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Assessment of Obesity among Sudanese Girls Studying in the Basic School (10-15 years old) at Khartoum Locality

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Abstract— Background*: Childhood obesity has reached the epidemic levels in developed and developing countries. Overweight and obesity have significant impact on both physical and psychological health. This study was cross- sectional that had been conducted in the period from August 2016 to March 2017 at six girls' basic schools at Khartoum locality. The main objective of this study was to identify the prevalence of general and central obesity among girls studying in basic schools at Khartoum locality, by using Body Mass Index for age (BMI) and waist to height ratio.* ***Methodology****: Sample size was 384 pupils from different schools girls aged between 10_ 15 years old. Data was collected by using questionnaire and anthropometric measurements of height, weight, waist circumference and waist to height ratio.* ***Results****: The result of study showed that, the prevalence of overweight and obesity was 20.3%. Regarding Waist to height ratio, 18 % of the girls had waist to height ratio less than 4, 67% had WHtR range between(0.4 _ < 0.5),13% had WHtR range between 0.5 _ < 0.6 and 2% had WHtR 0.6 and more. Those who exceed the normal WHtR were 15%. A significant relationship was detected between sport played by the pupils with BMI (0.005) and WHtR (P=.001).* ***Conclusion****: The results concluded that among the girl basic schools the prevalence of general obesity was 20.3% and central obesity was 15% and recommended more studies should be conducted among the pupils in basic school using the anthropometric indices..*

Keywords— *WHtR, BMI, Central obesity*.

I. INTRODUCTION

Obesity is the fifth leading risk factor for deaths and is a major contributors for developing diseases such as diabetes, heart disease, and some cancers (WHO, 2014). Excess body weight poses one of the most serious public health challenges in 21st century for all over the world. Evidence is now emerging to suggest that the prevalence of overweight and obesity is increasing worldwide at an alarming rate. Both developed and developing countries are affected. Moreover, as the problem appears to be increasing rapidly in children as well in adults, the true health consequences may appear in the future. (WHO, 2010).

Worldwide, approximately one billion people over the age of 20 are overweight and that more than 300 million are obese. Additionally, it is estimated that in 2015, there will be approximately 1.5 billion overweight and 700 million obese adults. Substantial numbers of literatures have been emerged to show that overweight and obesity are major public health challenges to the developing nations causing morbidities and mortalities (WHO, 2014).

Childhood obesity is reaching epidemic proportions worldwide, it is a complex health issue, occurs when a child is weight above the normal or healthy weight for his or her age and height. (Michelle, 2013).The main causes of obesity in youth are similar to those in adults, including some factors like behavior and genetics. Behaviors include dietary patterns, physical inactivity and medication use. More contributing factors in in a society include the food and physical activity, environment, education and skills, and food production, marketing and promotion (WHO, 2014). Body Mass Index (BMI) is used as a measure to evaluate the impact of obesity on cardiovascular and metabolic risk factors, both in children and adults. However, in children, the BMI measures have to be expressed as *z* scores or percentiles relative to age and sex as BMI is strongly related to growth and maturation. (Jasmeet, *et al.*, 2010). Moreover, BMI does not always relate to central obesity and it cannot differentiate muscle mass from bone and fat mass. Waist circumference can be used as a screening tool, but is not diagnostic of the body fatness or health of an individual (CDC, 2015).Waist-to-Height Ratio (WHtR) has been proposed as an easily measurable anthropometric index for detection of central obesity and to assess associations between cardio metabolic risk factor variables and central intra-abdominal obesity. (Mercado, 2016). Ashwell shape chart is newly assessment tool discovered by Dr Margret Ashwell to solve the problems observed in these tools. (Ashwell, 2011). Ashwell Shape Chart is a valid graphical representation designed for the assessment of health and nutrition risks of obesity. It had been proved that, the chart has the potential to be used by all ethnic groups in both adults and children over5 years. It saves time and efforts and can be used as a nutritional education tool in hospitals and communities as well. Using of the Ashwell Shape Chart will help to avoid errors and bias of the other tools. (Aswell, 2014) A very important advantage of this chart is the determination of the location or distribution of body fat, which can help in prevention of chronic diseases such as cardiovascular diseases and diabetes mellitus (Kamal and Osman, 2016).WHtR may allow the same boundary value for children and adults. There is now growing evidence that WHtR can be used to predict risk in children (Franzosi, 2006). Since the height and WC of children normally increases continually as they age, the same boundary value (WHtR=0.5) could be used to indicate increased risk across all age groups, (Ashwell, 2011).

