BODY MASS INDEX AND SEVERITY OF LUMBAR DEGENERATIVE DISC DISEASE IN ADULT PATIENTS USING OSWESTRY DISABILITY INDEX: ANY CORRELATION?

L.O. Ajiboye, MBBS, FMCOrtho, **S.A. Gbadegesin**, MBBS, FMCOrtho, FWACS, Orthopaedics and Trauma Department, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria, **M. Oboirien**, MBBS, FWACS, Spine Surgery Unit, Department of Orthopaedics, National Orthopaedic Hospital, Igbobi, Lagos, Nigeria, **M. Alimi**, MBBS, FMCOrtho and **H.O. Ajiboye**, MBBS, Health Service Department, Usmanu Danfodiyo University, Sokoto, Nigeria

Correspondence to: Dr. L.O. Ajiboye, Orthopaedics and Trauma Department, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria. Email: ajiboyelo@yahoo.com

ABSTRACT

Background: More than 90% of people will experience an episode of debilitating Low Back Pain (LBP) at some point in their lifetime. Lumbar Degenerative Disc Disease (LDDD) is the commonest cause of LBP globally in individuals aged 40 years and above. Body Mass Index (BMI) may be directly related to LDDD pathogenesis, progression, severity of symptom manifestation, and response to treatment.
Objectives: The aim of this study was to determine the relationships between BMI and symptoms severity of LDDD in adult patients using Oswestry Disability Index (ODI); to determine the relationship between BMI and the clinical severity of LDDDs, and to determine the relationship between BMI and ODI in these patients.
Methodology: All adult patients with signs and symptoms of LDDD presenting at clinic or emergency room were consecutively recruited and studied in two government tertiary hospitals in the North West and South West of Nigeria. The weight, height, symptomatology and ODI preformats were assessed for each patient. The information was analysed using Statistical Package for Social Sciences (SPSS) version 24.0. The statistical significance was set at $P< 0.05$. The chi-square tests were used to determine the relationships of BMI with the severity of symptoms and ODI in the studied patients.
Results: The study involved 344 patients with male to female ratio of 1:1.6 and mean age of 59.8 years. The patients with normal range of BMI and elevated BMI accounted for 32% (110 patients) and 68% (234 patients) respectively. The study showed 73% of the participants with severe forms of disability while 27% of them had mild to moderate disability. The durations of symptoms varied from 1 to 15 years with the mean symptoms duration of 5.63 years. All the patients presented with varied and multiple symptoms. Altered sensation (paraesthesia) was found in 99.4% of them. The involved levels of lumbar spine on radiographs were L5/S1 (40.4%), T12/L1 (18.6%), L4/L5 (21.3%), L1/L2 (11.2%), L2/L3 (3.3%), L3/L4 (2.7%) and T12/L1 to L5/S1 (2.5%). There was a significant relationship between clinical symptoms and patients BMI on Chi-Square Tests ($p < 0.05$). The BMI also showed a significant relationship with ODI (p value = 0.001) while in symptoms and ODI (p value < 0.05).
Conclusions: This study showed that there was a statistically significant ($P < 0.05$) relationship between BMI and clinical severity of LDDD including severity of Oswestry ODI with worsened symptoms among individuals with elevated BMI when compared to those with normal range of BMI.

Key words: Body Mass Index, Lumbar Degenerative Disc Disease, Clinical severity

INTRODUCTION

Lumbar Degenerative Disc Disease (LDDD) is the most common cause of chronic Low Back Pain (LBP) among the middle aged and above (1-4). It has high disability, morbidity and socioeconomic burden which all constitute major health concerns for health care providers, patients, relations and public health physicians (1,2,4). It reduces quality of life and work performance, and it is the most common reason for medical consultations in the spine out-patient clinics (1,2,4). The prevalence of LDDD varies with age, gender, heredity, geographical locations and races.

Increasing Body Mass Index (BMI) which may progress to obesity is a growing public health concern globally and the number of overweight or obese individuals is dramatically increasing worldwide (5,6). High BMI may pose negative effects on orthopaedic management of nearly all Musculoskeletal Diseases (MSDs) especially the LDDDs. Both elevated BMI and LDDD were generally assumed to be problems of Western nations, and that the prevalence in African countries including Nigeria is low, but recent findings proved otherwise (5,6).

