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Circulating adiponectin in obese and non-obese men and its relation with insulin resistance in obese subjects

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Abstract

Decreased adiponectin, an adipose tissue-derived hormone, is associated with obesity and inflammatory diseases. In this study, we aimed 1) to compare serum adiponectin between obese and non-obese men, 2) to determine its relation with insulin resistance in obese subjects. For this purpose, basal concentrations of adiponectin, insulin and glucose were measured after an overnight fast in fifteen non-trained obese or non-obese men matched for age (32 – 39 years). Independent sample T-test was used to compare variables between two groups and Pearson's correlation coefficient was used to relation between adiponectin and insulin resistance in obese subjects. Based on statistical data, serum adiponectin levels were significantly lower in obese subjects in comparison to non-obese group ($p = 0.011$). But we did not significant correlation between serum adiponectin with insulin resistance in obese subjects ($p = 0.329$, $r = 0.13$). In conclusion, these findings support lower adiponectin in obesity, but it appear to each independently affect glucose.

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Introduction

Adipose tissue is a soft connective tissue, which includes a wide network of blood vessels, collagen fibers, fibroblasts, immune cells and fat-filled cells called adipocytes Adipose tissue, used to be considered a specialized tissue for energy storage in the form of triglycerides but it was found that the fat tissue has an active role in energy homeostasis and controlling the functions of autonomic, neuroendocrine and immunity systems. Adipose tissue stem cells are also involved in the metabolism of glucocorticoids and sex steroids (Fauntuzi *et al.*, 2007). Adipocytes as an active and complex endocrine organ secreting materials such as hormones, prohormones, cytokines and enzymes play an important role in the metabolism of the whole body (Aldhahi *et al.*, 2007).

Adiponectin is an adipokine similar to collagen which is produced mainly by adipose tissue (Aldhahi *et al.*, 2007). Compared with other adipocytokines plasma adiponectin levels are reduced in obesity and insulin resistance (Weyer, 2001). Today adiponectin is known as a factor promoting fat oxidation and glucose uptake in skeletal muscles and decreased glucose output from the liver (Tai *et al.*, 2010). Literature suggests that systemic levels of this peptide hormone of 224 amino acids decrease in the presence of cardiovascular disease and metabolic syndrome and supports its anti-inflammatory and anti-diabetes properties (Hadaegh *et al.*, 2006). This hormone decreases insulin sensitivity in muscular tissue and the liver, and increases oxidation of free fatty acids (FFA) in some tissues, such as muscle fibers and decreases the serum concentrations of free fatty acids, glucose and triglycerides (Calabro *et al.*, 2007).

Low levels of circulating adiponectin are associated with obesity, insulin resistance, and with type 2 diabetes and cardiovascular disease (Fu *et al.*, 2005). Adiponectin plasma concentrations in humans are reduced with increased obesity and visceral fat accumulation and this is more common in men than women (Calabro *et al.*, 2007). Despite the fact that some studies support a kind of relationship between adiponectin and insulin resistance blood glucose in healthy subjects or patients (Yamauchi *et al.*, 2003), some studies also suggest the biological effects of adiponectin can be independent of insulin resistance and body fat mass (Tschritter *et al.*, 2003). The findings of this study showed that adiponectin affects lipid metabolism independently of body fat mass size or insulin sensitivity (Baratta *et al.*, 2004). Given the inconsistency in the said findings, this study aims to compare the resting level of adiponectin in obese men with normal weight men, and its relation with insulin resistance in obese men.

Method and subjects

This study was performed to objective comparison serum adiponectin and insulin resistance between obese and normal weight men and to determine relationship between serum adiponectin and insulin resistance in obese subjects.

Subjects

Fifteen non-trained healthy obese men aged 32 - 39 years and BMI 30 - 36 kg/m2 and fifteen non-obese men matched for aged were enrolled to participate in this study. All participants were non-smoker and non-athletes. All of subjects had not participated in regular exercise for the preceding 6 months, nor did all subjects have stable body weight. A detailed history and physical examination of each subject was carried out. The range of Body mass index was 26-36 kg/m2 for obese group and 20-25 kg/m2 for normal weight group. Subjects with any history of smoking, chronic cough, recurrent respiratory tract infection, personal history of asthma, chronic obstructive lung diseases were excluded from the study. Written consent was obtained from each subject after the experimental procedures and possible risks and benefits were clearly explained.

