

Clinical Study

# Relationship between leptin and adiponectin concentrations in plasma and femoral and spinal bone mineral density in spinal cord–injured individuals

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## Abstract

**BACKGROUND CONTEXT:** Previously, the associations between leptin and adiponectin levels with bone mineral density (BMD) have been reported in different populations, and occasionally, controversial results have been demonstrated. Until now, these relationships in spinal cord–injured individuals have not yet been described.

**PURPOSE:** We tried to investigate the correlation between leptin and adiponectin concentrations in plasma and BMD in Iranian patients with spinal cord injury (SCI).

**STUDY DESIGN/SETTING:** Cross-sectional investigation.

**PATIENT SAMPLE:** Referred patients with SCI who did not meet our exclusion criteria such as pregnancy, lactation, amputation, history of diabetes, cancer, endocrinology disease, and use of special medications entered the study.

**OUTCOME MEASURES:** Bone mineral density of femoral neck, trochanter, intertrochanteric zone, total hip, and lumbar vertebrae assessed by dual-energy X-ray absorptiometry and serum leptin and adiponectin levels measured by blood sample analysis using immunoassay techniques.

**METHODS:** Patient demographic characteristics were measured during face-to-face visits. Injury level and Spinal cord Injury Association (ASIA) score were assessed by clinical examination and were confirmed by imaging aids. Measured levels of leptin and adiponectin and dual-energy X-ray absorptiometry results were analyzed with partial correlation analysis method after adjustment for weight, body mass index (BMI), and age.

**RESULTS:** Total of 104 patients (19 females and 85 males) entered this investigation. Higher leptin concentration was significantly associated with higher BMD in femoral neck ( $p=.006$ ,  $r=0.73$ ), femoral intertrochanteric zone ( $p=.001$ ,  $r=0.83$ ), and hip ( $p=.001$ ,  $r=0.81$ ) only in female patients, whereas no such association was detected in male participants after adjusting for BMI and age. Leptin and adiponectin levels were not associated with lumbar spine BMD in both genders. Neither injury level nor ASIA score and plegia type (paraplegia or tetraplegia) influenced on leptin and adiponectin concentrations.

**CONCLUSIONS:** We found no association between leptin concentration and BMD in male individuals, whereas a positive correlation between leptin and BMD of femoral neck, intertrochanter, and hip was observed in female patients that shows a sexual polymorphism in this relationship. However, by considering the low number of female participants, these results should be interpreted

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cautiously. Lumbar spine BMD was associated with neither leptin nor adiponectin level in both genders. © 2015 Elsevier Inc. All rights reserved.

**Keywords:** Leptin; Adiponectin; Spinal cord injury; Bone mineral density; Femur; Spine

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## Introduction

It has been proposed that body fat mass may be positively associated with bone mineral density (BMD) [1–3]. This protective effect of obesity against bone mineral loss is known, and several mechanisms have been proposed such as increased mechanical loading and changes in some lipid-derived hormones' level [4]. Leptin is a 14-kDa protein that is mainly derived from fat tissue and is known as an appetite suppressor and stimulator of energy expenditure [5]. Its various endocrine functions have also been shown [6]. Many investigations have supported the positive effect of leptin on BMD as it has been shown that leptin promotes osteoblastic differentiation [7] along with inhibition of osteoblast apoptosis and osteoclastogenesis [8,9]. However, results in human models showed controversy in different investigated populations. Whereas some literature reported no association between leptin level and BMD [10–18], some reported a positive relationship [19–24] and some studies even revealed negative correlation [25–30]. In this regard, many populations have been investigated, and various outcomes can be because of differences in characteristics of studied cases. Many factors may influence the relationship between leptin and adiponectin concentrations and BMD. Adiponectin is an adipocytokine that is mainly expressed in visceral fat and bone marrow fat deposits [31]. As it has been shown that osteoblasts have adiponectin receptors, it has been proposed that this hormone influences bone metabolism [32]. The characteristics of the status of investigated population, background diseases, gender, and other hormonal changes that noticeably influence on fat distribution may play a part in BMD changes in response to alterations of leptin and adiponectin concentrations. Investigations in human immunodeficiency virus-infected men revealed that fat distribution may modify the relationship between leptin and bone density [27]. Up to now, the relationship between leptin and adiponectin levels and BMD has been investigated in premenopausal and postmenopausal women [12,18], hemodialysis patients [29], kidney transplant recipients [33,34], patients with Type II diabetes [21], and even healthy men and women [13,20,35,36], but until now, this association in spinal cord-injured individuals was not evaluated. In this study, we tried to investigate the effect of leptin and adiponectin concentrations on BMD in patients with spinal cord injury (SCI). Mostly, the negative association between adiponectin and BMD has been reported [37–39], but still, the controversial results exist as some studies have also detected no association between adiponectin level and BMD [40]. Again, different investigated population characteristics, gender, fat distribution, genetic tendency of each

specific nationality, and background diseases affect this relationship noticeably and lead to these variety of outcomes. Up to now, these associations were not described in SCI population. Here, we investigated the population of Iranian spinal cord-injured individuals to find out whether the correlation between leptin and adiponectin concentrations in plasma with BMD shows a special pattern in these patients.

## Materials and methods

### *Participants*

Spinal cord-injured individuals who were referred to Brain and Spinal Injury Research Center were invited to participate in these investigations, and patient selection was based on the inclusion criteria such as traumatic SCI and post-injury duration longer than 1 year. All patients were wheelchair users. It is noticeable that spared ability to walk after SCI is an important confounding factor because patients who are able to walk (assisted with canes or nonassisted) have a higher BMD because of lesser mechanical unloading. Exclusion criteria were pregnancy, lactation, amputation, and nontraumatic SCI etiology. Patients with history of diabetes, cancer, endocrinology disease, acute infection, use of special medications, such as glucocorticoid, hormones, thyroid hormones, anticonvulsive drugs, heparin, aluminum-containing antacids, lithium, omega-3 fatty acids, or other nutrient supplements, and smoking or alcohol consumption were also excluded.

### *Study design*

This investigation is a cross-sectional study aiming to evaluate the plasma concentrations of leptin and adiponectin in spinal cord-injured individuals and assess their relationship with BMD. Data were collected from November 2010 till 2011. All patients received adequate information about the study, and written consents were obtained before enrollment. The protocol was approved by the ethics committee at Tehran University of Medical Sciences.

### *Anthropometric measurements*

Patients' demographic characteristics including gender, age, and postinjury duration were obtained during face-to-face interviews. Body weight was measured using a digital wheelchair scale, body height was obtained measuring the supine length, and body mass index (BMI) was calculated as body weight (in kilograms) divided by height (in meters) squared.

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