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Problem statement:

The prevalence of childhood obesity has been increasing at unsettling rates across the world (Cali, 2008). In addition to striking the developed world, this pattern has also been noted in developing countries undergoing rapid epidemiological transitions, including those in East Africa (Belue, *et al.,* 2009). A study of schoolchildren in Beijing, China, reported that approximately 20% of children were overweight or obese (Mi, *et al*., 2004), In Karachi, Pakistan, an almost identical prevalence of 25% of children had a high BMI, with 6% of children overweight and 19% obese (Aziz, *et al*., 2009). In Iran, 8.8% were overweight, and 4.5% were obese (Kelishadi, *et al*., 2008). Study in Sudan, revealed that the prevalence of overweight and obesity among 270 Sudanese schoolchildren aged 15-18 years in Khartoum State, were found to be 28.5%% and 5.6%, respectively along 'with the 19.6% prevalence of under nutrition. Rate of overweight was very high among females (64%) compared to males. (Salih & Abdel Aziz, 2007), also study in Sudan found that of 304 children, 45 (14.8%) were overweight and 32 *(*10.5%) were obese. (Salman, *et al.,* 2011).

Justification of the Study

Obesity is increasing and become the main cause of many diseases such as hypertension, diabetes mellitus, hyperlipidemia, joint pain, cancer, cardiovascular diseases and it also can lead to death. There are many assessment tools of measuring obesity, such as BMI but these tools have many limitations, errors and biases (Kamal & Osman, 2016). Although there are some studies regarding the relationship between BMI and WHtR with cardiovascular (CV) disease in children and adolescents, yet information is scant on the utility of WHtR in assessing the status of abdominal obesity and related cardio metabolic risk profile among normal weight and overweight/obese children (Jasmeet, *et al.,* 2010). Few studies on obesity were found among Sudanese primary schools children, and might use the routinely anthropometric measures to assess obesity like BMI but no published data was found using Ashwell chart to determin central obesity among the children in basic schools, this drew attention of the researcher to investigate about the prevalence of obesity using Ashwell Chart for measuring waist to height ration among children in Sudanese primary schools.

The objective of the study:

To identify the prevalence of general and central obesity among girls in the basic schools by using Body Mass Index (BMI) and waist to height ratio in Khartoum locality.

II. METHODOLOGY

This study was a cross-sectional study; aimed to identify the prevalence of obesity and overweight among different six girls' basic governmental schools in Khartoum locality.

Sample size:

The sample size was determined by using the following formula:

$$n = \frac{z^2 pq}{d^2}$$

Where:

n: sample size

z: Standard normal variable corresponding to level of significances of 95%(1.96).

p: the prevalence rate of overweight and obesity in the schools (14.4)

q= 1-p

d: Marginal error equal to 0.05

$$n= \frac{(1.96)^2(14.4)(1-14.4)}{(0.05)^2} = 384 \text{ pupils}$$

Sample selection:

Six basic governmental girls' schools children were chosen randomly from Al Sajana and Al diuom Al shargia. From each school the 4th, 5th, 6th, 7th and 8th classes were selected. These classes were selected because they included the selected age (10 to 15 years old). A stratified multi stages sample technique was used to distribute the sample among the girls in the school class levels. The girls were selected from each class by systematic random sample. The sampling frame was design (pupils' lists) for each class. The interval was calculated as below. The first student in class was selected randomly then the second student was selected by adding the interval and so forth till the total sample was selected:

$$\text{Interval} = \frac{\text{Total of students in class}}{\text{Sample size}}$$

