

ASSOCIATION OF BLOOD PRESSURE, BMI AND PLASMA LEPTIN LEVELS IN YOUNG NORMAL WEIGHT MALE UNIVERSITY STUDENTS

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ABSTRACT

It is still controversial to know the precise association of plasma leptin with Body Mass Index (BMI) and blood pressure (both systolic and diastolic) for understanding their involvement in health and disease. Hence, we planned to study the association of blood pressure, BMI and plasma leptin levels in young Saudi normal weight male university students. The subjects (n: 28) in the age range of 18-23 years were consulted for the current study. Mean \pm SEM values of systolic blood pressure, diastolic blood pressure, body mass index and plasma leptin were determined and analyzed statistically. The present study showed significant linear association for BMI vs. leptin levels, BMI vs. systolic blood pressure, BMI vs. diastolic blood pressure, systolic blood pressure vs. leptin levels, and diastolic blood pressure vs. leptin levels. The present study, hence, presents new and interesting information for the types of association among plasma leptin, body mass index and systolic and diastolic blood pressure, and is promising in the management of general health, and clinical, diagnostic, therapeutic and pathophysiological aspects.

Keywords: Plasma leptin, blood pressure, BMI, young normal weight male subjects

INTRODUCTION

Important and interesting information about the role of leptin in health and disease especially related to hypertension and other related medical disorders has extensively been reviewed in literature (Hussain, 1991; Redon, 2001; Aneja *et al.*, 2004; Hussain *et al.*, 2007; Sattar *et al.*, 2009; Sohail *et al.*, 2013; Sohail and Hussain, 2013; Taylor *et al.*, 2014; Ayeser *et al.*, 2016; Serafi *et al.*, 2016; Serafi *et al.*, 2018).

Relationship between serum/ plasma leptin with body mass index and blood pressure has been studied (Kazumi *et al.*, 1999; Sattar *et al.*, 2009; Kerimkulova *et al.*, 2014) but results obtained are controversial. Serum leptin levels appeared to be positively correlated to the BMI (Kazumi *et al.*, 1999; Hirose *et al.*, 2001; Adami *et al.*, 2002; Al-Sultan and Al-Elq, 2006; Antunes *et al.* 2009). Studies also revealed BMI significantly and independently associated with increased serum leptin levels (Antunes *et al.* 2009; Nakamura *et al.*, 2009), or obesity related blood pressure changes (Taylor *et al.*, 2014).

There are several studies that reveal the relationship of leptin levels with the blood pressure (Hirose *et al.*, 1998; Kazumi *et al.*, 1999; Hirose *et al.*, 2001; Allison *et al.*, 2013; Kerimkulova *et al.*, 2014) and specifically the systolic blood pressure (Hirose *et al.*, 2001) or diastolic blood pressure (Wada *et al.*, 2006). Whereas no any significant correlation of leptin with systolic or diastolic blood pressure (Al-Sultan and Al-Elq, 2006) was also found.

In male adolescents, serum leptin levels significantly correlated with BMI, SBP, mean blood pressure and HR (Hirose *et al.*, 2001). Leptin levels in non-obese normal weight subjects and obese subjects were determined (Al-Sultan and Al-Elq, 2006) that showed that serum leptin significantly and positively correlated with BMI; but did not show any correlation with mean systolic BP or mean diastolic BP. A study comprising the estimation of leptin levels in overweight children and adolescents showed greater BMI significantly and independently associated with increased serum leptin levels (Antunes *et al.* 2009).

Subjects with high-normal and high blood pressure showed increased body mass index, % age body fat and serum leptin (Kazumi *et al.*, 1999). The association of leptin levels with the blood pressure profile, hypertension and BMI were found different in Urbanized Africans and Caucasians. Africans revealed higher leptin levels, blood pressure, carotid intima-media thickness and cross sectional wall area (CSWA) than Caucasians (Pieterse *et al.*, 2012). However, carotid CSWA associated significantly with leptin levels independent of BMI.

Leptin is considered as an independent mediator for obesity-related elevations in BP proved by a study showing significantly higher mean body mass index levels, systolic BP, and diastolic BP related to leptin levels (Nakamura *et*

et al., 2009). Leptin was found associated with diastolic blood pressure (DBP) but not with systolic blood pressure (SBP) in men with mean body mass index (BMI) of 23.0 kg/m^2 (Wada *et al.*, 2006). It is quite interesting to note that after dividing the subjects into those having normal blood pressure (SBP: $<130 \text{ mmHg}$; and DBP: $<85 \text{ mmHg}$) and those having higher blood pressure, leptin associated positively and significantly with DBP but not with SBP for subjects in the normal blood pressure range (Wada *et al.*, 2006). On the other hand, no any association of leptin with SBP or DBP was found statistically significant among the subjects with higher blood pressure, and it was interpreted that leptin may maintain and increase arterial tone for elevating DBP only within normal blood pressure limit (Wada *et al.*, 2006). On this basis it was concluded that perhaps leptin serves as a physiological mediator or at least a marker for elevating DBP in obesity (Wada *et al.*, 2006).

