ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

Association of Lumbar Disc Degeneration with Socio-Demographics of Low Back Pain Patients in Eldoret, Kenya

Julliette A. Orege, *Joseph M. Abuya, G. D. Onditi Elias
School of Medicine, Moi University, P. O. Box 4606-30100, Eldoret, Kenya.

Manuscript Info

Manuscript History:

Received: 11 May 2013
Final Accepted: 22 May 2013
Published Online: June 2013

Key words:
Association,
Lumbar Disc Degeneration,
Socio-Demographics,
Back Pain,

Abstract

This paper examines the relationship between the socio-demographics and clinical characteristics of patients with low back pain. It is based on a study conducted at the Radiology and Imaging departments of the Eldoret and Mediheal Hospitals in Eldoret, Kenya. The study was cross-sectional by design. It involved adult patients with LBP referred for lumbar spine MRI. A total of 185 patients, with LBP sampled systematically, with no history of lumbar surgery and no contraindications to MRI underwent MRI from October 2011 to April 2012 were studied. Data was analyzed using STATA version 10. Descriptive statistics were carried out for continuous variables using mean, median, standard deviation and inter-quartile range. Frequency tables were generated for categorical variables. The Chi-square test and Fishers' exact test were used to test for any associations. A p-value < 0.05 was considered statistically significant. The median age was 47 years and mean age was 47.32 ±14 years. LBP was seen in 50.81% men and 49.19%. M: F was1: 0.97. The main presenting complaints were LBP in 65.95%, radiating LBP in 30.81% and LBP with inability to walk in 3.24%. The median duration was 1 year and the mean was 3.79±5.82 years; 79.46% had no history of trauma. Predominant occupations were 36.22% sedentary, 17.30% farmer, 4.32% student, 12.97% housewife and 18.38% labourers. The patterns identified on MRI included: 80% degenerative disc disease, 23.78% lumbar spondylosis, 4.86% infections, 9.73% neoplasms and 15.68% other anomalies. 65.41% bulges and 23.24% herniations (62.79% broad based, 6.98% extrusions, 30.23% protrusions) were reported. There was no association between LDD and socio-demographic factors.

Introduction

Older age, female gender, low educational status, sedentary work, smoking, high BMI, trauma and psychological factors are some factors associated with low back pain (LBP) (Omokhodion, 2004; Mulimba, 1990; Rosecrance et al., 2006; Ongeti et al., 2012). Low back pain is mostly seen by the age of 50 years which falls within the working population (Ongeti et al., 2012; Luo et al., 2004; Quinet and Hadler, 1979).

****Corresponding author:*** **Joseph M. Abuya,**
School of Medicine, Moi University, P. O. Box 4606-30100, Eldoret, Kenya

In terms of low back pain and gender, some studies have shown no association between gender and LBP (Igbinedion and Akhigbe, 2011; Modic and Ross, 2007). However, other studies report high incidences in women (Galukande et al., 2006; Mulimba, 1990). With respect to low back pain and occupation, occupational risk factors associated with LBP have been identified as poor or awkward postures, bending, lifting and physical strenuous work (Solecki, 2011). A sedentary lifestyle has largely been associated with LBP (N'Gbesso and Alla, 1996; Frymoyer et al., 1983). LBP is also common in those involved in lifting heavy weight and doing field work

(Ansari et al., 2010). In terms of duration, Patients can present with either be acute, sub acute or chronic LBP (Frank, 1993; Yong et al., 2003). The presenting complaints in patients with low back pain include pain, motor and sensory deficits which are the most common symptoms in patients presenting with LBP (Biluts and Munie, 2012).

Pathophysiology and Differential Diagnosis of Low Back Pain

Different disc contour abnormalities, like bulges or herniations, compress directly and stretch nociceptors in dura or nerve root sleeve tissues resulting in ischemia from compression of vascular structures. Inflammation and secondary edema is also likely to play a role in some cases (Ongeti et al., 2012).

The differential diagnoses include non-degenerative diseases: inflammation, infection, neoplasms, vascular diseases, congenital malformations, trauma and degenerative diseases, such as spondylosis, disc disease (Brant and Helms, 2007).

