Prevalence of Insulin Resistance in Najran Area

By

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Abstract: Insulin resistance (IR) is defined as situation where there is insufficient biological or metabolic response to normal plasma levels of insulin. Obesity has the ability to engender insulin resistance (IR). Homeostasis Model Assessment-Insulin Resistance (HOMA-IR) is an indirect marker of IR. The present study revealed the prevalence of IR among overweight and obese individuals in Najran, Saudi Arabia. This study was carried out on 94 male individuals divided into 3 groups. Of these, 10 healthy control (GI), 44 prediabetic overweight and obese individuals with high normal serum glucose levels (GII) and 50 diabetic overweight and obese individuals with high serum glucose levels (GIII). Body mass index (BMI) was calculated for all individuals. In addition, fasting serum glucose and insulin levels were estimated for all individuals. The mean BMI was 21.84±1.28 kg/m^2 in GI, 28.68±2.42 kg/m^2 in GII and 33.82±2.78 kg/m^2 in GIII. The mean fasting serum glucose was 98.56±15.86 mg/dl in GI, 128.29±27.92 mg/dl in GII and 159.46±44.86 mg/dl in GIII. Such findings were correlated with increased fasting serum insulin levels (21.57±2.58 µU/ml in GII and 37.28±6.15 µU/ml in GIII) compared to GI (16.22±6.23 µU/ml). The mean HOMA-IR was 5.77±1.71 in GII and 12.67±4.07 in GIII compared to GI (4.07±1.04). We conclude that, increased BMI was associated with increased prevalence of insulin resistance and then T2DM.

1. Introduction

Insulin is the major anabolic hormone whose action is essential for appropriate tissue development, growth, and maintenance of glucose homeostasis. Insulin is secreted by the pancreatic β-cells in response to increased circulating levels of glucose and amino acids after a meal ***(DeFronzo, 1988; Shulman, 2000)***. Diabetes mellitus is the most common chronic endocrine disorder, affecting an estimated 5-10% of the adult population in industrialized Western countries, Asia, Africa, Central America and South America, and it has a large impact on society ***(Wild et al., 2004)***. Type 2 diabetes mellitus (T2DM) is a multistage process that begins as insulin resistance (IR), characterized by inability of the body to use its own insulin properly, and ends with exhaustion of the insulin-producing pancreatic β-cells, thereby leading to hyperglycaemia ***(Alqurashi et al., 2011)***. IR is measured by Homeostasis Model Assessment-Insulin Resistance (HOMA-IR), which is an indirect marker of IR. HOMA-IR was calculated, according to ***Anderson et al., (1995) and Haffner et al., (1997)***. Obesity is considered the most important risk factor for the development of T2DM , as obese individuals are seven times more likely to develop T2DM than are normal weight individuals ***(Bloomgarden, 2000)***. Evidence from epidemiologic and metabolic studies has shown that adverse metabolic consequences of excess fat are more closely related to the location of fat than to the amount of fat ***(Despres et al., 2001; Pi-Sunyer, 2004)***. Indeed, central accumulation of fat may be a better predictor of increased risk for T2DM than is absolute fat mass ***(Kissebah, 1989)***. In addition, central obesity is strongly correlated with IR in type2 diabetic patients ***(Duman et al., 2003)***. Other factors are implicated in the development of T2DM, including family history, physical inactivity and inherited factors. ***Alqurashi et al. (2011)***

reported that many epidemiological studies of the prevalence of diabetes in Saudi Arabia, 1982-2009 showed a further increase in the prevalence of diabetes mellitus in comparison with previous studies carried out in Saudi Arabia. In this study, the principal objective was to detect the prevalence of IR in young overweight and obese men in Najran, Saudi Arabia.

Overweight and obesity was measured by body mass index (BMI) which is commonly used to classify overweight and obesity in adults. The BMI is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2). The BMI provides the most useful population-level measure of overweight and obesity as it is the same for both sexes and for all ages of adults ***(Stein and Colditz, 2004)***.