III. RESULTS

Table (1) Anthropometric data for the girls studying at basic schools

BMI/kg/cm^2	No.	(%)
12 to 15	96	25.0
16 to 19	169	44.0
20 to 23	67	17.4
24 to 27	31	8.1
28 to 31	14	3.6
32 to35	4	1.0
36 to 39	3	.8
Total	384	100.0
BMI percentile (CDC,2015)	No.	(%)
< 5th percentile	61	15.9
5th percentile _ < 85th percentile	245	63.8
85th percentile _ < 95th percentile	41	10.7
≥ 95 th percentile	37	9.6
Total	384	100.0
Waist circumference/cm	No.	(%)
53 to 63	174	45.3
64 to 74	149	38.8
75 to 85	42	10.9
86 to 96	15	3.9
97 to 107	3	.8
108 to 118	1	.3
Total	384	100.0
Ashwell shape chart	No.	(%)
< 0.4 "Brown/chili region " Take care area	70	18
0.4 _ < 0.5 "Green/pear region" Ok area	257	67
0.5 _ <0.6 "Yellow/pear apple/ region" take action for children	50	13
≥ 0.6 "Red/apple region" take action	7	2
Total	384	100.0

Table (1) shows that age of the pupils were range between 10 to 15 years old, regarding anthropometric measures (15.9%) of pupils were underweight (< 5th percentile), (63.8%) had healthy normal weight (5th – < 85th percentile), (10.7%) of

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the pupils were overweight (85th - <95th percentile), and (9.6%) were obese ≥ 95th percentile. Waist cm among the pupils was found as follows:45.5%% of the pupils had waist circumference between 53-63cm, while 3% had waist circumference between108-118cm. Waist to height ratio result demonstrates ,18 % of the pupils had waist to height ratio less than 4, 67% had WHtR 0.4 _ < 0.5 ، 13% had WHtR 0.5 _ >0.6 and 2% had WHtR ≥0.6.

Table (2) Relationship between WHtR and obesity in the girls' family history of obesity

Variables	< 0.4		0.4 - < 0.5		0.5 - < 0.6		≥ 0.6		Total	
	NO	%	NO	%	NO	%	NO	%	NO	%
Parents	20	17.7	65	57.5	25	22.1	3	2.7	113	100
Brother	1	4.5	13	59.1	6	27.3	2	9.1	22	100
Sister	0	.0	19	95.0	0	.0	1	5.0	20	100
Never	49	21.4	160	69.9	19	8.3	1	.4	229	100
Total	70	18.2	257	66.9	50	13.0	7	1.8	384	100

Significant relationship was found between girls' WHtR and family history of obesity P= (.000).

Table (3) Relationship between BMI and the girls' family history of obesity

Variable	< 5th percentile		5th percentile - < 85th percentile		85th percentile-< 95th percentile		≥95th percentile		Total	
	NO	%	NO	%	NO	%	NO	%	NO	%
Parents	17	15.0	56	49.6	19	16.8	21	18.6	113	100.0
Brother	1	4.5	11	50.0	3	13.6	7	31.8	22	100.0
Sister	1	5.0	15	75.0	2	10.0	2	10.0	20	100.0
Never	42	18.3	163	71.2	17	7.4	7	3.1	229	100.0
Total	61	15.9	245	63.8	41	10.7	37	9.6	384	100.0

(P = .000)
Significant relationship between BMI and the girls' family history of obesity (P=0.000).

Table (4) relationship between girls' BMI percentile and the diseases

Variable	< 5th percentile		5th percentile - < 85th percentile		85th percentile - < 95th percentile		≥95th percentile		Total	
	No	%	NO	%	NO	%	NO	%	NO	%
Osteoarthritis	0	.0	1	100.0	0	.0	0	.0	1	100.0
Sleep Apnea	0	.0	3	50.0	2	33.3	1	16.7	6	100.0
Diabetes mellitus	0	.0	5	100.0	0	.0	0	.0	5	100.0
No one	61	16.4	236	63.4	39	10.5	36	9.7	372	100.0
Total	61	15.9	245	63.8	41	10.7	37	9.6	384	100.0

(P= .320)
No significant relationship was detected between girls' BMI percentile and the diseases (P=0.320).

