



Evaluation of Smoking, Diabetes Mellitus and Obesity Associations with Degenerative Lumbar Spinal Stenosis in Elderly

Laith Thamer Al-Ameri^{1*}, Ahmed Abed Marzook¹ and Saif Anmar Badran²

¹ Al-Kindy College of Medicine, University of Baghdad, Baghdad, Iraq

² College of Medicine, Ibn Sina University of Medical and Pharmaceutical Sciences, Baghdad, Iraq

*Corresponding e-mail: Laith.thamer@yahoo.com

ABSTRACT

Background: Degenerative lumbar spinal stenosis (LSS) is a common condition affecting mainly old age group with high incidence and prevalence, and is associated with many factors. **Aim:** Our study aimed to evaluate smoking, diabetes mellitus and obesity associations with degenerative LSS. **Patients and methods:** A comparative cross-sectional study with participants aged 60 years or older. Participants suffering from degenerative LSS were enrolled as the diseased group after diagnosis with MRI, healthy persons (age and gender matched) were considered as control group. Smoking, diabetes mellitus and obesity variables were collected and analyzed using chi-square and odds ratio. **Results:** Around 162 participants enrolled the study, 62 were considered as degenerative LSS group, whereas 100 were considered as the control group. In LSS group, a picture obtained was of 20:42 smokers to non-smoker, 22:20 diabetic to non-diabetic, 37:25 obese to non-obese. While in the controlled group a picture was obtained with 18:82 smokers to non-smoker, 18:82 diabetic to non-diabetic, 34:66 obese to non-obese. Chi-square p-value was of 0.037, 0.012 and 0.001 for smoking, diabetes mellitus, and obesity, respectively. The odd ratio was 2.17, 2.5 and 2.87 for smoking, diabetes mellitus, and obesity, respectively. All above results were significant. **Conclusion:** Each of smoking, diabetes mellitus, and obesity has a great association with the development of degenerative LSS in elderly age group. Obesity shows the highest association among them.

Keywords: Lumbar stenosis, Smoking, Obesity, Diabetes, Elderly

INTRODUCTION

LSS is a common degenerative disease affecting mainly older age group with a significant increase in incidence and prevalence at last decades that may be due to increase of average life span of the population and with the use of more advanced imaging techniques in diagnosis [1,2]. LSS is one of the most common causes for the elderly age group to undergo surgeries [3].

Pathophysiology of degenerative LSS may include disc degeneration demonstrated by loss of height with or without bulging, hypertrophy of ligamentum flavum and facet joint with osteophytes formation from vertebral endplate. All contribute to subsequent spinal stenosis in its anteroposterior, transverse or both of them and to foraminal stenosis with subsequent compression neural structures passing through and hence to clinical symptoms and findings [1,4].

The severity of LSS depends mainly on patients description of their symptoms as non-specific low back pain associated with radiculopathy with a group of symptoms termed as neurological claudication such as leg pain, heaviness, paresthesia, and weakness that could be relieved by flexion or bending forward, a condition could be explained by a temporary anatomical increase in anteroposterior diameter, and worsen by extension, standing or walking for a distance a length of which depends on the severity of the condition [5]. Other symptoms may include nocturnal leg cramps, abnormal gait pattern and neurological bladder symptoms mainly in severe conditions [6-8].

Diagnosis of degenerative LSS was started by choosing and classifying patients with symptoms caused by degenerative LSS [9]. It was followed by radiological imaging studies to confirm the diagnosis and to determine the severity of stenosis using cross-sectional area (CSA) to evaluate the stenosis. Magnetic resonance imaging (MRI) is the most

used technique as it could demonstrate CSA of the spinal cord and clearly determine levels required for surgical decompression, computed tomography scan with myelogram which could be considered in patients who are unable to undergo MRI technique [1,4,9,10].

Electrodiagnostic studies are only confined to patients with equivocal findings to support the diagnosis [11]. Although degenerative LSS is common in the population, little data is available about risk factors. Diabetes mellitus (DM) is a chronic disease associated with hyperglycemia caused by impaired insulin secretion with or without insulin resistance have shown to influence disc cell proliferation with subsequent degeneration [12-15]. Another important factor is smoking which is considered as a real social and health problem, smoking believed to affect spinal health and increase the risk to develop degenerative LSS [15-19]. Obesity defined by body mass index (BMI) more than 30 is associated with increased risk to develop degenerative LSS [15]. Nevertheless, earlier studies are conflicting about the effect of obesity to develop degenerative LSS [15,20-22].