Anthropometrical and biochemical measurements

Measurements consisted of anthropometric assessments (height, weight), glucose, insulin, and serum adiponectin and insulin resistance. Body weight, height, waist circumference and % body fat

measurements were obtained by standard methods. Body weight and height were measured on the same day to the nearest 0.1 kg and the nearest 0.1 cm, respectively. The waist circumference was measured to the nearest 0.1 cm, using a non-extendable flexible tape applied above the iliac crest and parallel to the ground; with the subject standing erect with abdomen relaxed, arms along the body, and feet together. Waist and hip circumferences were measured at the level of umbilicus and of trochanter major, respectively. Percentage body fat was measured using body composition monitor (OMRON, Finland). BMI was calculated as mass (Kg)/[height (m)]2. Resting blood pressure (BP) levels were measured in the right arm with a cuff sphygmomanometer after a participant had been resting for 10 min.

After an overnight fast, blood samples were collected in all subjects to assess fasting glucose, insulin, serum adiponectin. Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) was calculated by the formula fasting insulin (μ/ml) × fasting glucose (mmol/l)] / 22.5 (Conwell *et al.*, 2004).Blood samples were dispensed into EDTA-coated tubes and centrifuged for 10 minutes in order to separate serum. Glucose was determined by the oxidase method (Pars Azmoon kit, Tehran). Insulin was determined by ELISA method (Demeditec, Germany). Adiponectin concentrations were measured by immunosorbent assay (ELISA; Biovendor Company Biovendor Human Adiponectin, Czech)

Statistical analyses

Statistical analysis was performed with the SPSS software version 15.0. The Kolmogorov-Smirnov test was applied to determine the variables with normal distribution. Pearson correlations were used to establish the relationship between adiponectin concentrations with insulin resistance in obese subjects. An Independent sample T-test was used to compare all variables between obese and none-obese subjects. A p-value < 0.05 was considered to be statistically significant.

Results

Body weight and blood chemistry parameters of studied subjects are shown in Table 1. All values are represented as mean ± SD. Comparison of serum adiponectin between obese and non-obese men was first aim of present study. Data of independent T test showed that serum adiponectin in obese men was significantly lower than normal weight subjects (p = 0.011). Insulin resistance was also higher in obese men when compared to normal subjects (p = 0.014). We also observed significantly higher in obese than normal weight groups (p = 0.016).

Table 1. Anthropometrical and biochemical characteristics of studied subjects.

Variables	Obese men	Normal men
Age (year)	34.9 ± 3.9	36.4 ± 4.5
Weight (kg)	101.8 ± 12.4	75 ± 5.4
Height (cm)	176.9 ± 4.5	177.3 ± 5.1
Body Fat (%)	32 ± 3.7	24.1 ± 3.4
Body mass index (kg/m²)	32.5 ± 3	23.86 ± 2.4
Abdominal circumference (cm)	108 ± 9	90±4.3
Hip circumference (cm)	107.9 ± 8.03	93 ± 5.6
AHO	1.00 ± 0.03	0.96 ± 0.02
Glucose (mg/dL)	102 ± 8.1	88 ± 6.4
Insulin (µIU/ml)	8.46 ± 2.38	6.5 ± 1.31
Insulin resistance (HOMA-IR)	2.13 ± 0.61	1.41 ± 0.22
Adiponectin (µg/ml)	6.31 ± 1.83	8.6 ± 2.4

On the other hand, data by Pearson correlations analysis showed no significant correlation in serum adiponectin with insulin resistance in obese men (p = 0.329, r = 0.13, Fig 1). There were no correlations between serum adiponectin concentrations and fasting glucose in this subjects (p = 0.477, r = 0.02).

Discussion

While adipose tissue has significant advantages especially when hungry its excessive increase is associated with obesity-related health problems. Inflammatory features of obesity in the pathogenesis of obesity induced mortality are complex. With regard to its role in secretion and regulation of the secretion of certain hormones and hormone receptors, (Lowell, 1999; Chawla *et al*., 2000) adipose tissue is known as an important endocrine organ secreting some biological activators called adipocytokine (Steppan, 2001; Yang, 2005; Lazar, 2005).