2.Materials and Methods

2.1.Blood samples

Blood samples were collected in the morning after an overnight fasting (12 hours fasting) from 94 male individuals. Of these, 44 prediabetic overweight and obese individuals (GII), 50 diabetic overweight and obese individuals (GIII) and 10 healthy control individuals (GI).

2.2.BMI and IR Calculations

BMI was calculated by the body weight in kilograms divided by the square of the height in meters. ***The WHO (2004)*** regards a BMI greater than 25 kg/m^2 is considered overweight and above 30 kg/m^2 is considered obese. Homeostasis Model Assessment-Insulin Resistance (HOMA-IR) is an indirect marker of insulin resistance. HOMA-IR was calculated according to ***Matthews et al., (1985)***, using the Formula HOMA-IR = [Fasting insulin (μU/ml) ⁻ fasting glucose (mmol/L)/22.5].

2.3.Glucose and insulin measurements

Glucose levels were measured using a semi-automated HUMALYZER 3000 instrument (HUMAN diagnostics, Germany) by glucose oxidase test ***(Raba and Mottola, 1995)***. Insulin was measured using HUMAREADER (HUMAN diagnostics, Germany) by Insulin (Human) - ELISA Kit (PHOENIX PHARMACEUTICALS, INC)

2.4. Statistical analysis:

All statistical analyses were performed using GraphPad InStat 3 (GraphPad Software, Inc.2236 Avenida de la Playa La Jolla, CA 92037 USA). We used a two-tailed test, and a value of $P<0.05$ was considered to be statistically significant.

3.Results

3.1.Effect of increased BMI on fasting serum glucose:

We found that, there were high increases in the fasting serum glucose level in the tested groups (128.29±27.92 mg/dl in GII and 159.46±44.86 mg/dl in GIII) compared to GI (91.56±15.86 mg/dl) and the differences were extremely significant in GII and GIII compared to GI., **(Table 1)**.

3.2.Effect of increased BMI on insulin levels:

Such findings were correlated with fasting serum insulin levels that showed extremely significant increases between the tested groups (21.57±2.58 µU/ml in GII and 37.28±6.15 µU/ml in GIII) compared to GI (16.22±6.23 µU/ml), **(Table 1)**.

3.3.Effect of increased BMI on insulin resistance:

The above results were reflected on the ratio of the IR that showed extremely significant increases between the tested groups (5.77±1.71 in GII and 18.67±9.07 in GIII) compared to GI (4.07±.04), **(Table 1)**.

(Table 1): BMI, Glucose and Insulin Resistance in healthy control (GI), Prediabetic overweight and obese individuals (GII) and Diabetic overweight and obese individuals **(**GIII**)**

		BMI (kg/m^2)	Glucose mg/dl	Insulin µU/ml	Insulin Resistance (HOMA-IR)
GI (n=10)	Mean ± S.D.	21.84 ± 1.28	98.56 ± 15.86	16.22 ± 6.23	4.07 ± 1.04
GII (n=44)	Mean ± S.D.	28.68 ± 2.42	128.29 ± 27.92	21.57 ± 2.58	5.77 ± 1.71
	P1	<0.0001***	0.002**	<0.0001***	<0.0001***
GIII (n=50)	Mean ± S.D.	33.82 ± 2.78	159.46 ± 44.86	37.28 ± 6.15	18.67 ± 9.07
	P2	<0.0001***	<0.0001***	<0.0001***	<0.0001***

P1: Comparing GII to healthy control (GI), *P2*: Comparing GIII to healthy control (GI)

4.Discussion

In the present study, there were a significant increase in the mean BMI between the prediabetic overweight and obese individuals (GII) and diabetic overweight and obese individuals (GIII) groups compared to the control group (GI) (*P<0.0001*), **(Table 1)**. Obesity is considered as a big problem in the Kingdom of Saudi Arabia (KSA), ***(Mahfouz et al., 2007 and Amin et al., 2008). Al-Nozha et al., (2005)*** reported that about 72.5% of Saudis are either overweight or obese. Many studies have already demonstrated that lifestyle is strongly associated with the development of overweight and obesity ***(Wahl, 1999; Yannakoulia et al., 2004 and Mahan et al., 2004)***.