Association of Lumbar Disc Degeneration with Socio-demographic Factors

Some of the socio-demographic factors said to play a role in the development of lumbar disc degeneration (LDD) include older age, being female and sedentary work (Rosecrance et al., 2006; Yong et al., 2003). Studies done have shown a significant correlation ($p<0.05$) between disc degeneration and age (Mboka, 2011; Chaiwanichsiri et al., 2007). Of these, one study did not establish any association between disc degeneration and gender (Mboka, 2011). Another study reported greater disc degeneration with occupational and physical loading in the upper lumbar levels ($P = 0.055$-0.001), whereas sedentary work was associated with lesser degeneration ($P = 0.006$) (Battie et al., 2004). These univariate associations did not reach statistical significance in the lower lumbar region. The aetiology of lumbar disc degeneration (LDD) is multifactorial with most evidence pointing to an age-related process influenced primarily by mechanical and genetic factors (Hajipavlou et al., 2008; Hestback et al., 2004; Urban and Roberts, 2003).

Problem Statement

Low back pain is a burden to society and a major public health problem, especially because it results in disability to the working population. The problem of LBP is on the rise and 11% to 84% of the population in the developed world will experience back pain at some point in their lives (Walker, 2000). In the sub-Saharan Africa, studies in Uganda and Togo put the LBP prevalence at 20% and 35% respectively (Mijiyawa et al., 2000; Galukande et al., 2006). The presentation, detection and characterization of lesions in LBP using MRI is a practice well established in developing countries. However, studies showing the use of MRI for the evaluation of LBP cases are emerging but are not well documented in the developing world. Doctors in Kenya are challenged to identify the aetiology and predisposing factors of LBP among patients. The use of MRI to detect anatomical changes (disk contour abnormalities, e.g. bulges, herniations) and tissue properties (disc dehydration, reactive marrow changes) involving the intervertebral discs, bone marrow, neuroforamina, spinal canal and facet joints should therefore be embraced. MRI imaging findings reported by radiologists together with clinical parameters (lumbago, neurogenic claudication, sciatica) may be potential good predictors of surgical treatment outcomes.

Limitations of the Study

The population was a highly selected cohort of patients who could afford MRI excluding many poor patients who may have had the other patterns. Patients who were referred for MRI but did not turn up due to socio-economic reasons like lack of funds for both the MRI scan and transport.

Materials and Methods

Study Site

This study was carried out at The Eldoret Hospital and Mediheal Hospital in Eldoret East District in Kenya. The District lies between 34° 50’ and 35° 37’ East longitude and 0° 03’ South and 0° 55’ North latitude. It is located 320 Kms Northwest of Nairobi serving not only the residents of Uasin Gishu County, but also the entire North Rift, Western Province, and parts of Western Uganda and Southern Sudan. The Eldoret Hospital and Mediheal are both private multi-speciality hospitals with free standing imaging centers where the MRI scanners for the study are located. The study was conducted in the MRI departments of these hospitals.

Study Design

This study was a hospital-based cross-sectional study conducted from October 2011 to April 2012.

Study Population

The study included patients with LBP with or without radiculopathy who were referred for lumbar spine MRI at the radiology departments of the Eldoret and Mediheal hospitals from October 2011 to April 2012.

Sampling Procedure

Every other patient with LBP with or without radiculopathy referred for lumbar MRI was included

in this study systematically. The sample size was calculated from Fisher's formula

$n=Z^2P(1-P)/E^2$ where:
n= sample size,
Z = (1.96)
P = prevalence = 28.2%. This was the prevalence the of degenerative disc disease based on a study by Igbidenon et al. (2011).
95% confidence interval was used.
E = error margin 5%
Therefore $n= (1.96)^2 \times 0.28 (1 – 0.28/ (0.05)^2$
n = 310

To adjust for finite population we used the formula $n_f = \frac{n}{1+n/N}$

where N= population size.

In this case we anticipated 400 MRI done in seven months, n_f = sample size after adjusting for finite population, n = sample size from Fisher's formula

$n_f=310/1+309/400 =175$

We sampled an extra 5% to account for possible non-response

n=175 + 10 (5% of 175) so the sample size in this study was 185 patients.

Inclusion Criteria
All patients with LBP with or without radiculopathy as the primary and only diagnosis or in association with other pre-existing conditions referred for MRI.

Exclusion Criteria
Contraindications to MRI (metallic implants in the lumbar spine, pacemakers); prior lumbar spine surgery, and Pregnancy were considered in the exclusion criteria.

