Pharmacology & Pharmacy, 2014, 5, 789-795
Published Online July 2014 in SciRes. http://www.scirp.org/journal/pp
http://dx.doi.org/10.4236/pp.2014.58089

Relationship of Serum Leptin, BMI, Waist Circumference and Cholesterol Level among Teenagers in the Gaza Strip

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Received 16 May 2014; revised 18 June 2014; accepted 29 June 2014

Abstract

Leptin is one of the best known hormone markers for obesity. There is a limited anthropometric data in the Gaza Strip that reveals and arouses the nutritional status among all age groups especially adolescents aged 15 - 19 years old. The study aimed to assess the effect of Leptin hormone, lipid profiles, Body Mass Index (BMI) and waist circumference among secondary school age students in the Gaza Strip. Methodology: A cross sectional study included 442 cases of teenagers aged 15 - 19 years old from governmental and private schools in the Gaza strip. Blood samples were collected for analysis of Leptin hormone and lipid profile and measuring waist circumference for the teenager. Results: The mean of serum Leptin was (28.7) higher among cases than controls (28.1), but it was statistically insignificant (P = 0.85). It was found that there is a significant correlation between Leptin hormone and total cholesterol (Chol) (r = 0.24), high density cholesterol (HDL) (r = 0.27) and low density cholesterol (LDL) (r = 0.16). There was no relationship between Leptin hormone and triglycerides (TG) (r = −0.02). There was relationship between Leptin hormone and waist circumference in both males and females (r = 0.519, 0.544), respectively. There was no statistical significant deference noticed between Leptin hormone of obese objects and Leptin hormone of normal BMI objects of the same age (t-test = 0.93, P = 0.85). Conclusion: There are significant correlations between Leptin hormone and total Chol, HDL and LDL except for TG, and there were significant relationships between Leptin hormone and waist circumference which reflect the central obesity among males and females. There is no association between Leptin level and BMI.

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How to cite this paper: Taleb, M.H., Younis, S.J., Zabout, B., Najim, A.A., Ahmed, A.I. and El-Bayary, E.S. (2014) Relationship of Serum Leptin, BMI, Waist Circumference and Cholesterol Level among Teenagers in the Gaza Strip. *Pharmacology & Pharmacy*, **5**, 789-795. http://dx.doi.org/10.4236/pp.2014.58089

Keywords

Central Obesity, Leptin, Lipid Profile, Gaza Strip, Waist Circumference

1. Introduction

1.1. Background

This study focuses on nutritional status among adolescents aged 15 to 19 years old in the Gaza Strip and other factors associated with obesity including serum Leptin level, lipid profile, and anthropometrics. Nutritional status in the adolescents has a great influence upon a person's health in the adulthood. Obesity which is considered as a public health problem worldwide has highly prevalence among adolescents reaching to 11% and may be associated with increased risk for occurrence of many chronic diseases in the adulthood [1] [2].

1.2. Human Leptin

Human Leptin is a protein of 167 amino acids. It is manufactured primarily in the adipocytes of white adipose tissue, and the level of circulating Leptin is directly proportional to the total amount of fat in the body. In addition to white adipose tissue the major source of Leptin, it can also be produced by brown adipose tissue, placenta (syncytiotrophoblasts), ovaries, skeletal muscle, stomach (lower part of fundic glands), mammary epithelial cells, bone marrow, pituitary and liver. Leptin acts on receptors in the hypothalamus of the brain where it inhibits appetite. Leptin binds to neuropeptide Y (NPY) neurons in the arcuate nucleus, in such a way that decreases the activity of these neurons. Leptin signals to the brain that the body has had enough to eat, producing a feeling of satiety. Leptin produced primarily by white adipose tissue, is involved in energy regulation at the level of the hypothalamus through modification of energy intake and energy expenditure via a negative feedback loop. Since Leptin is primarily synthesized in adipocytes, there is a strong relationship between circulating Leptin levels and indices of body fat [3]. The present paper estimated the Leptin concentration in relation to waist circumference and lipid profile of secondary school adolescents.

1.3. Cholesterol and Triglycerides

Cholesterol is an essential nutrient for adolescents as it is needed to manufacture certain hormones including testosterone and estrogen. It is essential to the synthesis of vitamin D which is necessary for healthy bones and it is also utilized to repair the membranes around our cells. Triglycerides are molecules of fat that are enclosed along with cholesterol during transport in the bloodstream. When cholesterol and triglycerides and some other fats are transported together in the blood, they are packed together in bodies that are termed lipoproteins [4].