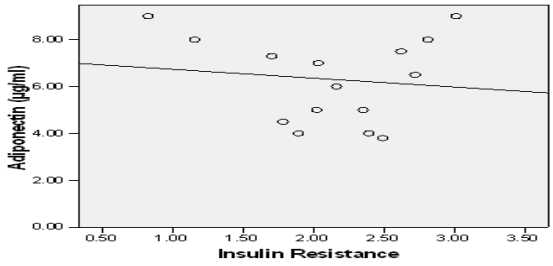

Fig. 1. The correlation pattern between serum adiponectin and insulin resistance in obese subjects

Increased adipose tissue brings about physiologic and morphologic changes including including outflow or discharge of macrophages and release of several proinflammatory cytokines and some of them affect directly or indirectly through the regulation of insulin sensitivity and insulin signal molecules involved in lipid and glucose metabolism (Kershaw *et al*., 2004). In such circumstances, anti-inflammatory factors such as adiponectin play an important role in regulating obesity-related disorders. Although adiponectin is produced exclusively in adipose tissue, its plasma levels are reduced in obese individuals (Arita *et al*., 1999). In support of this, results of this study showed that adiponectin levels in obese male subjects were significantly lower than serum levels in men with normal weight. It has been reported frequently that through certain genetic and environmental factors plasma or serum levels of adiponectin have a special role in the development and prevalence of diabetes and insulin resistance syndrome (Takashi *et al*., 2006).

Due to its anti-diabetic and anti-atherogenic effects, adiponectin recently is of considerable importance and significance and on the basis of this significance it is expected to be a tool for the treatment of diabetes and metabolic syndrome (Kadowaki *et al*., 2005). Unlike other adipocytokines, such as TNF-α and resistin causing insulin resistance, adiponectin expression is reduced in obese and insulin resistant animal models (Hu *et al*., 1995). Some previous studies report reduced adiponectin in obese humans, particularly those with abdominal obesity and its inverse relationship with insulin resistance (Ryo, 2004; Yatagai, 2003; Yamamoto *et al*., 2004).

In the present study, although the findings support lower levels of adiponectin and higher levels of insulin resistance in obese individuals compared to normal weight individuals and these findings are consistent with previous studies, unlike the statements of some researchers having seriously emphasized the inverse relation of adiponectin with insulin resistance (Peti *et al*., 2010; Meilleur *et al*., 2010), no significant association between them found is this study which is somewhat controversial and unexpected. However, although the role of adiponectin and insulin resistance in glucose homeostasis has been reported many times, it is also possible that both adiponectin and insulin resistance independently affect glucose levels, because some previous studies, also report no correlation between serum levels of adiponectin and insulin resistance or sensitivity and report their performance on blood glucose levels and other metabolic parameters to be independent of each other (Staiger *et al*., 2005; Yukihiro *et al*., 2002; Ma *et al*., 2002; Martin *et al*., 2008). However, due to the different number of samples in the present study compared with previous studies mentioned, the absence of a significant relationship between adiponectin levels with insulin resistance or glucose may be attributed to the small number of samples studied.

References

Aldhahi W, Hamdy O. 2003. Adipokines,

inflammation, and the endothelium in diabetes. Current Diabetes Reports **3(4),** 293-8.

Arita Y, Kihara S, Ouchi N, Takahashi M, Maeda K, Miyagawa Jet. 1999. Paradoxical decrease of an adipose-specific protein, adiponectin, in obesity. Biochemical_*a*nd Biophysical Researc*h* Communications **257,** 79–83.

Baratta R, Amato S, Degano C, Farina MG, Patanè G, Vigneri R, Frittitta L. 2004. Adiponectin Relationship with Lipid Metabolism Is Independent of Body Fat Mass: Evidence from Both Cross-Sectional and Intervention Studies. Journal of Clinical Endocrinology & Metabolism **89(6),** 2665-71.

Calabro P, Yeh ET. 2007. Obesity, inflammation, and vascular disease: the role of the adipose tissue as an endocrine organ. Sub-cellular biochemistry **42,** 63-91.

Chawla A, Saez E, Evans RM. 2000. Don't know much bile-ology. Cell **103,** 1–4.

Conwell LS, Trost SG, Brown WJ. 2004. Indexes of insulin resistance and secretion in obese children and adolescents: a validation study. Diabetes Care **27,** 314–19.

Fauntuzi G and Mazzone T. 2007. Adipose Tissue and Adipokines in Health and Disease. Humana Press imprint **5,** 31-44.

Fu Y, Luo N, Klein RL, Garvey WT. 2005. Adiponectin promotes adipocyte differentiation, insulin sensitivity, and lipid accumulation. Journal of Lipid Research **46(7),** 1369-79.

Hadaegh F, Harati H, Ghanbarian A, Azizi F. 2006. Association of total cholesterol versus other serum lipid parameters with the short-term prediction of cardiovascular outcomes: Tehran Lipid and Glucose Study. European Journal of Cardiovascular Prevention & Rehabilitation **13,** 571-577.