Leptin has been studied in obesity related hypertension and early onset essential hypertension (Taylor *et al.*, 2014), metabolic syndrome (Ayeser *et al.*, 2016) conditions with moderate association with BMI (Sattar *et al.*, 2009), obesity-hypertension syndrome (Aneja *et al.*, 2004), and other physiological/ pathophysiological studies (Itoh *et al.*, 2002; Allison *et al.*, 2013; Rahma *et al.*, 2013; Kerimkulova *et al.*, 2014). Another report contradicts with the mentioned reports and explain the association of leptin with BMI instead of BP (Ozawa *et al.*, 2014) whereas it has been questioned that BMI and BP also depend on various parameters including age, sex, type of obesity and race differences (Redon, 2001) and these parameters should also be considered important.

Leptin has a significant role in obesity-related hypertension, especially in adolescents showing that body mass index (BMI) and serum leptin level increase in the order of BP categories (normotensive $<$ high normal $<$ hypertensive); and significant correlation with both systolic and diastolic blood pressure even after adjustment for age and BMI (Hirose *et al.*, 1998).

In spite of all mentioned reports, it is still controversial that what is the precise association of plasma leptin with BMI and blood pressure (systolic and diastolic) especially in Saudi population for understanding the involvement of these factors in health and disease. Hence, we planned to study the association of blood pressure, BMI and plasma leptin levels in young normal weight male university students.

MATERIALS AND METHODS

Normal healthy young male university students ($n: 28$) in the age range of 18-23 years were consulted for the current study. This is a part of research project submitted to the Umm Al-Qura University, Faculty of Medicine. After the acceptance and issuance of the ethical report for the project by ethical committee, the research work was well planned. A comprehensive Questionnaire was initially prepared for recording the general, clinical, anthropometric, biochemical, physiological, and cardiovascular measurements. Recording and statistical analysis of body mass index (BMI; kg/m^2), blood pressure (BP; mmHg) and plasma leptin levels (ng/ml) were included for the present report. Body mass index was estimated by: $\text{Body Weight (kgs) / Body Height (m}^2\text{)}$.

Subjects in the present part of study were only the healthy normal male students who had no serious medical disorder. They were unmarried university students not having the habit of smoking and they all had healthy body weight. Detailed physical, psychological and socio-cultural information was collected in the Questionnaire. Age, ethnicity, education level, year of education, nutrition, temperament, personal habits and related information was gathered to initially assess the general health of the subjects for further decision whether to include or exclude for the present project study. Each subject was informed that the study undergoing is for research purpose and the subjective information, blood analysis and other tests/ examination will be done for the research purposes. Only those subjects were included in the study who showed willingness to be included in the present study.

After taking the consent of the subjects, physiological assessments including age, body weight, body height, temperature, blood pressure and physiological interview/ history were taken. In the next step, the blood samples were taken, and samples were divided into aliquots, and stored in appropriate temperature. Systolic and diastolic blood pressure and other physiological tests were carried out by general routine methods. Leptin Human ELISA Kit was used for the determination of the plasma levels of leptin. Statistical analysis was carried out following Zahir *et al.* (2014). Mean \pm SEM, values of t , Two-tailed P Values for one sample t -test results were obtained and the R^2 was estimated for the regression lines using specifically organized spreadsheets.

RESULTS

The mean \pm SEM values of systolic blood pressure, diastolic blood pressure, body mass index and plasma leptin levels in young normal weight male university students are given in Table 1, and shown diagrammatically in Fig. 1- Fig. 5. Two-tailed P values for the one sample t -test results are given in Table 1.

Table 1. Blood pressure, Body Mass Index and plasma leptin levels in normal male university students.

| Variables | | Values (Mean \pm SEM) | Two-tailed P Value (One sample t-test result) |
|--------------------------------|-----|-------------------------------|--|
| BMI (kg/m^2) | | 21.98 \pm 0.4128 (n: 28) | 0.5861 (t=0.55) |
| Plasma Leptin (ng/ml) | | 3.40 \pm 0.30 (n:28) | 0.1954 (t=1.33) |
| Blood Pressure (mmHg) | SBP | 118.86 \pm 1.06 (n:28) | 0.0012 (t=3.63) |
| | DBP | 73.93 \pm 1.07 (n:28) | 0.0010 (t=3.69) |

BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; n: number of subjects

The relationship between plasma leptin (ng/ml) and body mass index (kg/m^2) is represented in Fig.1. Linear and significant results were obtained for this relationship (R^2 : 0.70; p :2.77 E⁻⁸).

