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EVALUATION OF HOMA-IR(HOMEOSTATIC MODEL ASSESSMENT INSULIN RESISTENCE) AND ITS CORRELATION WITH ANTHROPOMETRY IN THE OBESE OR OVERWEIGHT CHILDREN AND ADOLESCENT

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ABSTRACT

Objective-evaluation of HOMA-IR(homeostatic model assessment insulin resistence) and its correlation with anthropometry in the obese or overweight children and adolescent. Methodology: Study was approved by the ethical committee and subjects were enrolled after written consent of parents/subjects. Various Anthropometric measurements were taken.

1. Weight: weight was recorded using the electronic weighing machine to nearest 1000 gram. Subjects were made to stand barefoot without touching anything else.

2. Height: it was measured to the nearest 1 cm using stadiometer. Subjects were made to stand barefoot on the foot board heel, buttocks, shoulders and occipit touching against the vertical plank, looking straight ahead with the head held in a way that it lies in the Frankfurt plane (i.e. lower border of orbital fossa on the same horizontal plane as the upper border of external auditory meatus in parallel to the ground). Height was measured to the nearest 1 cm using the scale mounted on vertical plank.

3.Body mass index (BMI): following formula was used to compute the BMI-

BMI (kg/m^2) = weight (kg)/height $(m)^2$

Each BMI value was converted into corresponding BMI percentile (age & sex specific). Than subjects were classified into 3 categories as follow

i. <85th centile – normal
ii. 85 – 95th centile – overweight
iii. >95th centile -obese[1]

Beyond 18 years

i. 18.5 – 22.9 kg/m2 – normal
ii. 23.0 – 26.9 - overweight
iii. > 27 - obese[2]

4.Waist circumference: measured using a non stretchable tape at the mid-point of the lowest rib-cage and the iliac crest to the nearest 1 cm in the standing position during end tidal expiration. It was measured twice and if the difference between the two readings was 0.4 cm a 3rd reading was taken and mean was calculated using the two closet values. Waist circumference percentiles were generated using age and sex specific Kuriyan chart of waist measurements for Indian children and based these percentiles subjects were categorized into three groups

1. <75th centile – normal
2. 75 – 90th centile – overweight
3. >90th centile – obese[3]

Beyond 16 years, based on sex following values were taken as cut off[4]

Girls <80cm – normal
>80 cm – obese
Boys <90 cm – normal
>90 cm – obese.

5. Hip circumference: recorded to the nearest 0.1 cm at the level of greater trochanter in the standing position. It was measured twice and if the agreement between 2 repeats was >0.4 cm, than a 3rd measurement was taken and the mean was calculated using the 2 closet values.

6. Waist/Hip ratio: it signifies the ratio of the truncal and extremity fat distribution. In male >0.9 and in female >0.8 were taken off as cut off.[5]

7. Neck circumference: measured in the standing position, head held erect at the level of thyroid cartilage. In the absence of data on the cut off values for neck circumference in Indian children we adopted the corresponding values from the US counterpart[6]

Result-total 30 subjects participated in the study. 17(57%) were male and 13(43%) were female. 6(20%) subjects were in 6-<10 year age group, 15(50%) were in 10-<15 year, and 09(30%) were in 15-19 year age group. Total 25 subjects had abnormal neck circumference. Out of 17% had normal neck circumference and 83% had higher neck circumference. it was found tha no significant correlation between neck circumference and insulin resistance (p value = 0.24) **Conclusion:** Insulin resistence is significantly associated with marker of adiposity like neck circumference.it association was significant.nc on application chi square trends the association between the bmi and homa-ir was found to be not significant.Our study show that the insulin resistence of adult disease erupt in childhood itself and therefore control of weight should be aim from early childhood so as to prevent complication of obesity in future.

