THE EFFECT OF BODY MASS INDEX ON DEVELOPMENT OF LUMBAR OSTEOARTHRITIS IN SYMPTOMATIC PATIENT

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ABSTRACT

BACKGROUND

The lumbar osteoarthritis is considered as one of the most important causes of disability in the society by negatively affecting the occupations or jobs related to patients having the disease. Such disease results also in high costs from recurrent hospitalizations, chronicity of disease and work loss. High body mass index; on the other hand, results also in different morbidities like diabetes, cardiovascular disease, respiratory disease, gallbladder disease, ...etc. It is believed that high body mass index may result in osteoarthritis like lumbar osteoarthritis.

OBJECTIVE

The objective of this study is to evaluate the impact of body mass index (BMI) on the development of lumbar osteoarthritis (OA) by accounting for the mechanical loading effects of total body weight on the development of lumbar OA.

PATIENTS AND METHOD

A retrospective study was done in Rheumatology outpatient clinic. In Ibn Sena Teaching Hospital-Iraq

200 people were included in this study, we divided them in to two groups of individuals; the first group consists of 100 patients with BMI ≥ 25 kg / m² and the second group also consists of 100 patients but with BMI < 25 kg / m² had been collected from Mosul City population during their visiting Ibn-Sina Teaching Hospital/ Rheumatology Clinic for low back pain. We selected those patients whose ages were above 40 years. The mean age $\pm$ SD was 48.4 $\pm$ 7.48 years for the first group and 47.6 $\pm$ 10.7 years for the second. Clinical and radiological assessment was performed for all patients. Both groups are compared regarding the development of lumber OA changes.

RESULTS

The results of this study showed that there were 71 (71%) had low back pain and lower limb symptoms among the patients in the first group and 31 (31%) among the patients in the second group ($p < 0.001$). Statistically, this was highly significant.

The frequency of Sleep difficulty and abnormal gait pattern was 81 (81%) and 42 (42%) in the first group VS. 56 (56%) and 21 (21%) in the second group respectively.

Pain during lateral flexion, rotation, rotation with extension and positive straight leg-rising test were 60 (60%), 40 (40%), 37 (37%) and 32 (32%) in first group and 31 (31%), 10 (10%), 8 (8%) and 9 (9%) in second group respectively. Different radiological signs (joint space narrowing, osteophytes, sclerosis and osteoarthritis) were present in 87 (87%), 82 (82%), 36 (36%) and 92 (92%) of first group and 21 (21%), 20 (20%), 12 (12%) and 26 (26%) of second group.

The above results were statistically highly significant ($P < 0.001$).

CONCLUSIONS

This study concluded that there was a direct positive correlation between BMI and the development of lumbar OA.

KEYWORDS: Body Mass Index-Lubooesteoarthritis

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INTRODUCTION

Osteoarthritis (OA) is the most common form of arthritis and the leading cause of disability in almost 80% of persons aged 40-60 or above [1],[2]. Osteoarthritis currently affects more than 20 million individuals in the United States, and this number is expected to increase [3]; [4]. OA results in 68 million lost workdays/year and 4 million hospitalizations/year; and approximately 100,000 patients in the United States are unable to walk from their bed to the bathroom because of OA [5].

Costs directly attributable to osteoarthritis are considerable in the United States, with work loss accounting for more than one half of the estimated annual expense of \$ 60 billion annually [6] ; [7]. Another major expense is the number of joint arthroplasties performed in patients in the advanced stage of the disease; in addition to the absence from work by those affected with the disorder [8].

Back pain is strongly associated with degeneration of the intervertebral disc. Disc degeneration, although in many cases asymptomatic, is also associated with sciatica and disc herniation or prolapse; so lumbar OA is considered as a major impact of low back pain (LBP) and chronic disability of elderly people in most developed countries, but the exact relationship between the two conditions(LBP and disability) remains unknown [9].

In the long term, lumbar OA can lead to lumbar spinal stenosis(LSS), a major cause of pain and disability in the elderly (Roberts& Urban., 2003 [9]) and the characteristic symptom of LSS is neurogenic claudication and/or lumbar or sacral radiculopathy [10].

