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Original Research Article

Correlation of Serum Insulin and HOMA-IR with Anthropometric Parameters and Blood Pressure in Obese Children

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Abstract:

Background: Obesity is considered unaesthetic and a social stigma, with severe health outcomes. Overweight / obese children are three times more prone to have hypertension because it causes increase in arterial stiffness which opens on to atherosclerotic vascular changes in young adulthood. Presence of childhood obesity, Insulin Resistance (IR) and its consequences may be amplified by puberty because of physiological decrease in insulin.

Methodology: One hundred and fifty subjects were examined for anthropometric parameters, blood pressure and biochemical parameters. Estimation of serum insulin was done by Enzyme-Linked Immunoassay method and Homeostatic Model Assessment (HOMA-IR) was calculated as:

[HOMA-IR = fasting serum insulin (μ U/ml) × fasting plasma glucose (mmol/l)/22.5].

Results: Mean serum insulin and HOMA-IR were significantly higher among obese children i.e., 14.96±3.86 and 2.93±0.99 respectively as compared to that among healthy adolescents i.e., 6.97±1.38 and 1.27±0.28 respectively.

Conclusion: The present study concludes that the obese children are at a higher risk of developing metabolic abnormalities because of increased level of insulin and insulin resistance.

Keywords: Childhood Obesity, Insulin Resistance, BMI, Blood Pressure, Hypertension.

Introduction

Obesity is defined as "a multifactor syndrome consisting of physiological, biochemical, metabolic, anatomical, psychological, and social alteration" [1]. It is also considered as a "collective adaptation to the pathological environmental pressure to eat too much and exercise too little". For many people, obesity is considered unesthetic and a social stigma, with severe health outcomes [2].

Degree of obesity and accumulation of visceral fat is strongly associated with both childhood metabolic syndrome (MetS) and CVD later in life. Obesity is mainly assessed by body mass index (BMI). There are some measures such as WC, WHtR and magnetic resonance imaging, using for estimation of visceral adiposity[3].

Intrauterine events and factors during early development associated with obesity, prediabetes, and MetS. Other factors can be genetic, socio-economic or environmental called as an "obesogenic environment"[4]. At the same time, other factors such as urbanization, high caloric diet and lack of physical activity are key contributors to the occurrence of childhood obesity, particularly in developing countries[5].

In 2016 according to WHO: Global Info Base data and analysis of overweight and obesity, more than 1.9 billion adults (39% male and 40% of female) aged 18 years and older are overweight. Of these over 650 million (13%) adults (11% of male and 15% of female) were obese. Over 340 million children and adolescents aged 5-19 years were overweight (19% male; 18% female) and obese (8% male; 6%female)[6].

Insulin, a pancreatic polypeptide hormone is a main lever of glucose homeostasis. Despite the fact that insulin have various actions, it's action on glucose homeostasis commonly allude to term IR which is defined as below normal biological feedback after given a certain amount of insulin which leads to compensatory hyperinsulinemia to maintain normal glucose concentration[7].

The earliest sign of disturbed glucose homeostasis is, an individual having normal fasting blood glucose in spite of hyperinsulinemia. The homeostatic model assessment for insulin resistance (HOMA-IR) is a representative of IR in which both fasting blood glucose and insulin are involved in the model. Central adiposity causes high free fatty acid level in blood released by adipose tissue, which showed a powerful association with IR and both obesity and IR are considered as a main component of MetS[8].

Childhood obesity have severe potential of adverse physical consequences such as dyslipidemia (an atherogenic lipid profile), hypertension, hyperinsulinemia and impaired glucose tolerance contributing in development of MetS. Thus, bearing in mind for future risk of metabolic abnormalities, the beginning of risk factor gathering is alarming sign. In the light of above stated the present study aims at finding the association of serum insulin and HOMA-IR with anthropometric parameters and blood pressure in obese children.

Methodology

The present study was conducted in the Department of Biochemistry, Dr S. N. Medical College and its associated group of hospitals, Jodhpur (Rajasthan). The subjects selected for the study were grouped as follows: - Group 1- Healthy children (n=75), Group 2- Obese children (n=75) Healthy and obese children aged between 5-9 years of either sex were included in the study.

Subjects with history of infection and chronic disease, type II diabetes mellitus, familial hyperlipidaemia, hypertension, genetic disorders, growth hormone deficiency, hypothyroidism were excluded from the study. An informed consent was taken from their parents or their guardian who participated in the study for physical examination and biochemical procedures after apprising them the nature and objective of the study.

Physical examination and Anthropometry

Height was measured in meters (without footwear) by using a standard measuring tape. Weight was measured on electronic weighing machine to the nearest 50 grams with children bare foot and wearing light clothing. Waist circumference in centimeters, measured at a point midway between lower margin of the rib cage and the highest point of the iliac crest, in the standing position with the abdomen relaxed, arm hanging by the side and the feet together using a standard measuring tape. Hip circumference in centimetres, at the level of greater trochentar in standing position with the arm hanging by the side using a standard measuring tape. Blood Pressure was recorded in the right arm of the relaxed, seated subject.