Study Flow
The author participated in the recruitment of patients with LBP from the two centres in Eldoret, Kenya: Mediheal and The Eldoret Hospital. We identified potential patients when their physicians ordered MRI scans of the lumbar spine after diagnosing LBP with or without radiculopathy. We targeted patients referred not only by general, but also patients from surgical subspecialty physicians, i.e. general, orthopedic and neuro-surgeons. The author participated actively in the diagnostic triage of these patients to make sure that all the patients met the eligibility criteria. All the eligible patients gave written informed consent. After enrolment the patients underwent a MRI of the lumbar spine. The MRI scans were conducted on systems with a field strength of 0.25-0.30T. Two evaluators (principal investigator and one radiologist) interpreted the images as part of our normal work flow. In all cases of disagreement between the two observers, a third opinion was sought from another radiologist. Preliminary reports were sent to the referring physician and the reports were then entered into the data collection form for the analysis of the study.

MRI Imaging Protocol
The MR imaging scans of patients referred with a clinical diagnosis of LBP were performed by two persons (a qualified technician and principal investigator). MR examination of the lumbar spine at presentation was performed with a 0.25 T (GE Medical Systems) or 0.30T (Siemens) MR imager using spine phased array coils. The scans consisted of sagittal and axial T1-weighted (repetition time/echo time (TR/TE) of 400/8 ms) and T2-weighted (TR/TE of 3,000/120 ms) turbo spin echo and STIR images. Enhanced T1W images with Gadolinium pentate dimeglumine were used in cases of infections and suspected neoplastic processes. A slice thickness of 4 mm was used for both sagittal and axial images. A field of view of 350mm and 200 mm for the sagittal and axial images, respectively; and a matrix of 192 by 256 were used. The images were collected as printed laser film hard copies and also electronically and stored directly as DICOM (Digital Imaging and Communications in Medicine) files in the MR workstation.

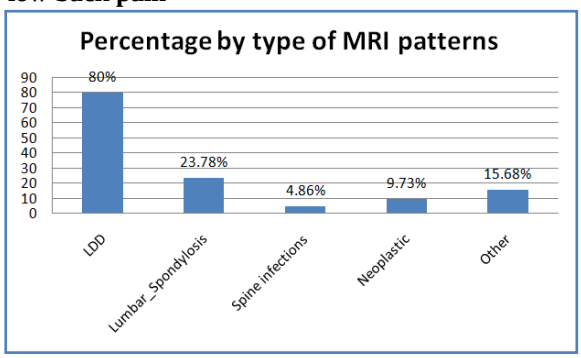
Data Management and Analysis
Completed standardized forms were checked for completeness and coded. The data was entered into a password protected computerized database. Data were analyzed using STATA version 10. Descriptive statistics were carried out for continuous variables using mean, median, standard deviation and inter-quartile range. While frequency listings were used for categorical variables. To assess whether there were any association between the outcome of interest and the socio demographic characteristics the chi square test was used. In cases where the cell count in any of the cells was below 5 the Fishers' exact test was used to test for any associations. In all the analysis p-value less than 0.05 was considered statistically significant. Dissemination of the study findings will be through publications and conferences.

Results

MRI Patterns of Low Back Pain in Eldoret, Kenya

A review of 185 MRIs of patients presenting with LBP in this study established lumbar disc degeneration 148(80%) which was the most common pattern. Other significant patterns encountered include: lumbar spondylosis 47(23.78%), infections 9(4.86%), neoplasms 18(9.73%) and other causes 29(15.68%). Figure 1 below portrays the findings.

Figure 1: A bar graph showing MRI patterns of low back pain



Association of Lumbar Disc Degeneration with Socio-demographic Factors

The author fit a logistic regression model to assess whether or not there was an association between the socio-demographic characteristics and the presence of LDD. The results are shown in the Table 1 below. We observed that none of the socio demographic characteristics was associated with LDD in the multiple logistic regression except age that tended towards significant.