Lumbar OA in many cases is asymptomatic but absence of symptoms does not exclude the disease, i.e Magnetic Resonance Image (MRI) imaging in asymptomatic patients over age 60 years reveals disk protrusions in 80% and degenerative spinal stenosis in 20% [11].

There is no exact cause of lumbar OA but obesity (high BMI) was considered to be one of the lifestyle factors that have been reported to be associated with the occurrence of lumbar disc disease [12].

Body Mass Index (BMI) is one of the important tools that asses the nutritional status of individuals or of the community and grade chronic energy deficiency in adults Weisell CR., 2002 [13];), and it was expressed as a ratio of weight in kg to height in meter squared, so the unit of BMI is (kg/m²) [14].

The high BMI (overweight and obesity) (BMI > 25kg / m² , BMI > 30 kg / m² respectively) were also associated with increased morbidity and mortality rates, and may have a role in the development of disc degeneration [15] ; [16], but with inconsistent results because most people have some degree of radiographic disease of the spine, even at young ages [16];[17] ; [18].

Aim of the Study

The aim of the study is to evaluate the effect of BMI on the development of lumbar OA.

PATIENTS AND METHODS

A sample of two groups of individuals (one hundred as patients with BMI > 25 kg / m² and other hundreds as control with BMI < 25 kg / m² had been matched for age and sex with low back pain (LBP) were included in the study.

Both groups were sent for lumbo sacral x-ray and the findings reported by a single radiologist were depended on Lane index grading system.

RESULTS

Table (1) show the mean value for age, BMI and male: female ratio for both groups with significant differences regarding BMI among them (p=0.000)

Table 1: Demographic Feature of the Study Population

	Case Group "BMI ≥ 25" n = 100	Control Group "BMI < 25" n = 100	P-Value ^a
Age mean±SD (years)	48.4±7.48	47.6±10.7	0.610
Male: female ratio	0.92:1.00	0.89:1.00	0.887 ^b
BMI mean±SD (Kg/m ²)	34.3±5.03	23.2±1.71	0.000

^aIndependent t-Test for two Means was used

^b Z-Test for Two Proportions was used

Table (2) show comparisons for clinical findings (symptoms and signs) between the two groups with significant differences among some of them.

Table 2

Symptoms and Signs	Case Group "BMI ≥ 25" n = 100 No. (%)	Control Group "BMI < 25" n = 100 No. (%)	P-Value ^a
Site of the pain			
Low back	29 (29.0)	69 (69.0)	0.000
Low back &Lower limb ^b	71 (71.0)	31 (31.0)	
Aggravating factors			
Physical activity	63 (63.0)	51 (51.0)	0.084
Cough/Sneezing	60 (60.0)	43 (43.0)	0.015
Standing	96 (96.0)	100 (100.0)	0.121
Sitting	95 (95.0)	93 (93.0)	0.551
Sleep difficulty	81 (81.0)	56 (56.0)	0.000
Others			
Saddle anesthesia	14 (14.0)	7 (7.0)	0.104
Sphincter dyscontrol	16 (16.0)	5 (5.0)	0.010
Signs			
Abnormal Gate	42 (42.0)	21 (21.0)	0.001
Loss of lordosis	44 (44.0)	45 (45.0)	0.887
Local tenderness	94 (94.0)	95 (95.0)	0.756
Pain during lat. flexion	60 (60.0)	31 (31.0)	0.000
Rotation pain	40 (40.0)	10 (10.0)	0.000
Rotation with extension pain	37 (37.0)	8 (8.0)	0.000

Table 2: Contd.,			
SLR	32 (32.0)	9 (9.0)	0.000
Femoral Stretching test	6 (6.0)	3 (3.0)	0.498
Neurological deficit	22 (22.0)	6 (6.0)	0.001

^a Z-Test for Two Proportions was used

Table (3) show radiological signs [joint space narrowing(JSN), Osteophytes, Sclerosis, and grading] for both groups

