THE ASSOCIATION BETWEEN RADIOGRAPHIC FEATURES IN PATIENTS WITH LUMBAR SPINE DEGENERATIVE CHANGES AND BODY MASS INDEX; A PRELIMINARY STEREOLOGICAL STUDY

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ABSTRACT

Objective: *To evaluate the association between radiographic features (osteophytes, disc space narrowing) in patients with lumbar spine degenerative changes and body mass index (BMI), with quantitative methods.*

Material and Method: *One-hundred and three women with lumbar spine degenerative changes who had lower back pain were included in the study. Patients were divided into two groups according to their BMI. Pain and functional status of patients were evaluated using visual analog scale (VAS) and Roland Morris Questionnaire (RMQ), respectively. The size of osteophytes and disc space narrowing were calculated on lateral roentgenogram of the lumbar vertebrae by using computer based stereological methods.*

Results: *No significant correlation was detected between the BMI and radiological findings. But, there was a positive correlation between the osteophyte surface area and RMQ, and VAS and RMQ ($p<0.05$).*

Conclusion: *No significant correlation was detected between the BMI and radiographic findings in lumbar spine degenerative changes. To our knowledge, this is the first study quantitatively assessing the association between radiographic findings and BMI in lumbar spine degenerative changes.*

Key Words: *Lumbar vertebra, body mass index, osteophyte*
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LOMBER OMURGA DEJENERATİF DEĞİŞİKLİKLERİ OLAN HASTALARDA RÖNTGEN BULGULARI İLE BEDEN KİTLE İNDEKSİ (BKİ) ARASINDAKİ İLİŞKİ; STEREOLOJİK BİR ÖN ÇALIŞMA

ÖZET

Amaç: Lomber bölgede dejeneratif değişiklikleri olan hastalarda, osteofit, disk aralığında daralma gibi röntgen bulguları ile beden kitle indeksi (BKİ) arasındaki ilişkiyi kantitatif metodlarla değerlendirmek.

Materyal ve Metod: Bel ağrısı ve bel omurgasında dejeneratif değişiklikleri olan 103 kadın çalışmaya alındı. Hastalar BKİ'ye göre iki gruba ayrıldı. Hastaların ağrı ve fonksiyonel durumları sırasıyla Vizüel analog skala (VAS) ve Roland Morris Questionnaire (RMQ) ile değerlendirildi. Hastaların osteofit boyutu ve disk mesafesi darlığı derecesi yan vertebra grafilerinde bilgisayar tabanlı stereolojik metodla değerlendirildi.

Bulgular: BKİ ile radyolojik bulgular arasında anlamlı bir ilişki tespit edilmedi. Ama osteofit yüzey alanı ve RMQ, ve VAS ve RMQ arasında pozitif bir korelasyon vardı ($p<0,05$).

Sonuç: BKİ ile bel omurlarındaki dejeneratif değişikliklerin radyolojik bulguları arasında anlamlı bir ilişki yoktu. Kanatimize göre bu çalışma BKİ ile bel omurlarındaki dejeneratif değişikliklerin radyolojik bulguları arasındaki ilişkiyi kantitatif olarak değerlendiren ilk çalışma idi.

Anahtar Kelimeler: Bel omurgası, beden kitle indeksi, osteofit **Nobel Med 2013; 9(3): 9-13**

INTRODUCTION

Lumbar spine degenerative changes are the most frequent reasons for lower back pain in older people. Typical radiological imaging show joint space narrowing and osteophytes. These radiological findings become more pronounced with age.[1] Obesity heads many factors which are account for the development of osteoarthritis. While there are many studies in the literature showing the relationship between obesity and knee and hand osteoarthritis, there are conflicting studies on hip and spine osteoarthritis. Obesity causes osteoarthritis development through mechanic load and systemic effects.[2] There have been many studies evaluating the risk factors in patients with osteoarthritis but these studies used qualitative methods as the measurement in radiological evaluation of lumbar spine area. Stereological methods are used to calculate an object's surface area and volume. There are many studies in the literature which have used this method.[3,4] To the best of our knowledge, this is the first study in literature investigating correlation between the lumbar spine degenerative changes and obesity with the use of stereological methods.

In our study, we planned to evaluate the relationship between obesity and radiological changes in patients diagnosed with lumbar spine degenerative changes using the stereological method.