Table (5) relationship between girls' WHtR and the some types of diseases associated with obesity

Variable	< 0.4		0.4 - < 0.5		0.5 - < 0.6		≥ 0.6		Total	
	NO	%	NO	%	NO	%	NO	%	NO	%
Osteoarthritis	0	0	1	100.0	0	.0	0	.0	1	100.0
Sleep Apnea	1	16.7	3	50.0	2	33.3	0	.0	6	100.0
Diabetes mellitus	1	20.0	4	80.0	0	.0	0.	0	5	100.0
No one	68	18.3	249	66.9	48	12.9	7	1.9	372	100.0
Total	70	18	257	67	50	13.0	7	2	384	100.0

(P=.774)
No significant relationship between girls' WHtR and some types of the diseases associated with obesity (P=0.774).

Table (6) relationship between girls' WHtR and playing sport

Variable	< 0.4		0.4 - < 0.5		0.5 - < 0.6		≥ 0.6		Total	
	NO	%	NO	%	NO	%	NO	%	NO	%
No	14	10.9	86	67.2	25	19.5	3	2.3	128	100.0
Yes	56	21.9	171	66.8	25	9.8	4	1.6	256	100.0
	70	18	257	67	50	13.0	7	2	384	100.0

(P=.001)
Significant relationship was detected between girls' WHtR and playing sport

Table (7) relationship between playing sport by the girls and BMI percentile for children

Variable	< 5th percentile		5th percentile - < 85th percentile		85th percentile - < 95th percentile		≥ 95th percentile		Total	
	No	%	No	%	No	%	No	%	No	%
No	10	7.8	87	67.4	15	11.6	17	13.2	129	100.0
Yes	51	20.0	158	62.0	26	10.2	20	7.8	255	100.0
Total	61	15.9	245	63.8	41	10.7	37	9.6	384	100.0

(P = .005)
Significant relationship was found between playing sport by the girls and BMI percentile for children) (P=.005).

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Table (8) relationship between periods of playing sport and BMI percentile for children

Variable	< 5th percentile		5th percentile _ < 85th percentile		85th percentile _ < 95th percentile		≥ 95th percentile		Total	
	No	%	No	%	No	%	No	%	No	%
30 minutes	18	25.7	41	58.6	9	12.9	2	2.9	70	100.0
One hour	14	23.7	36	61.0	5	8.5	4	6.8	59	100.0
More than one hour	19	15.0	82	64.6	12	9.4	14	11.0	127	100.0
Total	51	19.9	159	62.1	26	10.2	20	7.8	256	100.0

(P = .033)

Significant relationship was found between periods of playing sport and BMI percentile for children (P=0.33).

Table (9) relationship between BMI percentile and WHtR

Variable	< 0.4		0.4 _ < 0.5		0.5 _ < 0.6		≥ 0.6		Total	
	No	%	No	%	No	%	No	%	No	%
< 5th percentile	32	52.5	29	47.5	0	.0	0	.0	61	100.0
5th percentile - <85th percentile	37	15.1	202	82.4	6	2.4	0	.0	245	100.0
85th percentile -< 95th percentile	1	2.4	22	53.7	18	43.9	0	0	41	100.0
≥95th percentile	0	.0	4	10.8	26	70.3	7	18.9	37	100.0
Total	70	18.2	257	66.9	50	13.0	7	1.8	384	100.0

(P = .000)

Significant relationship was detected between BMI percentile and WHtR (P=.000).

IV. Discussion

The present study was designed to identify the prevalence of obesity among girls studying in the basic schools at Khartoum locality, their age range between 10 to 15 years old. Anthropometric indices was measured by using Body mass index and Ashwell shape chart for measuring waist to height ratio, Some interesting findings were detected in this study.