Increase in body weight increases musculoskeletal mechanical demands especially on Inter-Vertebral Discs (IVDs) and facet joints, and it causes a spectrum

of direct and indirect orthopaedic complications due to increased mechanical demands of the spinal column for support in individuals with elevated BMI. Increased body weight may be linked to the pathogenesis of LDDD, though direct evidence-based confirmation is lacking (7). Increased BMI also leads to increased load bearing and it has also been suggested that metabolic factors associated with obesity may be detrimental to healthy vertebral column (7,8). Hence, higher BMI may be a direct or an indirect risk factor for the pathogenesis of LDDD. Symptom severity of LDDD may be influenced by BMI of the patient both before treatment and response to any form of treatment.

The global epidemic of overweight and obesity - "globesity" - is rapidly becoming a major public health problem in many parts of the world. Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health (9). The World Health Organization (WHO) estimated the prevalence of obesity to be more than twice since 1980, with more than 10% of the world's population being defined as obese (10). In England, up to 25% of the population are obese with a higher prevalence in women than men (11). In the European Union member states up to 50% of adults are overweight or obese; and similarly, one third of adults in the United States, and in China are obese (11). In Nigeria, the prevalence of overweight individuals ranged from 20.3%–35.1%, while that of obesity ranged from 8.1%–22.2% (12).

BMI classification: Body Mass Index (BMI) is a simple index of weight-for-height that is useful in classifying weight into underweight, overweight and obesity in adults (9). It is defined as the weight in kilograms divided by the square of the height in metres (kg/m^2) (9).

BMI = Weight (kg)/ Height^2 (m^2)

BMI values are age-independent and the same for both sexes. However, BMI may not correspond to the same degree of fatness in different populations due, in part, to different body proportions. The health risks associated with increasing BMI are continuous and the interpretation of BMI grading in relation to risk may differ for different populations (9).

Table 1 shows the International Classification of adult underweight, overweight and obesity according to BMI (9).

Table 1

International classification of adult underweight, overweight and obesity acccording to BMI (9)

Classification	BMI (kg/m^2)		
	Principal cut-off points		Additional cut-off points
Underweight	<18.50		<18.50
Severe thinness	<16.00		<16.00
Moderate thinness	16.00 - 16.99		16.00 - 16.99
Mild thinness	17.00 - 18.49		17.00 - 18.49
Normal range	18.50 - 24.99		18.50 - 22.99 23.00 - 24.99
Overweight	≥25.00		≥25.00
Pre-obese	25.00 - 29.99		25.00 - 27.49 27.50 - 29.99
Obese	≥30.00		≥30.00
Obese class I	30.00 - 34.99		30.00 - 32.49 32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49 37.50 - 39.99	
Obese class III	≥40.00	≥40.00	

Source: Adapted from WHO, 1995, WHO, 2000 and WHO 2004

In our settings, despite the high prevalence of Low Back Pain (LBP) from LDDD in the population, the diagnostic approach and therapeutic options are diverse and often inconsistent due to fewer numbers of spine specialists, presentation to non-spine specialists and multiple investigations, resulting in rising costs and variability in management throughout the world.

Management of patients with LDDD could be challenging and expensive. Assessment of symptom severity in relation to BMI is important for the degree of interference with the Activities of Daily Living (ADL) as well as its implication on patient's quality of life. There are many assessment tools for the assessment of LDDD symptoms at presentation and follow-up for treatment, however in this study Oswestry Disability Index (ODI) version 2 was used because of its clinical importance on the details of activities of daily living.

MATERIALS AND METHODS

Three hundred and forty four patients aged between 31-78 years with symptomatic LDDD and met the inclusion criteria were consecutively recruited and studied in two tertiary government teaching hospitals. Informed consent was taken from each patient before the recruitment into the study. All the patients were clerked, examined in detail and investigated. Body weight and height measurements and radiographic findings were noted. Each patient's BMI was calculated. The bio-data, symptomatology and Oswestry Disability Index (ODI) score were recorded using profoma.

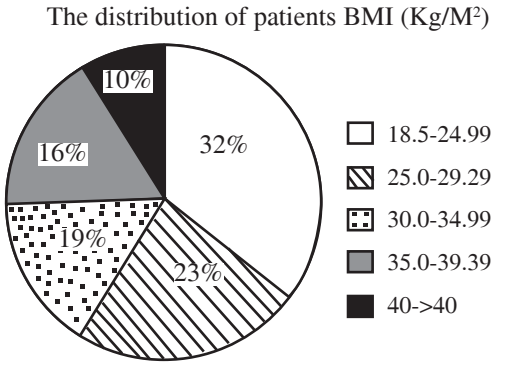
The inclusion criteria were patients aged 31 to 78 years with clinical features of LDDD who presented to a clinic or emergency unit. The exclusion criteria included patients with chronic low back pain from a cause other than LDDD, post-spinal surgery patients with back pain, patients with previous spine pathology (such as injury, infection, tumour, congenital or deformity), or patients with history of mental disorders. The information was analysed using Statistical Package for Social Sciences (SPSS) version 24.0. The statistical significance was set at $P< 0.05$. The chi-square tests were used to determine the relationship of BMI with the severity of symptoms and ODI in the studied patients.