MATERIAL and METHOD

Hundred and three patients who presented with lower back pain and were diagnosed with lumbar spine degenerative changes were included in the study. Patients with diabetes mellitus, inflammatory rheumatic disease, compression fractures or those who had undergone lower back surgery or a major trauma were excluded from the study. It was difficult to ensure correlation between groups and as most of our patients was female and in order to reduce the impact of gender on the study, only female patients were included. Thereafter, the patients were divided into two groups according to BMI values. Those with a BMI value of equal to or under 29.9 were placed in Group 1 and those with values higher than this were put into Group 2. Visual analog scale (VAS) scores were used to set patients' pain levels. The Roland Morris Questionnaire (RMQ) was applied to evaluate functional condition. Lumbar lateral X-rays were taken in the standard position and was transferred to a computer. The radiographs were subsequently evaluated by a single observer for the presence of the individual radiographic features. Each vertebral level from L1/2 to L4/5 was assessed for the anterior osteophytes and vertebral narrowing area by using on "image j" programme (digital planimetric).[5]

The ratio between the calculated surface and related vertebrae surface areas was established. In this way, a percentage value was obtained for the surface area of every level osteophyte and the disc space narrowing. By totaling these values, the patients' total osteophyte and disc space narrowing percentage value was obtained. Then the relationship between these results and BMI was investigated.

Ethic board approval of the study was obtained from the local ethic board committee of our hospital. All patients who participated to the study signed informed consent.

Stereological Method

This is a method used to calculate the surface area and volume of objects. Various methods can be used to calculate the surface area of objects. One of these is the use of rulers on the scanned area to count the dots; the other is computer supported digital planimetric programmes (image j). Many articles in the literature used these methods.[6-7]

Continuous variables were expressed as mean±standard deviation (SD). Prior to statistical applications, normal distributions of values in this study were verified by normality tests such as Kolmogorov-Smirnov. Parametric statistical analysis was then performed. Comparison for groups was performed using the independent t-test and ANOVA (post hoc Bonferroni test). Correlation analysis for continuous variables was performed using the Pearson correlation coefficient when indicated. $p<0.05$ was considered statistically significant.

RESULTS

Hundred and three female patients with a mean age of 60.9±8.2 years and average Body Mass Index (BMI) of 29.9±4.9 were included in the study. Group 1 consisted of 52 female patients with an average age of 61.2±8.4 years and a BMI of ≤29.9, while Group 2 included 51 patients with an average age of 61.2±8.4 years (Table 1). There was no significant difference between the two groups with respect to the mean ages of the groups (p=0.880). In Group 1, surface area of osteophytes, the area of disc space narrowing, VAS and RMQ were 0.022±0.021, 0.41±0.05, 5.4±1.3, 17.3±4.5, respectively. In Group 2, these values were 0.019±0.018, 0.40±0.06, 5.8±1.3, 16.7±4.8, respectively. When lower back survey results were evaluated, there was no significant statistical difference between groups (VAS for p=0.660, RMQ for p=0.220) (Table 2).

Correlation analysis revealed a significant positive correlation between VAS and RMQ and the weak →

correlation between the osteophytes area and disc narrowing space area was not statistically significant (Table 3).

DISCUSSION

Osteoarthritis (OA) is the most common articular disease and a leading cause of chronic disability. The lumbar spine is a common location for osteoarthritis.[1] OA is characterised radiologically by the presence of osteophytes, subchondral sclerosis and joint space narrowing. The axial skeleton shows the same classic alterations of cartilage loss and osteophytosis characteristic features.[8] Joint space narrowing which is because of cartilage loss, whereas both subchondral sclerosis and osteophytes which are hypertrophic responses of bone, thought to arise directly either to cartilage loss or to biomechanical stress. The pathophysiology and the inter-relationship of these features are not well understood.