Table 3

Radiological Signs	Case Group "BMI ≥ 25" n = 100 No. (%)	Control Group "BMI < 25" n = 100 No. (%)	P-Value ^a
JSN			
Non	13 (13.0)	79	0.000
Mild	60 (60.0)	11 (11.0)	0.000
Moderate	16 (16.0)	9 (9.0)	0.132
Severe	11 (11.0)	1 (1.0)	0.005
Osteophytes			
Non	18 (18.0)	80 (80.0)	0.000
Small	58 (58.0)	7 (7.0)	0.000
Moderate	19 (19.0)	10 (10.0)	0.068
Large	5 (5.0)	3 (3.0)	0.721
Sclerosis			
Non	64 (64.0)	88 (88.0)	0.000
Present	36 (36.0)	12 (12.0)	
Grading			
G: 0 no JSN &no osteoph.	8 (8.0)	74 (74.0)	0.000
G: 1 JSN(1)&/or osteoph.(1)	55 (55.0)	10 (10.0)	0.000
G: 2 JSN(2-3)&/or osteoph.(2-3)	37 (37.0)	16 (16.0)	0.001

^a Z-Test for Two Proportions was Used

Table (4) show highly significant differences, regarding the evidence of lumbar OA based on the grading system, between those of normal BMI(18.5_24.9) and those of high BMI(≥ 25) from the total study sample.

Table 4: Role of BMI in the Development of Lumbar Osteoarthritis in the Study Sample

(n = 200)

BMI Subgroups	Evidence of Lumber OA via JSN and Osteophytes(Grading System)		P-Value ^a
	No OA (Grade 0) No. (%)	OA present (Grade 1 & 2) No. (%)	
Normal weight (18.5_24.9) ^b	74 (90.2)	26 (22.0)	0.000
Overweight (25.0_29.9)	1 (1.2)	20 (17.0)	0.000
Obese Class I (30.0_34.9)	4 (4.9)	34 (28.8)	0.000
Class II (35.0 – 39.9)	3 (3.7)	23 (19.5)	0.001
Class III (≥40.0)	0 (0.0)	15 (12.7)	0.000
Total	82 (100.0)	118 (100.0)	---

^a Z-Test for Two Proportions was Used.

^b Only 3 Patients were Underweight and Included with Normal Weight Group

Table (5) show that the number of those with evident lumbar OA(118) is higher than the rest(82) and there is a

significant relationship between some clinical signs (abnormal gait, rotation pain, and rotation with extension pain) and evident lumbar OA ($p=0.000$).

Table 5: Relationship between Lumbar OA (Grade) and Clinical Signs in the Study Sample

(n = 200)

Clinical Signs	Lumber OA				P-Value ^a
	Present [n = 118]		Absent [n = 82]		
	No.	%	No.	%	
Abnormal Gait Pattern	48	40.7	15	18.3	0.000
Loss of lordosis	57	48.3	32	39.0	0.190
Local tenderness	112	94.9	77	93.9	0.761
Pain during lat. flexion	58	49.2	24	29.3	0.004
Rotation pain	42	35.6	8	9.8	0.000
Rotation with extension pain	36	30.5	9	11.0	0.000
SLR	33	28.0	8	9.8	0.001
Femoral Stretching test	7	5.9	2	2.4	0.313
Neurological deficit	22	18.6	6	7.3	0.014

^a Chi Square Test was Used.

Correlations :

Total $r = 0.491$ $p=0.000$

Normal Wt. $r = -0.088$ $p=0.381$

Obesity $r = 0.142$ $p=0.159$

DISCUSSIONS

In our study showed the percentage of lumbar OA increased as the BMI progressed above 25kg/m²

While there's a controversy among other studies regarding the relationship between BMI and lumbar OA had been reported.

an epidemiological study done by Chaiwanichsiri et al showed a statistically significant relationship between BMI and lumbar disc disease i.e a highly prevalent lumbar disc degeneration is associated with higher BMI [19].

- There were the study done by Like M et al revealed weaker but significant associations between weight and lumbar spine disease. i.e BMI above 25 kg/m² increases the risk of lumbar disc degeneration and also over weight may increase the mechanical load of the spine, thereby increasing the risk of degeneration and back disorders [20].
- One of the largest studies done by Creative D et al at 2013 to investigate lumbar spine disc degeneration had found that adults who are overweight or obese were significantly more likely to have disc degeneration than those with a normal body mass index (BMI)[21].
- Also another 2 studies done by Seidler A et al and Schumann B Reversed our study they showed inconsistent results and unclear evidence of an association and did not find a clear relationship between body weight and lumbar disc disease [22] ; [23].