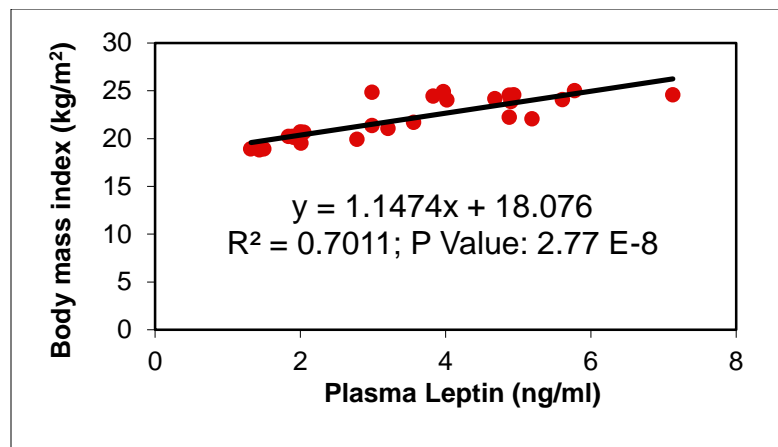


Fig.1. Association of plasma leptin and body mass index in male university students having normal body weight.

The plot of body mass index and systolic blood pressure (Fig.2) showed a positive and significant relationship (R^2 : 0.452; p : 0.000089).

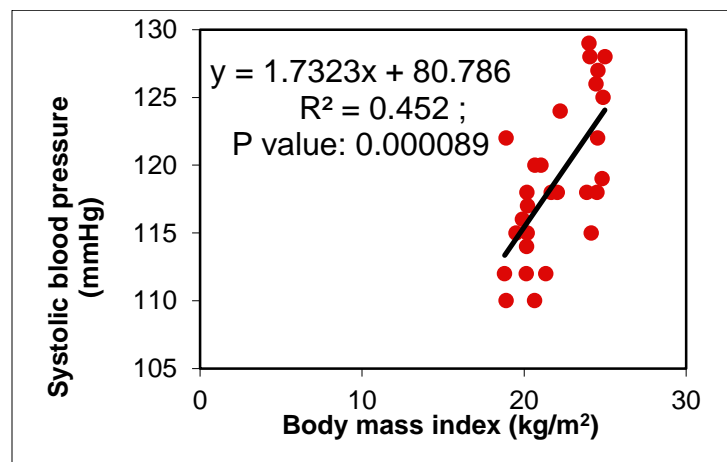


Fig.2. Association of body mass index and systolic blood pressure in male university students having normal body weight.

Body mass index plotted against diastolic blood pressure also showed linear and significant relationship (Fig. 3; R^2 : 0.3935; p :0.000353).

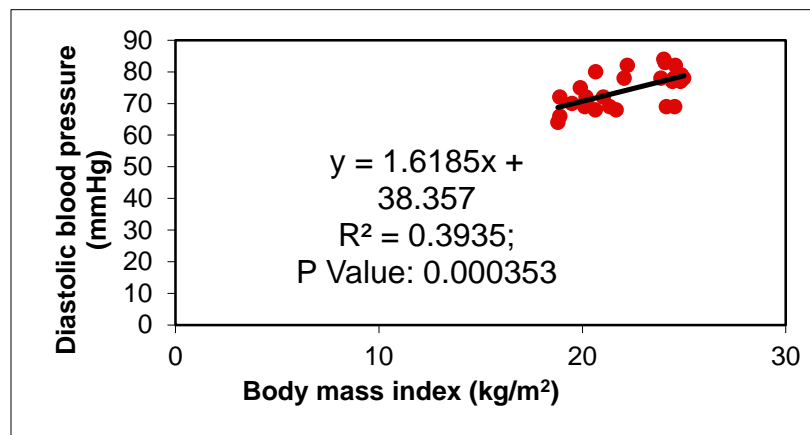


Fig. 3. Association of body mass index and diastolic blood pressure in male university students having normal body weight.

The results for the relationship of plasma leptin against systolic blood pressure represented R^2 as 0.3875 (Fig. 4; p : 0.000404).