Several measurements were calculated such as weight, height, waist circumference and WHtR. Almost two third of the girls were at normal health weight ,the prevalence of weight and obesity were detected among 20.3% of the total number of the girls, which was similar to the result reported by (Kahn, *et al.*, 2005). As previously stated, Body mass index (BMI) is a relatively simple index and the most used one to classify adults according to their amount of body fat, nevertheless, it is not easily applied to children, does not tell us the location of the body where fat is accumulated and may not be distinguishing the weight of muscles or edema in certain individuals or ethnic group differences (Kahn, *et al.*, 2005). High central fat distribution was detected among 15% of the pupils(from yellow to red area), According to Ashwell and Gibson, (2014), those children who fell at the brown area should take care and be aware of that they underweight, those fell at green area were at healthy normal weight, with this kind of body shape, extra fat is stored round the butt, hips and thighs, which is healthier than having an apple shape, pupils who fell at yellow area which is called (pear-apple shape) ,bordering on apple body shape, so should be advice to lose little weight and not to put on any more weight. The Chart still has boundary values set at WHtR 0.4 (brown to green), 0.5 (green to yellow) and 0.6 (yellow to red). However, the words used to describe action steps for WHtR greater than 0.5 and less than 0.6 have now been modified to show that this value should indicate 'Take Care' or 'Consider Action' for adults, whereas for children it indicates 'Take Action'. The implicated difference in health risk was based on the proportion of UK children and adults who fall above the boundary values of 0.5 and 0.6. Although there is now good global evidence for using WHtR 0.5 as the first boundary value for risk, the boundary values, 0.4 and 0.6 were set on pragmatic reasoning and it is essential to have data from many other population groups to corroborate these decisions (Browning, *et al.*, 2010) .Further research is needed to confirm the suitability of these boundary values for children in Sudan A significant relationship was detected between pupils BMI percentile and (WHtR), P = (0.000). It was observed that 43.9% of the pupils who had high BMI for age (85th percentile - < 95th percentile) had high WHtR(0.5-<0.6) and 89.2% of them with BMI of (≥ 95th percentile) had also high WHtR (0.5-≥ 6). Many girls at this age tend to accumulate more fat mass in their body than males. Overweight and obesity among girls increased throughout childhood and adolescence. The years following puberty appear to be a high risk period for the development of obesity in girls (Lundeen, e*t al.*, 2015).

A significant relationship was detected between sport played by the pupils and their WHtR (P=.001). It was observed that 21.8% of children who did not play sports fell between the range 0.5 and ≥ 0.6 at the Ashwell shape chart, this emphases the relationship of physical inactivity with central obesity. Study in Swedish children revealed that Low levels of total physical activity may play an important role in the development of overweight and excess of central adiposity in children and adolescents, independently of a number of factors such as television viewing and birth weight. (Ortega, *et al.*, 2007). In general practicing physical activity contributes in reducing central obesity to be in the normal range.

V. Conclusion and Recommendation

The results concluded that among the girl studying in the basic schools, the prevalence of general obesity was 20.3% and central obesity was 15% study recommended that health professionals should incorporate the use of simple indices {weight, height, and waist circumference} into routine clinical examination or screening among the Sudanese pupils male and female and Ashwell chart should be used by health professional in measuring central obesity.

REFERENCES

[1] Ashwell, M. (2011). Chart based on body mass index and waist to height ratio to assess the health risk of obesity :A review. The open obesity journal, 3:78-84,PP78-79.Availbe at www.Ashwell.uk.com/drmargraretashwel.htm.

[2] Ashwell ,M. and Gibson ,S. (2014).A proposal for a primary screening tool ;keep your waist circumference to less than half your height . obesity; exploring the causes ,consequences and solution journal,12:207,pp.3.licy 2006; 27: 250-64.