BMI was calculated from the height and weight. For the BMI, using IAP (Indian Pediatrics) growth charts for 5–18-year-old Indian children, approach 3rd, 5th, 10th, 25th, 50th, 23 adult equivalent (as overweight cut off), and 27 adults equivalent (as obesity cut off) percentiles[9].

Estimation of serum glucose was done by enzymatic glucose oxidase- peroxidase endpoint method[10].Estimation of serum insulin was done by Enzyme-Linked Immunoassay method[11] and HOMA-IR calculated as:

HOMA-IR = fasting serum insulin (μU/ml) × fasting plasma glucose (mmol/l)/22.5 [12].

Results

Table 1: Basic characteristics and Biochemical parameters in group-1 and 2

Parameters	Group-1 (Healthy Children) Mean±SD	Group-2 (Obese Children) Mean±SD	Group-1 vs Group-2 p value
Height	1.25±0.08	1.26±0.07	0.409
Weight	24.12±3.91	35.38±5.34	<0.0001(HS)
BMI	15.13±0.59	21.88±1.47	<0.0001(HS)
Waist circumference	55.63±3.03	67.71±8.02	<0.0001(HS)
Hip circumference	68.92±4.38	75.53±8.83	<0.0001(HS)
Waist to Hip Ratio	0.80±0.03	0.92±0.08	<0.0001(HS)
Systolic Blood Pressure	104.13±2.05	124.01±4.72	<0.0001(HS)
Diastolic Blood pressure	70.79±0.91	81.53±2.51	<0.0001(HS)
Fasting Blood Glucose	73.72±6.47	82.00±8.74	<0.0001(HS)
Serum Insulin	6.97±1.38	14.96±3.86	<0.0001(HS)
HOMA-IR	1.27±0.28	2.93±0.99	<0.0001(HS)

Table 2: Correlation of serum insulin &HOMA-IR in group-1

Defining criteria	Serum Insulin		HOMA-IR	
	r value	p-value	r value	p-value
BMI	0.287	**0.012*(S)**	0.239	**0.038*(S)**
WHR	0.251	**0.029*(S)**	0.255	**0.026*(S)**
SBP	0.035	0.765	0.089	0.446
DBP	0.055	0.635	0.088	0.499
Fasting Blood Glucose	0.256	**0.026*(S)**	0.282	**0.014*(S)**
Fasting serum Insulin	-	-	0.281	**0.014*(S)**
HOMA-IR	0.281	**0.014*(S)**	-	-

Table 3: Correlation of serum insulin &HOMA-IR in group-2

Defining criteria	Serum Insulin		HOMA-IR	
	r value	p-value	r value	p-value
BMI	0.342	**0.002*(S)**	0.299	**0.009*(S)**
WHR	0.304	**0.007*(S)**	0.328	**0.004*(S)**
SBP	0.285	**0.013*(S)**	0.266	**0.020*(S)**
DBP	0.264	**0.021*(S)**	0.292	**0.010*(S)**
Fasting Blood Glucose	0.376	**0.0009**(VS)**	0.366	**0.0009**(VS)**
Fasting serum Insulin	-	-	0.765	**<0.0001***(HS)**
HOMA-IR	0.765	**<0.0001***(HS)**	-	-

Discussion

Serum insulin and HOMA-IR in present study were significantly higher in obese children similar results were observed in earlier studies. Pratyusha et al documented that fasting insulin was significantly high in obese children with MetS and concluding that it is a frequent trouble in overweight/obese children[13]. Similarly, Rashmi Ranjan Das et alreported that mean HOMA-IR in overweight/obese children with MetS was higher than in those without MetS[14]. In contrary to current work, a cross sectional study Thakre R.R. et al reported that between obese and nonobese group, plasma glucose and insulin level showed a lesser variation, and having similar mean HOMA-IR[15].

In present study serum insulin and HOMA-IR showed significant positive correlation with BMI, WC and WHR in obese children. Similarly, Chang et aldemonstrated that fasting insulin level and IR positively correlated with BMI[16]. In accordance to our results Basreem et aldocumented that serum fasting insulin and HOMA-IR having significant positive correlation with BMI, WC but not with WHR and these findings also reflected the increase chances of MetS in overweight/obese children[17]. Romualdo et al found that IR was positively correlated with BMI[18].

We reported serum insulin and HOMA-IR showed significant positive correlation with SBP, DBP in obese group, these results were in accordance with Basreem et al[17]. We also found that between HOMA-IR and fasting blood glucose and between HOMA-IR and fasting insulin level showed statistically positive significant in obese children and adolescents in present study. Similar observations were made by many previous studies[13,14,17,18].

Conclusion

The results of present study demonstrated that accumulation of fat childhood and serum insulin level strongly associated with BMI, BP, FBG, and HOMA-IR which will lead into metabolic abnormalities in future and also suggested that counselling of these high-risk children should be done to control obesity either by physical exercise, dietary modifications and therapeutic medicines or any other ways which bring change in their lifestyle and prevents complications.

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