RESULTS

Three hundred and forty four patients from two tertiary government teaching hospitals were studied with male to female ratio of 1:1.6. The mean age was 59.8 years. Most of the participants (68.4%) resided in the cities, while 31.6% resided in the outskirts. The participants' marital statuses were 4.1% single, 87.2% married, 3.4% divorced/separated and 5.4% widowed. Their educational levels were ranked into tertiary level (57.8%), secondary level (24.10%), primary school level (7.10%), and informal education (11.00%). The patients with normal range of BMI accounted for 32% (110 patients) and all the patients with elevated BMI were 234 (68%) of the participants (Figure 1). The study showed that 251 (73%) patients of the participants had severe ODI scores while 27% of the participants had mild y=to moderate ODI scores (Figure 2).

Figure 1

Body Mass Index and its frequency distribution among the participants



Key

BMI:	Body Mass Index (kg/m^2)
Normal range:	18.50 - 24.9
Overweight:	25.00 - 29.99
Obese class I:	30.00 - 34.99
Obese class II:	35.00 - 39.99
Obese class III:	≥40.00

Comments

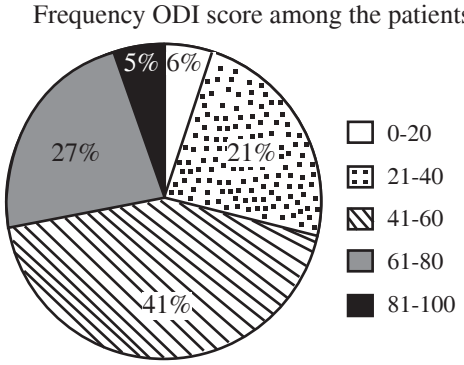
1. Patients with normal range of BMI have the highest frequency (32%) while those with class III obesity were the least (10%).
2. All patients with elevated BMI accounted for 68% of the participants (234 patients)

None of the participants had below normal range of BMI

Figure 2 shows the Oswestry Disability Index (ODI) score (%) and its distribution of frequency among the participants.

Figure 2

Oswestry Disability Index (ODI) score (%) and its distribution among the participants



Key

0% to 20%:	Minimal disability
21%-40%:	Moderate disability
41%-60%:	Severe disability
61%-80%:	Crippled
81%-100%:	Bed/Wheel chair bound

Comments

1. All together 73% (251 patients) of the participants had severe to wheel chair bound disability
2. All together 27% of the participants had mild to moderate ODI score

The patients' symptom durations varied from 1 to 15 years with the mean symptoms duration of 5.63 years. Two hundred and eighty four patients (82.6%) were seen in clinics while 60 patients (17.4%) presented to emergency department. All the patients presented with multiple symptoms of varied severity while 99.40% of them had altered sensation (paraesthesia) at presentation (Table 2). The involved anatomical levels of lumbar spine were L5/S1 (40.4%), T12/L1 (18.6%), L4/L5 (21.3%), L1/L2 (11.2%), L2/L3 (3.3%), L3/L4 (2.7%) and T12/L1 to L5/S1 (2.5%). There was a significant relationship between clinical symptoms and patients BMI with Chi-square tests (p values) of < 0.05 (Table 2). The BMI also showed a significant relationship with ODI (p value = 0.001) in Table 3 while ODI score showed a significant relationship with the clinical symptoms and signs (p value < 0.05) (Table 4).