The aim of our study was to find out the possible association between smoking, diabetes mellitus, obesity and getting degenerative LSS in old age patients attending private neurosurgery clinic in Baghdad.

PATIENTS AND METHODS

This is a comparative cross-sectional study which include old age (≥ 60 years) patients suffering from degenerative LSS attending private neurosurgery consultation clinic in Baghdad during the period extended from 1st January 2017 to 1st June 2017, the diagnosis of LSS was confirmed through MRI examination.

The other group with age and sex-matched participants proved by MRI to be free from degenerative LSS were studied as the control group. A direct interview was made to check, age, weight, height and smoking history for each studied person. Patients were considered as diabetic if they were under anti-diabetic treatment or their HBA1C $\geq 6.5\%$ and considered as obese if their BMI ≥ 30 [23,24]. Patients with a history of obesity showing normal BMI, former (previous) smokers, gestational DM and previously operated with spine surgery were excluded from the study.

Ethical Considerations

The research proposal was discussed and approved by scientific and ethical research unit in Al-Kindy College of Medicine. Written consents were taken from every studied person after full explanation of the aim of the study and the confidentiality of collected data.

Statistical Analysis

Data introduced to IBM-SPSS version 22 software for statistical analyses. Description of statistics was presented in tables. Chi-square and odds ratio calculations were used to express the variables, p-value < 0.05 was considered significant.

RESULTS

Total 71 patients were proved to have degenerative LSS by MRI, 9 of them were excluded from the study due to our exclusion criteria, 6 patients show normal BMI with previous histories of obesity, 2 patients with previous spine surgeries of lumbar laminectomy and fixation, and 1 with a history of gestational diabetes. A remaining 62 patients were eligible to enroll the study as LSS group.

One hundred participants were eligible to enroll in the control group. About 20 (32.23%) of LSS group and 18 (18%) of control group were smokers, X^2 , df (1)=4.33, p=0.037. This reflects a significant association between smoking and occurrences of degenerative LSS, OR=2.17 (Table 1).

Table 1 Association between smoking status and getting LSS

Factors	Group with LSS		Control group		Chi-square statistics	p-value	Odds ratio
	N=62	%	N=100	%			
Smoker	20	32%	18	18%	4.33	0.037	2.17
Non-smoker	42	68%	82	82%			

Regarding DM, in the control group, 18 (18%) members were previously diagnosed with DM, while group affected

with degenerative LSS, 22 (35.48%) shows a picture with DM, a significant association was observed between being diabetic and getting degenerative LSS, X^2 , $df(1)=6.29$, $p=0.012$, the odds ratio was 2.5 (Table 2).

Table 2 Association between DM status and getting LSS

Factors	Group with LSS		Control group		Chi-square statistics	p-value	Odd ratio
	N=62	%	N=100	%			
Diabetic	22	35%	18	18%	6.29	0.012	2.5
Non-diabetic	40	65%	82	82%			

Regarding obesity, in control group, 34 (34%) patients were obese, while group affected with degenerative LSS shows a picture of obesity in 37 (59.68%) patients, a significant association between being obese and getting LSS was found, X^2 , $df(1)=10.25$, $p=0.001$, $OR=2.87$ (Table 3).

Table 3 Association between weight status and getting LSS

Factors	Group with LSS		Control group		Chi-square statistics	p-value	Odds ratio
	N=62	%	N=100	%			
Obese	37	60%	34	34%	10.25	0.001	2.87
Non obese	25	40%	66	66%			

DISCUSSION

In this study smoking, DM and obesity evaluated each independently for possible association with developing degenerative LSS, few earlier research articles have dealt with associations of these factors and degenerative LSS.

Regarding smoking, our study shows a significant ratio with a p-value of 0.037 and odd ratio of 2.17 suggesting the association between smoking and developing degenerative LSS. These results agree with Jakoi, et al., they state an association with a p-value less than 0.05. Nevertheless, they show that smoking is more significant than either DM or obesity, while this study shows obesity has the most significant association [15]. Sharma, et al., show a significant relationship between smoking and degenerative LSS [16]. It is widely agreed now that smoking act directly on intervertebral disc affecting its viability and activity at the cellular level [25]. These changes caused by smoking and nicotine exposure seem to be dose-related affected by the number of cigarettes per day and duration of smoking in years [26].

DM shows a significant association with a p-value of 0.012 and odds ratio of 2.5, our results agree with others. Jakoi, et al., show a significant association with a p-value less than 0.05, Anekstein, et al., and Asadian both show significant results with a p-value of 0.001 and 0.0001 respectively [14,27].