[3] Aziz S, Noorulain W, Zaidi UER, Hossain K, Siddiqui IA. Prevalence of overweight and obesity among children and adolescents of affluent schools in Karachi. *Journal of the Pakistan Medical Association*. 2009;59(1):35–38. [PubMed] [Google Scholar]

[4] Browning LM, Hsieh SD, Ashwell M. A systematic review of waist-to-height ratio as a screening tool for the prediction of cardiovascular disease and diabetes: 0.5 could be a suitable global boundary value. Nutr Res Rev 2010; 23: 247-69

[5] Belue R, Okoror TA, Iwelunmor J, et al. An overview of cardiovascular risk factor burden in sub-Saharan African countries: a socio-cultural perspective. *Global Health*. 2009;5:p. 10. [PMC free article] [PubMed][Google Scholar]

[6] Cali AMG, Caprio S. Obesity in children and adolescents. *Journal of Clinical Endocrinology and Metabolism* .2008 ;93 (11) :s31–s36. [PMC free article] [PubMed] [Google Scholar]

[7] CDC (2015). Consequences of obesity, Centers for Disease Control and Prevention. Available from http: // www .cdc. gov/ obesity /childhood / causes.html [Accessed on 10 Aug 2016]

[8] Franzosi MG. Should we continue to use BMI as a cardiovascular risk factor? Lancet 2006; 368: 624–625.

[9] Jasmeet, S., Srinivasan, R., DasMahapatra, P., Fernandez, C., Chen, W., Xu, J. and Berenson, G. (2010). Utility of waist-to- height ratio in assessing the status of central obesity and related cardio-metabolic risk profile among normal weight and overweight/obese children: The Bogalusa Heart Study.DOI: 10.1186/1471-2431-10-73

[10] Kahn HS, Imperator G, Cheng YJ. A population-based comparison of BMI percentiles and waist-to height ratio for identifying cardiovascular risk in youth. J Pedatr 2005;146:482-488.

[11] Kamal, N. and Osman, F. (2016).Assessment of Health and Nutritional Risks of Obesity using Different Anthropometric Measurements (Body Mass Index and Ashwell Shape Chart). Dissertation B.sc. Ahfad university for woman, Khartoum, Sudan.

[12] Lundeen E. A. Norris S. A. Adair, L. S. Richter, L. M and Stein A. D. (2015) Sex differences in obesity incidence: 20-year prospective cohort in South Africa Pediatric Obesity published by John Wiley & Sons Ltd on behalf of World Obesity. Pediatric Obesity 11, 75–80.

[13] Mercado I, (2016), healthy hostos, Waist circumference. Available at http://commons.hostos.cuny.edu/healthyhostos/healthy-weight-2/waist-circumference/ [Accessed on Mar 12,2017].

[14] Michelle, O (2013) .Health Problems and Childhood Obesity, Available from http://www.letsmove.gov/health-problems-and-childhood-obesity [Accessed on Aug 20, 2016].

[15] Mi J, Cheng H, Hou DQ, Duan JL, Teng HH, Wang YF. Prevalence of overweight and obesity among children and adolescents in Beijing in 2004. *Zhonghua Liu Xing Bing Xue Za Zhi*. 2006;27(6):469–474. [PubMed] [Google Scholar]

[16] Ortega ,Francisco B , Jonatan R Ruiz, and Michael Sjöström,(2007) .Physical activity, overweight and central adiposity in Swedish children and adolescents: the European Youth Heart 2007 Nov Int J Behav Nutr Phys Act. 2007; 4: 61. 19;4:61. doi: 10.1186/1479-5868-4-61.

[17] Salih OA, AbdelAziz E. Underweight, overweight and obesity among Sudanese secondary school children of Khartoum State. *Ahfad Journal*. 2007:38–46Ahfad Journal ; Jun2007, Vol. 24 Issue 1, p59

[18] Salman, Zeena Gregory D. Kirk, Mark D. DeBoerHigh Rate of Obesity-Associated Hypertension among Primary Schoolchildren in SudanInt J Hypertens. 2011; 2011: 629492. Published online 2010 Dec 22. doi: 10.4061/2011/629492PMCID: PMC3014717

[19] WHO (2010). Obesity and Overweight. Obesity Report. 10 Facts on Obesity. World Health Organization. Technical Report Series, 207.Available from http://www.who.int /features/factfiles/obesity/facts/es/ index 1.html. [Accessed on 23 Sep 2016].

[20] WHO (2014). Overweight and obesity, Obesity and overweight Obesity: preventing and managing the global epidemic. Report of a WHO Consultation. WHO Technical Report Series. Geneva.