Various risk factors have been defined as related to the development of OA. The most important of these is age. Aging is the primary predictor of osteoarthritis, with most people older than 70 years of age showing some signs of disease in at least one joint.[9]

Degenerative changes become more pronounced as age progresses. In 80 years and over, the rates increases to as much as 90%.[10]

Arthritis Research UK published a report in 2009 entitled "Osteoarthritis and obesity" in which they highlight the severe consequences of obesity for musculoskeletal health. Throughout the report, however, the mechanical effect of excess body weight is assumed to be the direct cause of osteoarthritis (OA).[11]

Obesity is a significant risk factor for developing osteoarthritis in weight-bearing and non-weight-bearing joints. Although the pathogenesis of obesity-associated osteoarthritis is not completely understood, recent studies indicate that pro-inflammatory metabolic factors contribute to an increase in osteoarthritis risk. Adipose tissue, is a local source of pro-inflammatory mediators that are increased with obesity and have been shown to increase cartilage degradation in cell and tissue culture models. One adipokine in particular, leptin, may be a critical mediator of obesity-associated osteoarthritis via synergistic actions with other inflammatory cytokines. Biomechanical factors may also increase the risk of osteoarthritis by activating cellular inflammation and promoting oxidative stress. However, some types of biomechanical stimulation, such as physiologic cyclic loading inhibit inflammation and protect against cartilage degradation.[12]

Table 1: Demografic and clinical features in all patients.

	Group 1 (BMI<30)	Group 2 (BMI≥30)
Patient number	52	51
Age	60.9±8.2	61.2±8.4
BMI	26.3±2.4	33.7±3.9
Osteophytes area	0.022±0.021	0.019±0.018
Disc narrowing space area	0.41±0.05	0.40±0.06
VAS	5.4 ±1.3	5.8 ±1.3
Roland Morris	17.3 ±4.5	16.7±4.8

BMI: Body mass index, VAS: Visual analog scale

Moreover, when osteoarthritic chondrocytes were obtained from patients with a range of body mass indexes, MMP13 gene expression was only altered by physiologic concentrations of leptin in cells from obese patients.[13]

Obesity is one of the most influential but modifiable risk factors because it exerts an increased mechanical stress on cartilage. However, the high prevalence of OA in obese individuals in non-weightbearing areas, like finger joints, suggests that the link between being overweight and OA lies with factors other than simple biomechanics. An important correlation has been made between obesity and inflammation. Adipose tissues play an important role in this context because they are the major source of cytokines, chemokines, and metabolically active mediators called adipokines (or adipocytokines).[14]

Obesity is a chronic disease caused by an imbalance between the energy ingested and expended. An increase in size fat cells produce the clinical problems associated with obesity on account of the increased secretion of free fatty acids and numerous peptides from enlarged fat cells. Finally obesity causes the spectrum of medical (such as diabetes mellitus, stroke, osteoarthritis, heart disease, and some forms of cancer), social, and psychologic disabilities includes a range of medical and behavioral problems.[15]

However, mechanical factors alone do not seem to be sufficient to explain the relationship between osteoarthritis incidence and obesity.[16] Further studies are needed to explore the biological mechanisms that link overweight and obesity with these co-morbidities.[16]

Generally, there is not always a correlation between clinical complaints and radiological scores. Pye et al. evaluated the relationship between lower back pain and radiological changes of the lumbar vertebrates in 289 female and 286 male patients. Each vertebral level from L1/2 to L4/5 was assessed for the presence and severity of anterior osteophytes, end plate sclerosis, and vertebral narrowing, using a reference atlas and a →

Table 2: Comparison of clinical and radiological scores in groups

	Group 1	Group 2	p
Osteophytes area	0.022±0.021	0.019±0.018	0.634
Disc narrowing space area	0.4±0.05	0.4±0.06	0.171
VAS	5.4 ±1.3	5.8 ±1.3	0.660
Roland Morris score	17.3 ±4.5	16.7±4.8	0.220

VAS: Visual analog scale

Table 3: Correlation of the examination parameters (r values)

	Age	BMI	Osteophytes area	DNSA	VAS	RMS
Age	1	0.07	0.06	0.04	0.07	0.09
BMI	0.07	1	0.01	-0.15	0.14	-0.04
Osteophytes area	0.06	0.01	1	0.12	-0.01	0.35*
DNSA	0.04	-0.15	0.12	1	-0.04	-0.17
VAS	0.07	0.14	-0.01	-0.04	1	0.59*
RMS	0.09	-0.04	0.35	-0.17	0.59	1

BMI: Body mass index, VAS: Visual analog scale, DNSA: Disc narrowing space area, RMS: Roland Morris score, *p<0.05

semiquantitative score (grade 0, none; grade 1, mild; grade 2, moderate; grade 3, severe). In the radiological findings they observed that osteophytes and endplate sclerosis was higher in women, but that there was no difference between the gender in disc space narrowing. While they found a strong relationship between disc space narrowing and lower back pain, there was no relationship between the other parameters.[17] In our study, a significant correlation was found between radiographical variations (osteophytes area) and clinical findings (RMS).