- In our study, there are significant differences between both groups (case and control) in relation to some clinical findings like LBP which was higher in case group(71%) than the control group(31%) [$p \leq 0.000$] as shown in the table (2)]. This is constant with study done by Roberts &Urban., 2003 [9] who had thought that there is strong association or implication between the two conditions (LBP and lumbar OA), but disagree with other studies done by Jenssen et al., 2002 [24] and Niosi.,2004 [25] who saw that the exact relationship between these conditions remained unknown.
- Sleep difficulty represented in the current study higher percent for the case group (81%) in comparison with the control group(31%) [$p \leq 0.000$] as shown in the table(2)] and these results agreed with the study done by Asher.,2008 [26] who had suggested that persistent back pain, especially at night, will prevent the patient from sleeping and no study found disagreed with the current one.
- Some lumbar spinal movements, like lateral flexion, rotation and rotation with extension, and straight leg- rising (SLR) appeared to be present in higher proportions(81%, 60%, 40%, 37% and 32% respectively) among individuals of case group, than those results present in the individuals of the control group[(56%, 31%, 10%, 8% and 9% respectively ($p \leq 0.000$) shown in the table(2)], and this also agreed with the study done by Lyle et al.,2004 [27] who had seen that such movements are painful ones that represent a predictor of severity in patients with degenerative lumbar conditions.
- The plain radiographs, lateral views in standing position, was performed for lumbosacral region by the radiologist for the studied population, and according to Lane index (radiological index for lumbar osteoarthritis) [28]), it was discovered higher percentage of mild JSN, small osteophytes, sclerosis and 5th level involvement(L5- S1 D.S) in the case group (60%, 58%, 36% and 32% respectively)($p \leq 0.000$), than those of control group (11%, 7%, 12% and 6% respectively); accordingly; grade 1 and grade 2(which represented presence of OA) appeared to be higher in the case group(55%, 37% respectively)($p \leq 0.000$) if they were compared with the control group (10%, 16% respectively). All these results shown in table (3) for this study were constant with a study done by Like et al., 2005 [20] who had concluded that the BMI above 25 kg/m² increases the risk of lumbar disc degeneration and also with a study done by Hangai et al., 2008 [29] who concluded that high BMI is associated with disc degeneration (DD); Creative., 2013 who saw that one of the largest studies to investigate lumbar spine disc degeneration had found that adults who are overweight or obese were significantly more likely to have disc degeneration than those with a normal body mass index (BMI). Assessments using magnetic resonance imaging (MRI) showed that elevated BMI is associated with an increased number of levels of degenerated disks and greater severity of disc degeneration, including narrowing of the disc space. Moreover, previous research has linked higher BMI to low back pain, which is often debilitating and can limit function, impact psychological well-being, diminish overall quality of life, and is associated with substantial socioeconomic and health-care cost. In a special report on obesity, the American Academy of Neurosurgeons states that obese people are 4 to 5 times more likely to be diagnosed with OA [30] and this consistent with the results of the current study.
- Magnetic resonance (MR) imaging is the imaging method of choice for degenerative disk disease, spinal stenosis, infection, and neoplasia of the lumbar spine. Computed tomography (CT) has been largely replaced by MR imaging for these diagnoses. The role of MR imaging in the evaluation of facet joint degeneration is less clear. Osteoarthritis of these joints may be demonstrated in patients who present with back pain with or without pain

radiating into the legs [31]. Although MRI and CT scan are more confirmative than plain radiograph, they cannot be used in this study because they are highly expensive and not always available.