Table 1: A Multiple Logistic Regression Table showing Association between LDD and Socio-demographic Factors

LDD	Odds ratio	p-value	[95% Confidence interval]	
Male vs Female	0.457	0.139	0.162	1.290
Age	1.036	0.061	0.998	1.076
Occupation				
Farmer vs Sedentary	0.549	0.362	0.151	1.993
Housewife vs Sedentary	0.308	0.096	0.077	1.232
Laborers vs Sedentary	2.358	0.253	0.542	10.265
Others vs Sedentary	0.404	0.172	0.110	1.482
Trauma history (Yes vs No)	0.909	0.859	0.318	2.598

Figure 2: A sagittal T2W image showing a normal lumbar spine in a 49 year old female patient referred for MRI

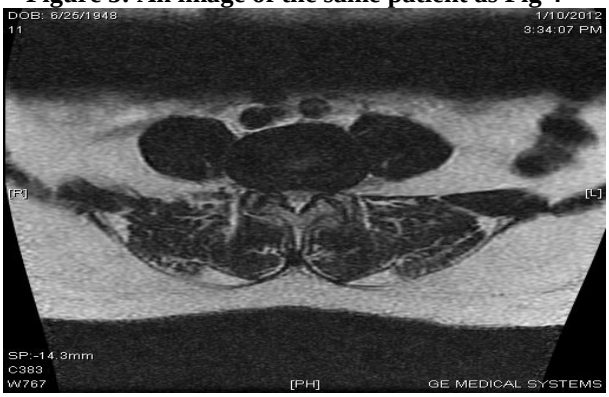
Figure 3: An image of the same patient in Fig 2

An axial T2W image showing a normal lumbar intervertebral disc

Figure 4: Lumbar spondylosis with multilevel degenerative disc disease leading to nerve roots impingement and spinal canal stenosis in a 63 year old female referred for lumber MRI

A sagittal T2W image showing all discs have low signal (low water content/desiccation), diffuse disc bulges at L2-L3, L3-L4, L4-L5 and L5-S1 that are narrowing both neural foramina and impinging on the exiting nerve roots.

Figure 5: An image of the same patient as Fig 4

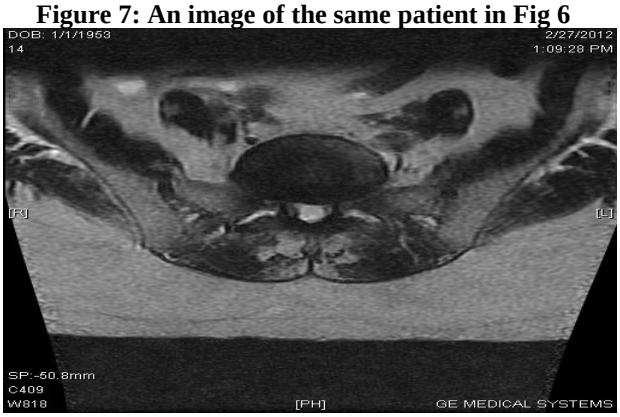


Axial T2W image showing a diffuse disc bulge (down arrow) of L4-L5 that is narrowing both neural foramina and impinging on the exiting nerve roots. Note the ligamentum flavum and facet joint hypertrophy leading to spinal canal stenosis.

Figure 6: Degenerative disc disease at L4-5, L5-S1 in a 59 year old female patient referred for lumbar MRI

A sagittal T2W image showing a broad based posterior herniation (up arrow) of L5-S1 which is causing significant compression on cauda equina.

Figure 7: An image of the same patient in Fig 6



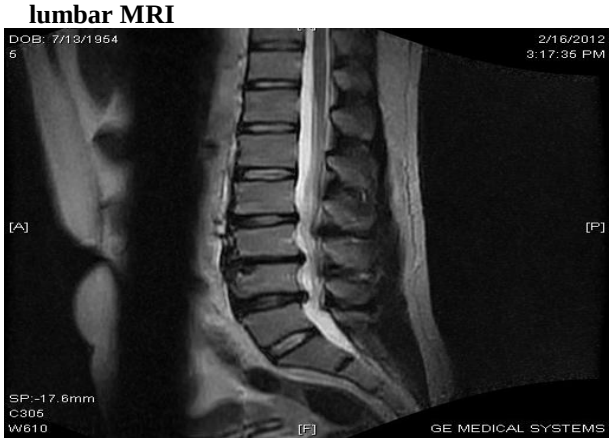
An axial T2W image showing a broad based posterior herniation (down arrow) of L5-S1 which is causing bilateral neural foramina compromise and significant compression on cauda equina.