A number of studies have shown that obesity represents one of the most important risk factors and it is also a predictor for progression of OA, especially of a knee, hand and less of the hip joint. Relationship between BMI and OA of the knee is mainly linear, and duration of increased joint loading or gaining weight is also significant.[18]

Kalıchman et al. evaluated the association between age, sex and BMI and lumbar spine degeneration features (intervertebral disc narrowing, facet joint OA, spondylolysis, spondylolisthesis and spinal stenosis).[19] 104 men and 83 women were included in the study. A significantly higher prevalence of facet joint OA was found in the obese group.[19]

Cvijetic et al. evaluated the association between spinal degenerative changes and some risk factors in the elderly population.[9] A population sample of 280 women and 263 men, older than 45 years, participated in the study. Radiographs of the thoracic and lumbar spine were evaluated for the presence of osteophyte formation and vertebral deformities. Osteophyte size was graded on a scale (semi quantitive) from 0 to 4. Vertebral deformities were determined by the semiquantitative method of McCloskey. There was a significant association between deformities and osteophytosis on the lumbar segment of the spine. Analysing the influence of several risk factors, age was found to be the most associated with both vertebral deformities and osteophytosis.

Obesity was significantly associated with osteophytosis.[10] In a study by Muraki et al., 2288 participants aged > or = 60 years (818 men and 1470 women) were analysed. The prevalence of radiographic lumbar spondylosis was investigated in a large-scale population study and the association with low back pain was examined.[20] The radiographic severity at lumbar intervertebral levels from L1/2 to L5/S1 was determined by Kellgren/Lawrence [KL] grading. Age and body mass index were risk factors for both KL > or = 2 and KL > or = 3 spondylosis. Although KL = 2 spondylosis was not significantly associated with lower back pain compared with KL = 0 or 1, KL > or = 3 spondylosis was related to the pain only in women. The author suggested that high prevalence of radiographic lumbar spondylosis in elderly subjects. Gender seems to be distinctly associated with KL > or = 2 and KL > or = 3 lumbar spondylosis, and disc space narrowing with or without osteophytosis in women may be a risk factor for low back pain.[20]

There are articles in the literature stating that there is no relationship between obesity and degenerative changes. In a study by Horvath et al., a survey was conducted on 10,000 people between the ages of 14-65 regarding lower back pain. People with lower back pain complaints and written consents were asked to participate in a further clinical investigation, where radiological and clinical assessment was performed. A total of 4,389 persons (44.1%) reported lower back pain.[21] The Oswestry disability index (ODI) in the examined group of patients averaged 35.1%; radiological degenerative signs were observed in 392/682 (57.5%). Individuals with signs of radiological degeneration had a statistically significant higher ODI value, age, and a higher, yet not significantly increased BMI value than radiographically negative patients. Higher osteoarthritis prevalence was found in individuals with radiographic signs of spinal degeneration. Similar results have been emphasized in different studies.[22,23]

In conclusion, there are conflicting results regarding obesity and radiological changes in the lumbar vertebrae. In our study, no significant relationship was determined between obesity and the radiological changes in the vertebrae (osteophyte development→

and disc narrowing space). While in some studies obesity has been shown to increase lower back pain in women, in our study no significant difference was found.[20,21]

Our study has some limitations. When compared to studies in the literature, this study had lower number of patients. However, our study has a potential of providing basis for comprehensive studies in the field. The relatively small number of patients limit the statistical power of our study. The fact that the radiological evaluation was carried out by one person, and that the groups were formed from only female patients can be counted as limitations. The feature that separates our study from other studies in the literature is that by using a different method in the radiological evaluation: the results were evaluated quantitatively.

As a result, we were unable to find any statistically significant difference between radiological changes due to lumbar spine degenerative changes and obesity. To our knowledge, our study was the first to investigate this relationship using a different method (stereological methods). We believe that further studies are needed using this method on larger patient populations.

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