There are two different lipoproteins that have important health concerns for adolescents. LDL can be thought of as a villain. When cholesterol is transported in this manner, it can interact with the walls of one's arteries and become destructive. If LDL cholesterol collects on the wall of an artery, it can trigger white blood cells to collect at the site and this apparently produces a fatty substance that is called plaque which is considered as risk factors for many chronic conditions, including cardiovascular and coronary artery diseases, and metabolic perturbations such as diabetes. Over time, the artery can narrow and this will reduce blood flow. Calcium may also collect at the site and this could produce a blood clot. The reduced blood flow may produce signs of heart disease, and a blood clot in the coronary arteries that supply blood to the heart muscle may cause a heart attack [5] [6].

Raised cholesterol increases the risks of heart disease, stroke, cardiovascular disease and obesity. It's therefore important to keep cholesterol levels within normal levels by eating a diet lower in fats. If levels are elevated despite dietary measures, there are medications designed to lower cholesterol levels [7].

2. Methodology

2.1. Study Design, Target Population and Sampling

This is a cross sectional study carried-out in the five governorates of Gaza Strip. The study population was ado-

lescents aged 15 - 19 years old that were chosen from secondary schools, public and privet schools. Sample selected upon a probability proportional to enrolment size.

2.2. Data Collection Tools

We used face to face interview questionnaire, measured the waist circumference by tape meter, and collected blood sample for analysis of serum Leptin and lipid profile.

2.3. Serum Leptin Analysis Method

Determination of human Leptin level was assayed by competitive enzyme immunoassay technique using a commercial ELISA kit (Diagnostic System Laboratories Inc., Webster, TX, USA). Six ml of 12 hrs fast blood samples were collected from the subjects in plastic centrifuge tubes without any anticoagulant. The tubes left for a while, centrifugation at 3000 rpm for 20 minutes, then the separated serum was stored frozen at −70˚C for serum human Leptin analysis. After that the frozen serum samples were thawed at 4˚C - 8˚C then mixed by gentle shaking at room temperature prior to use. In the assay, standards, controls and unknown serum or plasma samples were incubated in microtitration wells, which have been coated with anti-human Leptin antibody. After incubation and washing, the wells were treated with another anti-human Leptin detection antibody labeled with the enzyme horseradish peroxidase (HRP). After a second incubation and washing step, the wells were incubated with the substrate tetramethylbenzidine (TMB). An acidic stopping solution was then added and the degree of enzymatic turnover of the substrate was determined by dual wavelength absorbance measurement at 450 nm. The absorbance measured was directly proportional to the concentration of human Leptin present. A set of human Leptin standards was used to plot a standard curve of absorbance versus human Leptin concentration from which the human Leptin concentrations in the sample can be calculated.

2.4. Determination of Leptin and Lipid Profile Levels

Cut off point for Leptin levels are between 1 - 5 ng/dl in men and 7 - 13 ng/dl in women, chol 200 mg/dl, TG 200 mg/dl, LDL 100 - 129 mg/dL, and HDL 40 - 49 mg/dL in men, 50 - 59 mg/dL in women.

2.5. Statistical Analysis

After data collection, we analyzed it by using SPSS WIN (Version 13).

2.6. Ethical Consideration

Official approval to conduct the research study was obtained from Al-Azhar University, college of pharmacy, the ministry of education and higher education after letter of request was sent. Official approval from Helsinki committee also obtained. Adolescent student parents were given a full explanation in the Arabic language about the purpose of the study and confidentiality of the information and that participation was completely optional.

3. Results

3.1. Leptin and BMI

There was no statistical significant deference noticed between Leptin hormone among obese participants and Leptin hormone of normal BMI participants of the same age (t-test = 0.93, P = 0.85), as shown in **Table 1**.

3.2. Leptin and Lipid Profile

There is a significant correlation between Leptin hormone and Chol, HDL and LDL. There was no relationship between Leptin hormone and TG, as shown in **Table 2**.

3.3. Leptin and Waist Circumference

There is a significant relationship between Leptin hormone and waist circumference which reflect the central obesity in males and females, as shown in **Table 3** and **Table 4**.

Table 1. Differences in Leptin hormone in obese versus control objects.