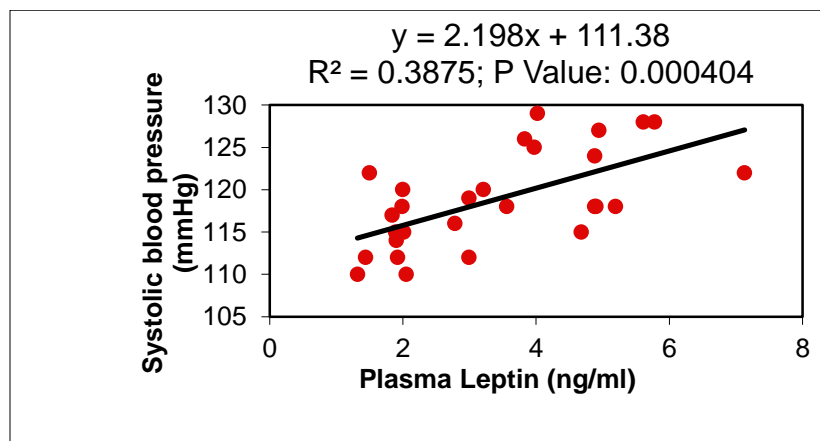


Fig. 4. Association of leptin and systolic blood pressure in male university students having normal body weight.

The results for relationship between plasma leptin and diastolic blood pressure were found positively and significantly related (Fig. 5; R^2 : 0.2853; p : 0.003412).

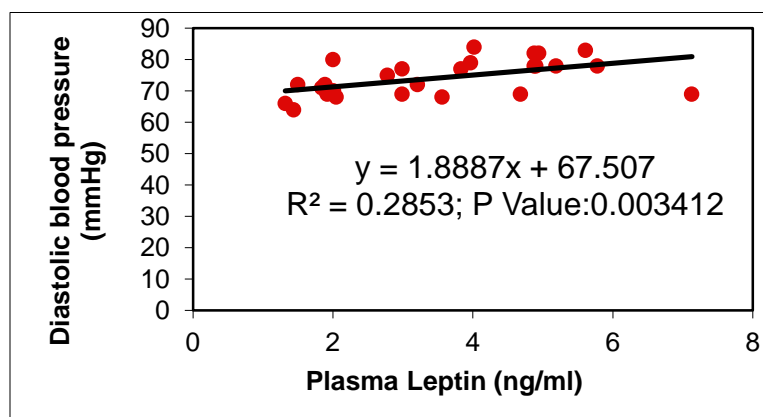


Fig. 5. Association of leptin and diastolic blood pressure in male university students having normal body weight.

The present study hence, provides information about the linear significant association for BMI vs leptin levels, BMI vs systolic blood pressure, BMI vs diastolic blood pressure, systolic blood pressure vs leptin levels, and diastolic blood pressure vs leptin levels.

DISCUSSION

The present study provides the original data of the body mass index, blood pressure and leptin levels in Saudi young male subjects in the age range of 18-23 years. No such study for the mentioned age range in male young subjects was carried out in Saudi Arabia. Hence, this report serves as the new information and can be compared with the international reports.

Linear and significant relationship between plasma leptin and body mass index obtained in the present study interprets the association between plasma leptin and body mass index very similar to the previous investigations (Antunes *et al.* 2009; Nakamura *et al.*, 2009) where body mass index was found associated significantly and independently with increased serum leptin levels.

The positive and significant association between body mass index and systolic blood pressure in the present report does not contradict the previous studies (Redon, 2001; Allison *et al.*, 2013; Kerimkulova *et al.*, 2014).

Body mass index plotted against diastolic blood pressure has however, not been precisely investigated. Leptin and diastolic blood pressure showing linear and significant relationship in the present work are similar to one another study (Wada *et al.*, 2006) though no any significant correlation of leptin with systolic or diastolic blood pressure was also documented (Al-Sultan and Al-Elq, 2006) in a different age group of subjects. Hence, we suggest for further studies to clarify the association of body mass index with the diastolic blood pressure.

The results for the relationship of plasma leptin against systolic blood pressure representing significant association in the current work are not different from the studies investigating the association between serum/plasma leptin with the blood pressure (Hirose *et al.*, 1998; Kazumi *et al.*, 1999; Hirose *et al.*, 2001; Allison *et al.*, 2013; Kerimkulova *et al.*, 2014) and specifically the systolic blood pressure (Hirose *et al.*, 2001).

The results for relationship between plasma leptin and diastolic blood pressure to be positively and significantly related in the present study resemble partly to a report where leptin associated positively and significantly only with DBP but not with SBP for subjects in the normal blood pressure range (Wada *et al.*, 2006).

The present study in the Saudi young male subjects in the age range of 18-23 years presents new and interesting information for the types of association among plasma leptin, body mass index and systolic and diastolic blood pressure, and is promising for the management of general health, and clinical, diagnostic, therapeutic and pathophysiological aspects.

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