Figure 8: Lumbar spondylosis with multilevel degenerative disc disease leading to nerve roots impingement in a 42 year old male referred for lumber MRI

Figure 9: An image of the same patient as Fig 8

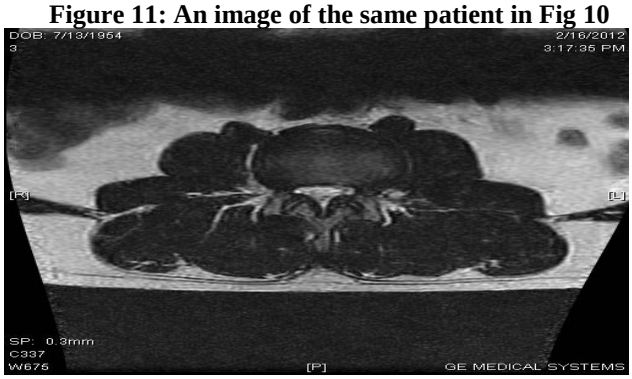
An axial T2W image showing a protrusion (down arrow) of L1-L2 which is indenting the thecal sac and impinging on cauda equina nerve roots.

Figure 10: Degenerative disc disease at L3-4, L4-L5 in a 57 year old male patient referred for lumbar MRI



A sagittal T2W image showing an extrusion (down arrow) of L3-L4 causing significant compression on cauda equina. Schmorl's node (right arrow) noted on L4 vertebral endplate.

Figure 11: An image of the same patient in Fig 10



An axial T2W image showing an extrusion (down arrow) of L3-L4 causing significant compression on cauda equina.

Figure 12: Lumbar spondylosis and multilevel degenerative disc disease in a 78 year old female patient referred for lumbar MRI causing compression on cauda equine

A sagittal T2W image showing disc bulges at L2-3 and L3-4, note anterior listhesis (up arrow) of L4 over L5 due to spondilysis.

Discussion

According to literature, various factors related to LBP have been mentioned, some of which are; older age, female gender, low educational status, sedentary work, smoking, high BMI and psychological factors (Rosecrance et al., 2006). However, in this study only age, gender, occupation, presenting complaint and duration of pain were assessed.

Low Back Pain and Age

The participants' mean age was 47.32 ± 14.00 and the median was 47 years. This is a working age in Kenya. A study done in Kenya showed that LBP occurs mostly in those with a mean age of 40.9 ± 13.2 whereas another Ethiopian study showed the mean age to be 42.4 ± 13.22; an age group that corresponds to a large component of the working population (Ongeti et al., 2012; Kebede et al., 2010). These findings though slightly lower, are comparable with the current study. The glaring difference is that none of these studies give the median ages. In USA, Britain and many other countries, LBP is a common occupational disorder, especially in adults of working age (Luo et al., 2004). The findings of the current study have shown that LBP is predominant in the middle age group, and at the age of 50 years and above. Hence, LBP increasing with age could be likely a result of disc degeneration resulting from the normal aging process. This finding is reinforced by Quinet et al. (1979) who concluded that the aetiology notwithstanding, (85-95%) of adults show evidence of DDD at autopsy by the age of 50 years.

Low Back Pain and Gender

Males were 50.81% and 49.19 % were females with a M: F (1: 0.97). This generally indicates that the number of males though slightly higher, was almost equal and thus comparable to that of females. Different findings have been reported in two East African studies which showed that women had a higher incidence of LBP (Galukande et al., 2006; Mulimba, 1990). A study carried out in Nigeria yielded 40.9% males and 59.1% females with a M: F (1: 1.4). These findings likewise showed that more females were affected than males, a fact that can be attributed to the type of population sampled. This Nigerian study by Igbinedion et al. (2011) found that gender was not significantly associated with LBP. Likewise, in the developed world, studies have shown that functional incapacity as a result of LBP

and its sequelae of disc degeneration is seen in both sexes (Modic et al., 1985).

Low Back Pain and Occupation

The present study reveals that majority of the patients presenting with LBP were employed. What is more, the results demonstrate that LBP was most common, up to 36.22% in those patients with a sedentary lifestyle as compared to 17.30% farmers, 12.97% housewives, 18.38% labourers and 4.32% students. Similarly, N'Gbesso et al. (1996) has observed LBP lesions in subjects whose work required limited physical stress in the lumbo-sacral spine. The authors continued to say that particularly those whose sedentary lifestyle demanded variable postures and prolonged sitting are more exposed to LBP. Frymoyer et al. (1983) also support a sedentary lifestyle as an important risk factor for LBP. However, Ansari et al. (2010) have found abnormalities in 42% manual labours, 24% sedentary workers, 26% housewives and 4% students who had prolapsed lumbar intervertebral disc. The study showed that manual labour was the predominant occupation reinforcing the fact that occupations that require repetitive heavy lifting or operation of machine tools also result in LBP as reported in our study.