Table 2

Distribution of clinical symptoms /signs with BMI

Clinical symptoms and signs	Body Mass index(BMI) (kg/m^2)						
	18.50 - 24.99 (Normal range)	25.00 - 29.99 (Overweight)	30.00 - 34.99 (Obese class I)	35.00 - 39.99 (Obese class II)	≥40.0 (Obese class III)	Patient without symptom	Total
Altered lower limb sensation	109	79	65	54	35	2(0.6%)	344
Distal limb/toe weakness	19	20	25	34	26	220(64%)	344
Axial LBP	81	71	55	49	35	53(15%)	344
Mechanical LBP	84	70	58	51	35	46(13.4%)	344
Unilateral radiculopathy	27	6	2	6	2	1(0.3%)	344
Bilateral radiculopathy	81	73	62	47	34	2(0.6%)	
Loss of sphincteric control	15	2	2	9	13	303(88%)	344

Comments

1. 99.40% of the participants altered sensation
2. The frequency of bilateral radiculopathy (radiating pain) increases per increase in BMI and 86.3% of the participants had bilateral lower limbs radiculopathy
3. The incidence of distal limb weakness increases per increase group of BMI
4. The chi-square tests for the clinical symptoms (in relation to BMI) showed significant p values of < 0.05 in most of the symptoms except in altered sensation in lower limb where p value is > 0.05: (Altered sensation in lower limb (0.381), distal lower limb weakness (0.01), loss of sphincteric control (0.003), mechanical LBP (0.013)

Table 3

The relationship between BMI and Oswestry Disability Index (ODI)

		Oswestry Disability Index (ODI) version 2 Score (%)					
		0-20 (Minimal disability)	21-40 (Moderate disability)	41-60 (Severe disability)	61-80 (Crippled)	81-100 (Bed/Wheel chair bound)	Total
BMI	18.5-24.99	5	38	47	15	5	110
	25.0-29.99	4	9	47	17	2	79
	30.0-34.99	6	11	23	24	2	66
	35.0-39.99	2	9	19	22	3	55
	≥40	7	4	2	15	6	34
Total		24	71	139	92	18	344

Key

BMI:	Body Mass Index (kg/m^2)
Normal range:	18.50 - 24.9
Overweight:	25.00 - 29.99
Obese class I:	30.00 - 34.99
Obese class II:	35.00 - 39.99
Obese class III:	≥40.00

Comments

1. Majority (139 patients) of the participants had Severe Disability ODI scores (41-60%)
2. Majority (110 patients) of the participants had normal range of BMI (18.5-24.99)
3. Out of 34 participants with class III obesity, 21 (62%) had worst scores (Crippled and wheel chair bound) in all the groups
4. Chi-square test revealed Pearson Chi-Square (p value) of 0.001

Table 4

The relationship between Oswestry Disability Index (ODI) score with clinical symptoms and signs

Clinical symptoms and signs	Oswestry Disability Index (ODI) Score (%)					Patient without symptom	Total
	0-20	21-40	41-60	61-80	80-100		
Altered sensation in lower limb	22	73	137	95	15	2(1%)	344
Distal lower limb weakness	12	13	32	53	14	220(64%)	344
Loss of sphincteric control	1	6	11	15	8	303(88%)	344
Mechanical LPB/ pain with ROM	19	60	100	90	15	60(17%)	344
Axial LBP	20	56	112	89	14	53(15%)	344

Key

Oswestry Disability Index (ODI) Version 2

0% to 20%:	Minimal disability
21%-40%:	Moderate disability
41%-60%:	Severe disability
61%-80%:	Crippled
81%-100%:	Bed/Wheel chair bound

Comments

1. All the clinical symptoms except altered sensation in lower limb (p=0.810) has chi-square that showed p value < 0.05 (similar to those in Table 2)

DISCUSSION

Lumbar Degenerative Disc Disease (LDDD) is the commonest cause of Low Back Pain (LBP) globally among adults and a leading cause of disability, morbidity, mental disorders with high socioeconomic burden (1-4). The incidence is on the increase even in Nigeria and more individuals will come down with the clinical conditions.

The study was conducted among 344 patients with male to female ratio of 1:1.6. This ratio is closed to what was reported in Benin-City by Igbinedion *et al.* (13) where female: male ratio of 1:1.4 was reported. In our study 85.6% of the participants presented at Surgical Out-Patient Department while 14.4% presented to Emergency Room unlike what was reported in Enugu, Nigeria by Eyichukwu *et al.* (14) in the study where 20% of the patients presented as acute LBP to Emergency Room and the rest as chronic case in Out-patient Clinic. This difference might be that the study was conducted in a population where there were mixture of peasant farmers, traders and civil servants unlike this study that was conducted in the cities among population of civil servants and traders largely. The patients with normal range of BMI accounted for 32% while elevated BMI accounted for 68% (234 patients) of the participants. This may be that BMI plays a role as risk factor for the development of lumbar DDD, manifestation of the symptoms of lumbar DDD or both.