The present study revealed that, there were high increases in the fasting serum glucose levels in GII and GIII compared to healthy control group (GI) (*P<0.0001*). Such results were accompanied with significant increases in the fasting serum insulin levels in GII and GIII compared to GI (*P<0.0001*). At the same time, these results were reflected on the ratio of the HOMA-IR, where HOMA-IR showed significant increases in GII and GIII compared to GI (*P<0.0001*). At the same time, HOMA-IR was found to be strongly correlated with both fasting serum glucose (r=0.97, *P<0.0001*), and serum insulin (r=0.86, *P<0.0001*). While, HOMA-IR was found to be less correlated with BMI (r=0.31, *P=0.028*). Our results are similar to findings of many other studies in which IR was found to play a major role in the development of glucose intolerance and T2DM in overweight and obese individuals, ***(Katz et al., 2000; McAuley et al., 2001; Cummings and Schwartz 2003; Sesti, 2006)*** and ***Bloomgarden, 2000)*** reported that obesity is considered the most important risk factor for T2DM, as obese individuals are seven times more likely to develop T2DM than are normal weight individuals.

Conclusions:

We conclude that, increased BMI was associated to increased IR and T2DM. Reduction in overweight and obesity rates are of considerable importance to public health. So, physical activity should be encouraged as a strategy directed towards weight reduction in the obese.

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الملخص العربي

تعتبر مقاومة الانسولين من الحالات الأيضية التي تزيد من فرص الإصابة بمرض السكري من النوع الثاني . فعندما يكون هناك مقاومة للانسولين، فإن الجسم يعاني من مشاكل الاستجابة للانسولين .و بالتالي فإن معدلات السكر في الدم ترتفع فوق الحد الطبيعي .تهدف هذه الدراسة الى التعرف على مدى انتشار مقاومة الانسولين في سن الشباب المبكر حيث أنه يعتبر سبب رئيسي لحدوث مرض السكري من النوع الثاني. وقد أجريت هذه الدراسة على ٩٤ حالة من الشباب في منطقة نجران و الذين تتراوح أعمارهم بين ١٨–٣٠ سنة و كان منهم ١٠ حالات في الوزن الطبيعي و ٤٤ حالة يعانون من الوزن الزائد أو السمنة بدون الاصابة بمرض السكري و كذلك ٥٠ حالة يعانون من الوزن الزائد أو السمنة مع الاصابة بمرض السكري.

تم قياس مؤشر كتلة الجسم و السكر الصائم و كذلك قيم الانسولين لكل الحالات. و قد وجد أن متوسط مؤشر كتلة الجسم للمجموعة الأولى الطبيعية كان ٢١.٨٤±١.٢٨ و في المجموعة الثانية ٢٨.٦٨±٢.٤٢ بينما كان ٣٣.٨٢± ٢.٧٢ في المجموعة الثالثة. أما بالنسبة لمستوى السكر فقد كان ٩٨.٥٦±١٥.٨٦ في المجموعة الأولى و ١٢٨.٢٩±٢٧.٩٢ في المجموعة الثانية و ١٥٩.٤٥±٤٤.٨٦ في المجموعة الثالثة. و بالنظر لكل هذه المشاهدات فان الزيادة في متوسط مؤشر الوزن و السكر كانت مصحوبة بزيادة في متوسط مستوى الانسولين في الدم. و بحساب متوسط مقاومة الانسولين لكل المجموعات فقد وجدت زيادة في المجموعة الثانية و الثالثة بالمقارنة مع المجموعة الأولى. و لذلك تم التوصل في هذه الدراسة الى أن الزيادة في مؤشر كتلة الجسم يكون مصحوبا بزيادة في مقاومة الانسولين و حدوث مرض السكري من النوع الثاني مستقبلا.