INTRODUCTION

Diabetes is most common ebdocrinological disorder charactrised by chronic hyperglycemia due to an absolute or relative deficeiency of insulin.[7] around the globe news on diabetes 366 million people have diabetes in 2011 by 2030 this will have risenb to 552 million.it is fourth leading cause of death in globlly.atleast 50%of all people with diabetes are unaware of their codition in some countries this figure may reach 80%.in indian scenario and 61.3 million 2011 and this will have risen 101.2million 2030.[8] indian develop diabetes at an earlier age with lower level of obesity.untill recently predominant form of diabetes in children type 1 however during past 2 decades an increased frequency of type 2 dm.has been reported in children especially in adolescent.this increased the frequency of type 2dm seems to parellal with increased in the prevalence and severty of obesity in children and adiolsaent.type 2 dm hand in hand with childhood obesity represent an emereging health problem of 21st century(9)insulin resistence is key factor leading to type 2 dm.insulin resistence usually denotes resistence to the effect of insulin on glucose uptake, metabolism and storage. insulin resistence is associated with obesity,type 2 dm cardiovascular disease and cardiometabolic risk marker such as duslipedimia hypertension and central obesity.

Need for the study- risk factor of type 2 dm 2 types-1-modifiable,and type 2 non modifiable. this study aim to evaluating insulin resistence and establish a correlation with certain modifiable factor and anthropometry.as s sequel to this study ,the aim is to target these modifiable factor on their established correlelation. and thereby decreased risk of type 2 dm in this high risk group.

AIMS AND OBJECTIVE

To evaluate insulin resistence by homa-ir in these obese, overweight children and adolescent, association of insulin resistence with bmi neck circumference and waist hip ratio. *Materials and methods*

Study design: cross sectional observational study
Study period: 1st sept.2012 to 31st august 2013.

Study setting: Endocrinological clinic, Department of pediatrics, NSCB Medical College Jabalpur Madhya Pradesh

Sample size: 30 overweight and obese children and adolescents.

INCLUSION CRITERIA

1. Obese children BMI ≥85% for the particular age and sex
2. Age 06-19 years
3. Free of any systemic or metabolic disorder and free of medications

Exclusion criteria

1. Subjects who refused to give consent
2. Subjects with any metabolic and systemic disorder or any medication known to affect energy metabolism or body weight.

METHODOLOGY

Study was approved by the ethical committee and subjects were enrolled after written consent of parents/subjects. Various Anthropometric measurements were taken.

1. *Weight*

Weight was recorded using the electronic weighing machine to nearest 10 gram. Subjects were made to stand barefoot without touching anything else.

2. *Height*

It was measured to the nearest 1 cm using stadiometer. Subjects were made to stand barefoot on the foot board heel, buttocks, shoulders and occipit touching against the vertical plank, looking straight ahead with the head held in a way that it lies in the Frankfurt plane (i.e. lower border of orbital fossa on the same horizontal plane as the upper border of external auditory meatus in parallel to the ground). Height was measured to the nearest 1 cm using the scale mounted on vertical plank.

3. Body mass index (BMI)

following formula was used to compute the BMI-

$$BMI\ (kg/m^2) = \text{weight (kg)}/\text{height (m)}^2$$

Each BMI value was converted into corresponding BMI percentile (age & sex specific). Than subjects were classified into 3 categories as follow

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1. Waist circumference: measured using a non stretchable tape at the mid-point of the lowest rib-cage and the iliac crest to the nearest 1 cm in the standing position during end tidal expiration. It was measured twice and if the difference between the two readings was 0.4 cm a 3rd reading was taken and mean was calculated using the two closet values. Waist circumference percentiles were generated using age and sex specific Kuriyan chart of waist measurements for Indian children and based these percentiles subjects were categorized into three groups
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7. Neck circumference: measured in the standing position, head held erect at the level of thyroid cartilage. In the absence of data on the cut off values for neck circumference in Indian children we adopted the corresponding values from the US counterpart.

SMR

Tanner's staging was done in all the subjects. Fasting blood sample were obtained after a minimum fasting of 8 hours and were transported to the laboratory on ice (4-8˚C) for estimating plasma glucose by glucose oxidase peroxidase method. Fasting serum insulin was estimated by "enhanced pulse" – chemiluminesecence system (Monobind– USA).