Hu E, Liang P, Spiegelman BM. 1995. AdipoQ is a novel adipose-specific gene dysregulated in obesity. Journal of Biological Chemistry **271,** 10697–10703.

Kadowaki T, Yamauchi T. 2005. Adiponectin and adiponectin receptors. Endocrine Reviews **26,** 439–451.

Kershaw EE, Flier JS. 2004. Adipose tissue as an endocrine organ. Journal of Clinical Endocrinology & Metabolis **89,** 2548–2556.

Lazar MA. 2005. The humoral side of insulin resistance. Nature Medicine **12**, 43–44.

Lowell BB. 1999. PPARgamma: an essential regulator of adipogenesis and modulator of fat cell function. Cell **99,** 239–242.

Ma K, Cabrero A, Saha P, Kojima H, Li L, Hing-Junn B, Paul A, Chan L. 2002. Increased ß-oxidation but no insulin resistance on glucose intolerance in mice lacking adiponectin. Journal of Biological Chemistry **277,** 34658–34661.

Martin M, Palaniappan LP, Kwan AC, Reaven GM. 2008. Ethnic differences in the relationship between adiponectin and insulin sensitivity in South Asian and Caucasian women. Diabetes Care **31,** 798–801.

Meilleur KG, Doumatey A, Huang H, Charles B, Chen G, Zhou J, Shriner D, Adeyemo A, Rotimi C. 2010. Circulating adiponectin is associated with obesity and serum lipids in West Africans. Journal of Clinical Endocrinology & Metabolism **95(7),** 3517-21.

Peti A, Juhasz A, Kenyeres P, Varga Z, Seres I, Kovacs GL, Paragh G, Bajnok L. 2010.

Relationship of adipokines and non-esterified fatty acid to the insulin resistance in nondiabetic individuals. Journal of Endocrinological Investigation [Epub ahead of print].

Ryo M. 2004. Adiponectin as a biomarker of the metabolic syndrome. _Circulation Journal **68,** 975–981.

Staiger K, Stefan N, Staiger H, Brendel MD, Brandhorst D, Bretzel RG. 2005. Journal of Clinical Endocrinology & Metabolism **90(12),** 6707-13.

Steppan CM. 2001. The hormone resistin links obesity to diabetes. Nature **409,** 307–312.

Tai ES, Tan ML, Stevens RD, Low YL, Muehlbauer MJ, Goh DL. 2010. Insulin resistance is associated with a metabolic profile of altered protein metabolism in Chinese and Asian-Indian men. Diabetologia **53(4),** 757-67.

Takashi K, Toshimasa Y, Naoto K, Kazuo H, Kohjiro U, Kazuyuki T. 2006. Adiponectin and adiponectin receptors in insulin resistance, diabetes, and the metabolic syndrome. Journal of Clinical Investigation **116,** 1784–1792.

Tschritter O, Fritsche A, Thamer C, Haap M, Shirkavand F, Rahe S, Staiger H,Maerker E,HaringH, StumvollM. 2003. Plasma adiponectin concentrations predict insulin sensitivity of both glucose and lipid metabolism. Diabetes **52,** 239–243.

Weyer C. 2001. Hypoadiponectinemia in obesity and type 2 diabetes: close association with insulin resistance and hyperansulinemia. Journal of Clinical Endocrinology & Metabolism **86,** 1930-1935.

Yamamoto Y, Hirose H, Saito I, Nishikai K, Saruta T. 2004. Adiponectin, an adipocyte-derived protein, predicts future insulin-resistance: two-year follow-up study in Japanese population. Journal of Clinical Endocrinology & Metabolism **89,** 87–90.

Yamauchi T, Kamon J, Waki H, Imai Y, Shimozawa N, Hioki K, Uchida S. 2003. Globular adiponectin protected ob/ob mice from diabetes and ApoE-deficient mice from atherosclerosis. Journal of Biological Chemistry **278,** 2461–2468.

Yang Q. 2005. Serum retinal binding protein 4 contributes to insulin resistance in obesity and type 2 diabetes. Nature **436,** 356–362.

Yatagai T. 2003. Hypoadiponectinemia is associated with visceral fat accumulation and insulin resistance in Japanese men with type 2 diabetes mellitus. Metabolism **52,** 1274–1278.

Yukihiro Y, Hiroshi H, Ikuo S, Motowo T, Matsuo T, Koichi M. 2002. Correlation of the adipocyte-derived protein adiponectin with insulin resistance index and serum high-density lipoprotein-cholesterol, independent of body mass index, in the Japanese population. Clinical Science **103,** 137–142.