The study showed a total of 251 patients (73%) of the participants had severe to wheel chair bound disability scores while 27% of the participants had mild to moderate disability. These ODI scores could be partly due to the fact that the study was carried out in referral centres with many patients been referred for specialty care after failed initial treatment. The severity of ODI scores in this study could also be due to late presentation among the patients which could have made the pathology worse and affect the functions like study findings by Ajiboye *et al* (15). The radiographic levels of lumbar spine involvement were L5/S1 40.4%), T12/L1 (18.6%), L4/L5 (21.3%), L1/L2 (11.2%), L2/L3 (3.3%), L3/L4 (2.7%) and T12/L1 to L5/S1 (2.5%). This levels are similar to Ajiboye *et al. (*16) and Eyichukwu *et al's.* (14) findings in Lagos and Enugu respectively where they reported L4/L5 and L5/S1 as most frequently involved spinal segment. Anatomically, spinal segments L4/L5 and

L5/S1 being a junction between very mobile lumbar and a non-mobile sacral region and also the facet joints at L4/L5 are more sagittally oriented with the more ease of listhesis. These might be the reasons for higher frequency of this pathology at these regions.

All the patients studied showed multiple and varied severity of symptoms. The altered sensation symptoms were the commonest and noted in 99.4% of the participants. This is followed by axial and mechanical low back pain 87.5% and 84% of the participants respectively. Impaired or complete loss of either faecal and/or urinary sphincter control was noted in 11.9% of the participants. It is noted that the higher the BMI, the higher the frequency of different symptoms/signs in the groups. The chi-square tests showed significant relationship between BMI and clinical symptoms with the p values of < 0.05 in all the symptoms. Weiler *et al.* (17) reported a high degree of correlation between histological changes of IVD degeneration with BMI in a study of 854 patients. Weiler *et al.* (17) also noted that increased BMI was identified as a positive risk factor for the development of symptomatic, clinically significant disc degeneration. These findings are similar to the findings of our study. The relationship of symptoms with BMI in our study also, is similar to the report by Fanuele *et al* (18) where they noted worsened symptom severity with the higher body mass index. Samartzi*s et al.* (19) in a large community based study of systematic assessment of lumbar disc degeneration on MRI also noted a significant association between the presence, extent, global severity of disc degeneration and clinical severity with elevated BMI ($P < 0.001$). This significant relationship could be explained by the increased mechanical demands in terms of the increased load transfer down the lumbar spine, hence more compressive force is experienced by the lumbar spine (muscles, ligaments, facet joints, vertebral bodies and IVD) with the increasing BMI. Most (85.6%) participants have bilateral radiculopathy (radiating pain) symptoms. It is also noted that bilaterality of the radiculopathy symptoms increases with BMI and all the participants with BMI $\geq 40.00 kg/m^2$ had bilateral radiculopathy symptoms. This may be as a result of higher rate of central canal stenosis in patients with elevated BMI. This may have direct or indirect effects on the nerves (*cauda equina*) in the lumbar canal before exiting the canal.

There is a statistically significant relationship between BMI and ODI (P value = 0.001). This could be explained by the more mechanical demands on the diseased lumbar spinal segment to carry out routine daily activities and even at rest with significant load on the affected segment of the spine in patients with higher BMI. This finding here was also similar to Fanuele *et al's.* (18) report from a large scale study where ODI was reported to be significantly worse for patients with a higher BMI. Kara *et al.* (20) in their prospective study reported that BMI is one of the major risk factors for poor ODI scores, functional and economic situations of patients who had undergone one or more than one operation for lumbar DDD. In another study in India which assessed risk for post-operative adjacent segment degeneration by Ha *et al.* (21) it was reported that the presence of disc degeneration, age greater than 65 years and elevated BMI were significant risk factors for both adjacent segment degeneration and worsening of ODI. These aforementioned findings from the studies like in our study too, showed that elevated BMI is one of the factors responsible for clinical and functional severity of symptoms among patients with lumbar DDD.

The challenges/limitations experienced in the study include:

(i) Some questions in the questionnaire are difficult to answer due to culture, beliefs or stigmatization of the participants, for example questions related to sex in elderly women or unmarried Nigerian patients.
(ii) It was a non-interventional study.

CONCLUSIONS

This study demonstrates that BMI is one of the factors responsible for the poor function, worse ODI scores and severe clinical symptoms in adult patients with lumbar degenerative disc disease.

RECOMMENDATIONS

Weight accumulation should be publicly discouraged by public health education to prevent the worsening symptoms of LDDD.

DISCLOSURE

(i) No conflict of interest among the authors.
(ii) No funding or grants for the study.

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