HOMA-IR (Homeostatic Model assessment of insulin Resistance) was estimated as
HOMA-IR = Fasting glucose (mmol/L) x Fasting insulin(µU/ml)/22.5
HOMA-IR centiles based on sex and pubertal staging were generated based on insulin resistance indexed in healthy children. (10) HOMA-IR >90th centile.

Observation

Total 30 subjects participated in the study. 17(57%) were male and 13(43%) were female. 6(20%) subjects were in 6-<10 year age group, 15(50%) were in 10-<15 year, and 09(30%) were in 15-19 year age group. Clinical, Anthropometric & Biochemical characteristics of the subjects are shown in table 1.

Table: 1 Clinical, anthropometric, and Biochemical characteristics of the subjects

Parameters	Mean ± SD (Range)
Age	12.7 ± 3.3 (7-19)
BMI kg/m2	27.7 ± 4.2 (20-35.9)
Waist circumference (cm)	92.3 ± 12.7 (67-116)
Waist/Hip ratio	0.93 ± 0.09 (0.77-1.17)
Neck circumference (cm)	34.1 ± 2.8 (28-40)
Fasting sugar	87.1 ± 7.6 (73.1-107)
Fasting insulin	17.4 ± 13.5 (1.6-61)
HOMA-IR	6.7 ±3.07 (0.4-14.5)

HOMA-IR was correlated with neck circumference. Total 25 subjects had abnormal neck circumference. Out of these 13 had normal HOMA-IR while 12 had insulin resistance (HOMA-IR>90%).on statistical analysis it was found that abnormal neck circumference was statisticaaly not significantly associated with insulin resistance (p value = 0.24) as shown in table 2.

TABLE=2

	HOMA-IR <90th percentile	HOMA-IR >90th percentile
NC normal(n=5)	4 (80%)	1 (20%)
NC > normal(n=25)	13(52%)	12 (48%)
Total	17(57%)	13(43%)

X^2 = 1.33, p value = 0.24

HOMA-IR was correlated with waist-hip ratio. Total 23 subjects had abnormal abnormal waist hip ratio. Out of these 13 had normal HOMA-IR while 10 had insulin resistance (HOMA-IR>90%).on statistical analysis it was found that abnormal waist hip ratio was statisticaaly not significantly associated with insulin resistance (p value = 0.97)as shown in table 3.

TABLE=3

	HOMA-IR< 90th percentile	HOMA-IR >90th percentile
W/H <0.9 OR <0.8	4 (57%)	3(43%)
W/H >0.9 OR >0.8	13(56%)	10(44%)
Total	17(56%)	13(44%)

Pvalue=0.97

HOMA-IR>90TH Percentile vs BMI percentile respectively males and females p value 0.06and 0.83this difference was found to be statistically insignificant=TABLE=4 and 5

HOMA-IR (>90th percentile)vs BMI percentile females.

TABLE=4

	HOMA-IR (<90TH percentile)	HOMA-IR (>90TH percentile)
Bmi%tile	86.4 89.8 93.4 96.5 97.4 98.4 99.5	97.1 97.5 98.1 98.2 98.5 98.6 98.9 99.4 99.4 99.5
Mean	94.4±4.85	98.5±0.81

P value=0.06

HOMA-IR (>90th percentile)vs BMI percentile males.

TABLE: 5

	HOMA-IR (<90th TH percentile)	HOMA-IR (>90th percentile)
Bmi%tile	91.3 91.8 91.8 93.6 94.2 95.2 95.9 97.8 98.0 99.8	92.6 95.8 97.6
Mean	94.92. ±9	95.4±2. 5

P value=0.83.