- In the assessment of absence, presence and severity of the disease according to Lane grading system and in comparison with BMI subgroups, as shown in table (4), it was found that the higher percent of those having BMI $\geq 25 \text{ kg/m}^2$, had OA (grade 1 and grade 2),(17%, 28.8%, 19.5% and 12.7% respectively) compared with those had no OA (1.2%, 4.9%, 3.7% and 0.0 respectively). Such results again had proved that increased BMI can lead to increase the risk for the development of lumbar disc degeneration and agreed with study of Like et al., 2005 [20], although the mechanism by which overweight causes lumbar disc degeneration was poorly understood. The contribution of both mechanical and systemic factors is likely. Overweight may increase the mechanical load of the spine, thereby increasing the risk of degeneration and back disorders.
- The current study showed that there was a direct relationship between those having some clinical signs like abnormal gait pattern (40.7% - 18.3%), rotation pain(35.6%- 9.8%) and rotation with extension pain (30.5%- 11%) with evident lumbar OA (as defined by Lane grading system, grade 2 and 3). These results agreed with study performed by Daniel L.et al., 2001 [32] who had seen that symptoms associated with spinal cord compression include gait disturbances with balance difficulty, and also agreed with a study done by Whitman.et al, 2006 [33] who suggested that exercise-induced pain, especially on walking, suggests osteoarthritis or spinal stenosis.
- In table(3), it was found that 82 individuals(82%) among those have BMI $\geq 25 \text{ kg/m}^2$ had osteophytes while only 20 individuals(20%) among those have BMI $< 25 \text{ kg/m}^2$ had osteophytes. This results agreed with a study done by O'Neill et al.2009 [34]. who had explored osteophytosis within a UK adult population over age 50 years, finding 84% of men and 74% of women to demonstrate at least one vertebral osteophyte, with increased incidence among individuals with more physical activity, self-reported back pain, or higher BMI scores [11] ; and also the current results consistent with another study done by Pye et al (2009 [34]) showed that increased weight was associated with an increased risk of osteophytes.
- In the table (3 and 4), it had been noticed several findings like that 25 individuals (25%) have variable D.S affection although they have BMI $< 25 \text{ kg/m}^2$. In the table (7), variable numbers of individuals, though they have no lumbar OA, they have variable clinical findings. Such results may be related to age [35]; [36]. and/ occupational [37] ; [38] ; [11] and/ Heavy or abnormal loading [39] ; [9] ; [40]) and/ genetic [41] ; [42].
- From the results, there was a direct positive correlation ($\rho = 0.49$) between BMI $> 25 \text{ kg/m}^2$ and lumbar OA grading and this result agreed with studies done by many researchers:
- Hassett et al (2003) [17] saw, according to a number of studies, that BMI is a risk factor that associated with prevalence of lumbar disc degeneration. Chaiwanichsiri (2007) [19] showed that a highly prevalent lumbar disc degeneration is associated with higher BMI especially in female gender and elderly
- Two epidemiological studies showed a statistically significant relationship between BMI and lumbar disc disease (disc herniation in men, but not in women, and spondylosis in both sexes). Six other studies revealed weaker but significant associations between weight and lumbar spine disease.

- Manek et al (2003) [43] found a strong association was between high BMI and the presence of knee OA (odds ratio 3.90) ($P = 0.0001$). Swagerty and Hellinger had seen that biomechanical factors like obesity are associated with osteoarthritis. Similar results had also been proved by Oliveria et al (1999) [44] who saw that obesity is a risk factor for the development of OA of hand, hip and knee and he considered the obesity as a modifiable risk factors of OA. No study yet provided results that disagrees the ones of the present study except some reviewed studies that showed inconsistent results and unclear evidence of an association [23]; and Seidler and colleagues who did not find a clear relationship between body weight and lumbar disc disease [22].

CONCLUSIONS AND SUGGESTIONS

From the results, it can be concluded the following:

- The percentage of lumbar OA increased as the BMI progressed above 25 kg/m^2 .
- There was a direct positive correlation ($\rho = 0.49$) between $\text{BMI} > 25 \text{ kg/m}^2$ and development of lumbar OA with highly significant differences ($p < 0.001$).
- The $\text{BMI} 25 \text{ kg/m}^2$ were seen to be a cutoff point below which no progression of lumbar OA had been noticed.
- The severity of LBP increased with the progression of lumbar OA and $\text{BMI} > 25 \text{ kg/m}^2$.
- Further studies are needed to see the relationships between:-
 - Age and lumbar OA.
 - Sex and lumbar OA.
 - BMI and OA in joints other than lumbar spines like hands and foot joints.
 - BMI and rheumatological diseases other than OA like Rheumatoid arthritis (RA), Systemic Lupus Erythematosus (SLE), Gout,....etc.

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