Duration of Low Back Pain

A high number of the participants presented with chronic LBP after a very long average duration of 3.79±5.82 years. This highlighted the fact that chronic LBP was common among our patients. This finding is in agreement with a study by Yong et al. (2003) where 56.0% presented with chronic LBP of more than 3 months. This particular study did not specify the exact duration but just generalized all the patients who had pain of greater than 3 months as having chronic LBP. These findings serve to show that patients live with LBP for a long time, such that by the time they can access medical care they have chronic LBP which could explain the high number of patients with LDD unlike in the developed countries.

Presenting Complaints in Patients with Low Back Pain

The study found that the main presenting complaints were 65.95% LBP, 30.81% LBP with radiculopathy and 3.24% LBP with inability to walk. However, Biluts et al. (2012) reported 92.5% pain, 63.7% numbness and 30.5% neurologic claudication as the three most common presenting symptoms. The disc displacements arising from lumbar spine degeneration directly stretch nociceptors in dura or nerve root sleeve tissue causing ischemia, inflammation and secondary edema which cause LBP. Overall, pain, motor and sensory deficits are the most common symptoms which are also reflected in our study.

History of Trauma and in Patients with Low Back Pain

The study found 79.46% to have no previous history of trauma whereas 20.54% had a history of trauma. These findings are different from those of a previous Kenyan study which found trauma in 26.2% (Ongeti et al., 2012). The lack of a history of trauma in our study alludes to the fact that it is a minor factor in the development of LBP and there are other factors like age, occupation and genetic predisposition that play a bigger role in the development of LBP.

Association of Lumbar Disc Degeneration with Socio-demographic Factors

Attempts were made in this study to identify if there is a relationship between lumbar degenerative disc disease and socio-demographic factors. We observed that none of the socio demographic characteristics was associated with LDD in the multiple logistic regression except age that tended towards significant. Studies done have shown a significant correlation ($p<0.05$) between disc degeneration and age (Mboka, 2011; Chaiwanichsiri et al., 2007). The same studies did not establish any association between disc degeneration and gender (Mboka, 2011). Another study reported greater disc degeneration with occupational and physical loading in the upper lumbar levels ($P = 0.055$-0.001), whereas sedentary work was associated with lesser degeneration ($P = 0.006$) (Battie et al., 2004). These univariate associations did not reach statistical significance in the lower lumbar region. The aetiology of LDD is multifactorial with most evidence pointing to an age-related process influenced primarily by mechanical and genetic factors (Hajipavlou et al., 2008). Findings in this current study reinforce findings reported in studies in the developed world about the substantial role of genetics in the development of LDD as opposed to the minor effects of particular environmental factors like job type (Hestback et al., 2004; Urban and Roberts, 2003).

Conclusion and Recommendations

The study revealed that disc bulges and herniations are common disc contour abnormalities in patients with chronic low back pain. The most common site for LDD is L4/5 followed by L5/S1.

The common complication arising from LDD is impingement and compression of exiting nerve roots. Public hospitals in Eldoret, in this case the Moi Teaching and Referral Hospital (MTRH), should be equipped with adequate radiological equipment

which includes a MRI machine. Equipping hospitals with MRI scans and subsidizing the cost of MRI scanning can improve diagnosis and management of patient with LBP, thus reducing disability in these patients.

References

Ansari, A., Mondle, M. and Hossain, M. (2010). Abnormalities in plain x-ray findings of lumbo-sacral spine in prolapsed intervertebral disc. *Medicine Today*, 22(1): 6-11.

Battie, M. C., Videman, T. and Parent, E. (2004). Lumbar disc degeneration: epidemiology and genetic influences. Spine, 29(23): 2679-90.

Biluts, H. and Munie, T. (2012). Review of lumbar disc diseases at Tikur Anbessa Hospital. Ethiop. Med J., 50(1): 57-65.

Brant, W. E. and Helms, C. A. (2007). Fundamentals of Diagnostic Radiology (3rd ed.). 2007 Lippincott Williams & Wilkins.