DISCUSSION

G shrinivasa rao at al[11] found prevelance of the insulin resistence obesity dyslipedimia among children and adolescent is increasing rapidly in india and it is well established that obesity is risk factor for metabolic syndrome type 2 diabetes and can adult and children.[12,13,14] the goal of study to evaluated tha IR in children and its relation with several anthropometric indices.in current study we found that IR is high in both obese and overweight children and stastically significant association could be be demonstrated with one of the anthropometric marker neck circumference but in our study statistically significant association ir could not be established with other anthropometric parameter BMI and WHR IR and BMI in our study mean value with HOMA-IR value less than 90th percentile and value more than 90th percentile in both males and females gender was found to be statistically insignificant. murdock at al[15] found the high prevelance of IR among overweight and obese children as seen in current study. Also found another study significantly elevated BMI, WHR in both obese and overweight children and adolescents than controls and our observations strongly suggest the association between adiposity and insulin resistance[16,17] adequate proxy measure for monitoring the underlying increases in health risk due to excess weight at

population level. it is attractive and cheap and non invasive means of assessing excess body fat. allthough BMI not gold standard measure of overweight or obesity (national obesity observatory june 2009). It advantage in term of ease of measurment, established cut offs and exsisting published statistics make it only currently variable option for high level of summary figure of population level. BMI not provided any indication of the distribution of body fat. low sensitivity for screening of obese individual. children and adolescent grow both in weight and height and gain lean body mass and adipose tissue throught out childhood and adolescent and there are large between population inter and intra individual variation.[18] Waist circumference the measurement of waist circumference is an attempt to capture information regarding the distribution of body fat. visceral adipose tissue that has been linked to increased health risk and metabolic disorder in children and adults.in adult measurement of WC as an indicators of intra abdominal fat mass more directly correlate with CVD risk than overall obesity determined by BMI.[19] but health risk associated with an exxesive abdominal fat distribution in chidren is unclear. wc is highly sensitive and specific measure of upper body fat and has been shown to correlate with insulin resistence in adults. measurement of WC in children good correlation in IR-syndrome shown that various studies.[20] but adiposity for children will change will age so it is not possible to use of fixed set of threshold as used in adults. in current study we have used these charts as reference with cutoff 75th percentile for overweight and 90th for obesity. waist circumference help to identifying the obese children who are at high risk for developing insulin resistence syndrome. WAIST TO HIP RATIO--in current study no association was found between insulin resistence and this ratio. Several study dr kusum and kalker et al study also found no correlation between insulin resistence and W/H ratio. The use of ratio such as WHR to asses obesity may not be appropriate because the are highly age dependent and may obscure stronger relation that may be present with separate circumference measurements. kalker at al[21] study but not found correlation between percentage overweight and. thus WHR is not a good marker of adiposity and cardiovascular health in children.NC and IR-in current study ,neck circumference is found to be closely associated with insulin resistence(more close in females, p value 0.096 as compared to males. p value 0.118) but statistically significant association could not be established in individual sexs. however statistically significant value is established when neck circumference of both the sexes simultaneously was taken into account. while not significant association was found when homa-ir 90th percentile was taken as cut off earlier. framington sarah at al upper body sc fat as estimated by neck circumference may confirm risk above and beyond the visceral abdominal fat. anatomically upper body s/c fat is unique fat depot located in a separate compartment compared with VAT. this fat depot may play important role in risk factor for free fatty acid concentration. and elevated free fatty acid concentration associated with IR.(22)some studied indicated that neck cecumference may be independent correlate of metabolic risk factor above and beyond BMI and WC in adults. very few peadiatrician investigators have explored the potential value of NC as an index of high BMI. and its association with metabolic profile-eleveted IR (23,24,25)thus NC could be useful screening instrument for identifying overweight or obese children, who are at high risk of having insulin resistence.

CONCLUSION

Insulin resistence is significantly associated with marker of adiposity like neck circumference.it association was significant.nc on application chi square trends the association between the BMI and HOMA-IR was found to be not significant. Our study show that the insulin resistence of adult disease erupt in childhood itself and therefore control of weight should be aim from early childhood so as to prevent complication of obesity in future.

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