Case versus control	N	Mean (ng/ml)	Std. Deviation (ng/ml)	t-test	P-value
Case	58	28.7	15.8	0.18	0.85
Control	70	28.1	21.9		

Table 2. The relationship between Leptin hormone and lipid profiles.

	Leptin	TG	Chol	HDL	LDL
Leptin	1	−0.02	0.24**	0.27**	0.16*
TG	−0.02	1	−0.16	−0.14	−0.15
Chol	0.24**	−0.16	1	0.31**	0.96**
HDL	0.27**	−0.14	0.31**	1	0.09
LDL	0.16*	−0.15	0.96**	0.09	1

*Correlation is significant at the 0.01 level (2-tailed). **Correlation is significant at the 0.05 level (2-tailed).

Table 3. The relation between Leptin hormone and central obesity among males of the study population.

Correlations			
		Leptin	Male waist circumference
Leptin	Pearson Correlation	1	0.519**
	Sig. (2-tailed)		0.000
Male waist circumference	Pearson Correlation	0.519**	1
	Sig. (2-tailed)	0.000	

**Correlation is significant at the 0.01 level (2-tailed).

Table 4. Correlation between Leptin hormone and central obesity among females of the study population.

Correlations			
		Leptin	Female Waist circumference
Leptin	Pearson Correlation	1	0.544**
	Sig. (2-tailed)		0.000
Female Waist circumference	Pearson Correlation	0.544**	1
	Sig. (2-tailed)	0.000	

**Correlation is significant at the 0.01 level (2-tailed).

4. Discussion

The understanding of Leptin role in various biological processes has evolved since the isolation of the hormone a decade ago. It no longer is thought exclusively as a satiety hormone, but it is now known to affect more than energy balance, including immune response, inflammation, and cell proliferation [8]. Ultimately, altering circulating Leptin levels through interventions may affect the regulation of physiological processes that may be involved in co morbidities associated with obesity. Circulating concentrations of Leptin are influenced by the quantity of adipose tissue in the body [9], and administration of the hormone to Leptin-deficient animal models decreases body weight through lowering food intake and raising energy expenditure [10]. These studies demonstrate that Leptin is involved in the regulation of body energy balance. Recent evidence hints that Leptin may be involved in certain disease states like osteo-arthritis [11].

The hyperleptinemia that is commonly present in obese humans suggests that there is a defect in the recognition of the hormone by the receptor in the hypothalamus, and notin a deficiency of Leptin production by the adipocytes. This implies a Leptin resistance similar to the insulin resistance in type II diabetes [12]. It is not certain if the Leptin resistance present in the hypothalamus is a cause or a consequence of obesity [3].

The present study shows that obese adolescents had similar serum Leptin with matched normal weight adolescents. During puberty Leptin hormone flaring up and responsible of waking up the sex genitalia for both male and female [13], so adolescents normal, overweight or obese should have high levels of Leptin hormone. Underweight adolescents had decreased level of the hormone, and as a result suffer from delayed puberty. A study was conducted at the GS in 2007 showed that obese adult individuals had higher serumleptin and lower serum OB-Re levels than normal body weight adult individuals. It also showed that serum Leptin level was directly correlated with BMI [14].

Cholesterol and triglycerides are two forms of lipid, or fat, which circulate in the bloodstream. They are both necessary for life itself. Cholesterol is necessary for building and maintaining key parts of cells (such as cell membranes), and for making several essential hormones (sex hormone, aldosterone, etc.) [15]. Triglycerides, which are chains of high-energy fatty acids, provide much of the energy needed for tissues to function. But when blood levels of cholesterol or triglycerides become too high, the risk of developing cardiovascular disease is significantly increased. And this is why the need to be concerned about lipid profile levels. Triglycerides and cholesterol are increased with obesity, which make the subject facing double risk to developed cardiovascular disease and diabetes mellitus [4]. The American Academy of Pediatrics (AAP) recommendations to asses adolescents whose parents or grandparents at or below age fifty-five years had coronary artery disease, suffered a heart attack, symptoms of coronary artery insufficiency, had disease of the blood vessels in the brain or who have other risk factors including obesity, hypertension, diabetes, history of smoking or a diet high in saturated fats.

