2-5 years in regard to sex.

Age	Males		Females		Total	
	Years	NO.	Mean	NO.	Mean	
2-3	3	1.035	4	1.005	7	
3-4	6	1.015	5	1.005	11	
4-5	5	0.97	8	0.97	13	
Total		14		17		31

**10. Relation between body mass index (BMI) and waist to hip ratio (W/H) in children above 2 years:**

Regarding to the relation between the body mass index and waist to hip ratio, this table (6) show no relation between them in children between 2-5 years old.

Table (6) Relation between the BMI and waist to hip ratio in children above 2 years

BMI	W/H ratio		W/H ratio	Total
	2-3 y	3-4 y		
Normal	38	49	62	149
Overweight	7	9	10	26
Obese	8	12	15	35
Total	53	70	87	210

df=4 not depended or no relation

**11. Relation between body mass index (BMI) and weight for age (W/A) among children above 2 years:**

Regarding to the relation between the body mass index and weight for age, the table (7) show no relation between them in children between 2-5 years old.

**Table (7) Relation between the BMI and W/A among children above 2 years.**

BMI	W/A	W/A	W/A	Total
	2-3 y	3-4	4-5	
Normal	42	55	71	168
Obese	11	15	16	42
Total	53	70	87	210

df=2 p<0.05 no relation

**12. Relation between weight for age (W/A) and waist to hip ratio (W/H) among children below 2 years:**

Regarding to the relation between the weight for age and waist to hip ratio, the table (8) show no relation between them below 2 years old.

**Table (8) Relation between weight for age and waist to hip ratio among children below 2 years.**

W/A	W/H	W/H	Total
	0-1 y	1-2 y	
Normal	18	37	55
Obese	10	5	15
Total	28	42	70

df=2 p<0.05 no relation

## Discussion

The use of waist to hip ratio for assessing nutritional status is now being applied worldwide. Even though the waist circumference has been reported to be a better indicator of obesity related risks (hyperlipidemia and cardiovascular complication) than body mass index or waist to hip ratio, it still vitally that all three measures are assessed. Each one has its own strengths and weakness, and each will identify different aspect of obesity. In children, especially those below 5 years old, the body mass index and weight for age percentile remain the major aspect to determine the obesity while the waist circumference and the waist to hip ratio have a limited value. The present study was the first carried out in Tikrit University College of Medicine and at Tikrit city to assess children obesity according to waist circumference to hip circumference. Therefore, the methods and results developed would be useful a basic information in further studies among this age group. The present study had several strengths including a sociodemographic samples (urban and rural) and simple anthropometric measurement, in addition, the results had been adjusted for age.

### 1. The obesity and age:

This current study show increase in the prevalence of obesity with age, the

age group 4-5 years have higher incidence of obesity than other groups age. This result is agreement with Fiore H who found in 20.000 children aged 0-10 years in USA that the prevalence of obesity increase with age especially during puberty (15).

### 2. The obesity and sex:

In this study show, the prevalence of obesity was higher in females (53.9%) than males (46.1%) although statistically not significant. This finding does not coincide with Ruiz-Extremera A in here cohort study of African American, which concluded that female sex is an independent risk factor (16). Kaplan KM, Wadden TA in their study of childhood obesity and self-esteem found that the females (56.3%) have higher prevalence of obesity than males (43.7%) (5).

### 3. The obesity and the residence:

This study show the prevalence of obesity was higher in urban areas (57.3%) than rural areas (42.7%). This result was agree with Blecker U, Mehta DI, Dietz WH in their study of obesity evaluation and treatment, who found that the prevalence of obesity in higher in urban areas (58%) than rural areas (42%) (17). But this study disagreement with Eneli, Dele Davis H, in the USA who observed an increase in the prevalence of obesity in both urban and rural areas (2).

#### **4. The obesity and social level:**

The study show a significant association between the obesity and social level. Increase in the prevalence of obesity in the children seems to be associated with high social level of the parents, by the obese children with high social class of parents (47.7%) have higher incidence than middle social class and low social class. This result is disagreement with Mr. Jone treacy irland, who found increased body mass index values in children with lowest social level (45.6%) (4), but the study which done by Neumark-Sztainer D, Wall M, Story M, in USA show the mothers of obese children were not different from mothers of non-obese children in education (18).

#### **5. The obesity and family history:**

This current study show the most obese children had no family history of obesity (84.6%).The result of this current study is not disagreement with Armstrong J in his cross sectional study in Canada, which show a strong relation between the obesity and family history, who found that (65.4%) of obese cases have a positive family history of obesity while (34.6%) have negative family history(19).

#### **6. Role of waist / hip ratio in screening of obesity:**

This current study show there is no role of waist to hip ratio in screening

or evaluation of obesity in children below 5 years, So remaining the weight for age is the standard method to evaluation the obesity in children below 2 years old, and the body mass index is the best way in determine the obesity in children above 2 years old. This result is agree with the result of Speiser PW, Rudolf MC, Anhalt H in their study about childhood obesity (20).

#### **Conclusion:**

1. The prevalence of obesity still high among children below 5 years old who attending PHCC was 39 cases (13%).
2. The obesity was more common in females 21 cases (53.9%) than males 18 cases (46.1%).
3. The prevalence of obesity is higher in children with positive family history of obesity.
4. The obesity was more common in urban area 26 cases (15.2%) than rural area 13 cases (10.2%).
5. The sleeping disturbance and snoring were the most associated disease to the obese children below 5 years old.
6. The associated risk factors for obesity were dietary habit, family history and social level.
7. There is no role of waist to hip ratio to determine the obesity and it's complication below the 5 years old.

### Recommendations:

Orientation of the medical of the primary health care center, together with the pediatricians for evaluation of overweight and obesity in preschool and school age group with advice the family for introduce the healthy food. Parent should not introduce food without overall nutritional value simply to provide calories.

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