Chaiwanichsiri, D., Jiamworakul, A. and Jitapankul, S. (2007). Lumbar disc degeneration in Thai elderly: a population based study. J Med Assoc Thai., 90(11): 2477-81.

Frank, A. (1993). Low back pain. BMJ., 306: 901-9.

Frymoyer, J. W., Pope, M. H., Clements, J. H. and Wilder, D. C. (1983). Risk factors in low back pain. An epidemiological survey. J Bone Joint Surg. Am., 65(2): 213-218.

Galukande, M., Muwazi, S. and Mugisa, B. D. (2006). Disability associated with low back pain in Mulago Hospital, Kampala Uganda. Afr Health Sci., 6(3):173-6.

Hajipavlou, A. G., Tzermiadianos, M. N., Bogduk, N. and Zundrick, M. R. (2008). The pathophysiology of disc degeneration: a critical review. J Bone Joint Surg Br., 90(10): 1261-70.

Hestback, L., Iachine, I. A., Lebouf-Yde, C., Kwik, K. O. and Manniche, C. (2004). Heredity of low back pain in a young population: a classical twin study. Twin Res., 7(1): 16-26.

Igbinedion, B. O. E. and Akhigbe, A. (2011). Correlations of radiographic findings in patients with low back pain. Niger Med J., 52(1):28-34.

Kebede, T., Bedane, A., Admassie, D. and Zenebe, G. (2010). Patterns of lumbar myelographic findings in patients with LBP-A 5 years retrospective study at Yehuleshet Higher Clinic, Addis Ababa, Ethiopia. Ethiop Med J., 48(3): 229-36.

Luo, X., Pietrobon, R., Sun, S. X., Liu, G. G. and Hey, L. (2004). Estimates and patterns of direct health care expenditures among individuals with back pain in the United States. Spine, 29: 79-86.

Mboka, J. (2011). Pattern of spine degenerative disease among patients referred for lumbar magnetic resonance imaging at Muhimbili National Hospital Dar-es-Salam Tanzania March-September 2011. Mmed Radiology Dissertation. Muhimbili University of Health and Allied Sciences.

Mijiyawa, M., Oniankitan, O., Kolani, B. and Koriko, T. (2000). Low back pain in hospital out patients **i**n Lomé (Togo). Joint Bone Spine, 67: 533-538.

Modic, M. T., Feiglin, D. H., Piraino, D. W. et al. (1985). Vertebral osteomyelitis: assessment using MR. Radiology, 157:157-66.
Modic, M. T. and Ross, J. S. (2007). Lumbar degenerative disc disease. Radiology, 245(1):43-61.

Mulimba, J. (1990). The problems of low back pain in Africa. *East African Medical Journal,* **67:** 250-53.

N'Gbesso, R. D. and Alla, B. K. (1996). Myelography and aspects of lumbar spine diseases in Abidjan. Ann Radiol (Paris), 39(6): 244-8.

Omokhodion, F. O. (2004). Low back pain in an urban population in Southwest Nigeria. Trop Doct., 34(1): 17-20.

Ongeti, K. W., Ogeng'o, J., Saidi, H. and Pulei, A. (2012). Prolapsed intervertebral disc in an African population: Kenyan experience. East African Orthopedic Journal, 6.

Quinet, R. J. and Hadler, N. M. (1979). Diagnosis and treatment of backache. Semin Arthritis Rheum., 8(4): 261-287.

Rosecrance, J., Rodgers, G. and Merlino, L. (2006). Low back pain and musculoskeletal symptoms among Kansas farmers. American Journal of Internal Medicine, 49(7): 547-556.

Solecki L. Low back pain among farmers exposed to whole body vibration: A literature review. Med Pr. 2011; 62(2): 187-202.

Urban, J. P. G. and Roberts, S. (2003). Degeneration of the intervertebral disc. Arthritis Res. Ther., 5(3): 120-130.

Walker, B. (2000). The prevalence of low back pain: a systematic review of the literature from 1966 to 1998. *Journal of Spinal Disorders,* **13**(3)**:** 205-217.

Yong, P. Y., Alias, N. A. A. and Shuaib, I. L. (2003). Correlation of clinical presentation, radiography and MRI for low back pain-A preliminary survey. JHK Coll Radiol., 6: 144-151.

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