In the present study, it was found that the Leptin hormone increased with the increase of Chol, HDL and LDL, except for TG. In 2007, a study conducted by Zabut on adults of GS found that the study also examined whether Leptin and soluble Leptin receptor (OB-Re) are statistically correlated with lipid parameters among all study subjects. It was found that serum Leptin levels were positively correlated with triglyceride, cholesterol and LDL. An inverse relationship was found between Leptin and HDL. Conversely serum OB-Re levels were negatively correlated with cholesterol, LDL and triglyceride. In contrast to Leptin, OB-Re was also positively correlated with HDL. It can be concluded that Leptin production occurs mainly in adipocytes and is highly related to lipid profiles. Increasing OB-Re may be one factor operating in the lowering risk of obesity related diseases [14]. Cholesterol and triglyceride are transported in the body fluids in the form of lipoprotein particles. The relationships between serum Leptin concentrations, OB-Re concentrations, lipids and lipoproteins are not so clear. It was reported that school children with higher plasma Leptin levels have significantly higher triglyceride, LDL and apoprotein A levels than those with relatively lower Leptin levels [16]. In contrast, it was demonstrated that a relationship between Leptin concentrations and lipid profile and lipoprotein levels among hyperlipidemic adult patients was not statistically significant [17].

Waist circumference can be considering the reflection of central obesity. Central obesity which are viewed like apple shape, are of main concerned because central obesity are linked directly with cardiovascular disease [15]. Studies have demonstrated that adults in the United States have higher rates of coronary artery disease compared to other countries [18]. Also the main cause of death in the GS was the cardiovascular disease [19]. Obesity is no longer considered as a risk factor of cardiovascular disease; it now consider as a disease itself [20].

In the present study, it was found that Leptin hormone increase with the increase of central obesity among studied population of both adolescent males and females. No study before this study discusses the relationship between central obesity and Leptin hormone. This finding revealed that abdominal adipocytes are of main source of Leptin secretion. Hyperleptinemia were well known to be associated with cardiovascular disease [3]. Also central obesity was well known to be associated with cardiovascular disease and insulin resistance [12]. The relation between cardiovascular disease, hyreleptinemia and central obesity which discussed separately in the past studies, were in this study linked together. Leptin was known as a satiety hormone. Whether the accumulations of fatty tissue around the gastro-intestinal tract are linked with this effect or not, more studies should be done on that area.

Peripheral obesity is reflected by skin fold thickness [20]. Peripheral obesity is described as pear shape. Studies showed that the risk of cardiovascular disease was linked with central obesity but not with peripheral obes-

ity. In males, fats accumulate in the both shoulders. In contrast, in females fats accumulate in the buttocks and thighs [15].

The present study found that Leptin hormone increase with the increase of peripheral obesity among studied population of male adolescents. No relationship was found between Leptin hormone and peripheral obesity among studied population of female adolescents. No study before this study discuses the relationship between peripheral obesity and Leptin hormone. Normally females have subcutaneous fat and fatty tissue mass more than lean body mass. In contrast, males have lean body mass more than fatty tissue mass [15]. The accumulation of subcutaneous fat in male reflects the peripheral obesity which is up normal in males. This may be the linkage between Leptin hormone and peripheral obesity in male. More studies should be done on that area.

5. Conclusions

Obesity and overweight are the main malnutrition problems. The overall prevalence of overweight was 11.3% of the surveyed adolescents. There was no differences noticed in Leptin hormone for surveyed obese adolescents and cross matched normal BMI adolescents of the same age (t-test = 0.93, P = 0.85). The high standard deviation of Leptin level among the study population revealed that it is very heterogeneous.

It was found that there are significant correlations between Leptin hormone and total Chol, HDL, and LDL except for TG. It was found that there were significant relationships between Leptin hormone and waist circumference which reflect the central obesity among males and females (P = 0.00). Furthermore, it was found in males a significant relationship between Leptin hormone and skinfold thickness, which reflected peripheral obesity among males (P = 0.00) and not for females (P < 0.17).

Acknowledgements

We are very much thankful to the deanship of postgraduate studies & research affairs of Al-Azhar University, deanship of college of pharmacy, and special thanks to secondary schools, public and privet schools in the Gaza Strip. Finally, we would thank all the parents and volunteers who participated in this study.

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List of Abbreviations

BMI: Body Mass Index
Chol: Total cholesterol
GS: Gaza Srtip
HDL: High density cholesterol
LDL: Low density cholesterol
MOH: Ministry of Health
TG: Triglycerides
WHO: World Health Organization

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