Obesity gets the higher results of significance in our study related to other researched factors with a p-value of 0.001 and odds ratio of 2.87. Earlier studies show conflict regarding the association between obesity and degenerative LSS, Jakoi et al., Fanuele et al., both show significant results. Nevertheless, a study conducted by Ibrahim, et al., shows no direct effect of obesity on low back pain [20]. We agree that obesity has a significant association with degenerative LSS which is proved with results from many articles worldwide [15].

CONCLUSIONS AND RECOMMENDATIONS

Smoking, DM, and obesity have great associations with the development of degenerative LSS in elderly age group, this makes it important to support education for the population about the risk of smoking, DM and obesity and their impact on general health particularly the spine.

Further studies are required to evaluate whether good diabetic control, smoking cessation and weight loss have beneficial effects on long-term management or in prophylaxis of degenerative LSS.

DECLARATIONS

Conflict of Interest

The authors have disclosed no conflict of interest, financial or otherwise.

REFERENCES

- [1] Genevay, Stephane, and Steven J. Atlas. "Lumbar spinal stenosis." *Best Practice and Research Clinical Rheumatology*, Vol. 24, No. 2, 2010, pp. 253-65.
- [2] Kalichman, Leonid, et al. "Spinal stenosis prevalence and association with symptoms: the Framingham Study." *The Spine Journal*, Vol. 9, No. 7, 2009, pp. 545-50.
- [3] Szpalski, Marek, and Robert Gunzburg. "7 The role of surgery in the management of low back pain." *Best Practice & Research Clinical Rheumatology*, Vol. 12, No. 1, 1998, pp. 141-59.
- [4] Saleh, A., R. Sadeghpour, and K. K. Kang. "Degenerative lumbar spinal stenosis: diagnosis and management." *Journal of Spine*, Vol. S2, 2013, p.2.
- [5] Morishita, Yuichiro, et al. "Neurogenic intermittent claudication in lumbar spinal canal stenosis: the clinical relationship between the local pressure of the intervertebral foramen and the clinical findings in lumbar spinal canal stenosis." *Clinical Spine Surgery*, Vol. 22, No. 2, 2009, pp. 130-34.
- [6] Matsumoto, Morio, et al. "Nocturnal leg cramps: a common complaint in patients with lumbar spinal canal stenosis." *Spine*, Vol. 34, No. 5, 2009, pp. 189-94.
- [7] de Graaf, Irene, et al. "Diagnosis of lumbar spinal stenosis: a systematic review of the accuracy of diagnostic tests." *Spine*, Vol. 31, No. 10, 2006, pp. 1168-76.
- [8] Inui, Yoshihiro, et al. "Clinical and radiologic features of lumbar spinal stenosis and disc herniation with neuropathic bladder." *Spine*, Vol. 29, No. 8, 2004, pp. 869-73.
- [9] Konno, Shin-ichi, et al. "A diagnostic support tool for lumbar spinal stenosis: a self-administered, self-reported history questionnaire." *BMC Musculoskeletal Disorders*, Vol. 8, No. 1, 2007, p. 102.
- [10] De Schepper, Evelien IT, et al. "Diagnosis of lumbar spinal stenosis: an updated systematic review of the accuracy of diagnostic tests." *Spine*, Vol. 38, No. 8, 2013, pp. 469-81.
- [11] Haig, Andrew J., et al. "The sensitivity and specificity of electrodiagnostic testing for the clinical syndrome of lumbar spinal stenosis." *Spine*, Vol. 30, No. 23, 2005, pp. 2667-76.
- [12] Johnson, William EB, Simon Stephan, and Sally Roberts. "The influence of serum, glucose and oxygen on intervertebral disc cell growth in vitro: implications for degenerative disc disease." *Arthritis Research and Therapy*, Vol. 10, No. 2, 2008, p. R46.
- [13] Sakellariadis, Nick. "The influence of diabetes mellitus on lumbar intervertebral disk herniation." *Surgical Neurology*, Vol. 66, No. 2, 2006, pp. 152-54.
- [14] Anekstein, Yoram, et al. "Diabetes mellitus as a risk factor for the development of lumbar spinal stenosis." *The Israel Medical Association Journal*, Vol. 12, No. 1, 2010, pp. 16-20.
- [15] Jakoi, Ande M., et al. "The Clinical Correlations between Diabetes, Cigarette Smoking and Obesity on Intervertebral Degenerative Disc Disease of the Lumbar Spine." *Asian Spine Journal*, Vol. 11, No. 3, 2017, pp. 337-47.
- [16] Sharma, Manoj Kumar, and Elena Petrukhina. "Strong Association of Smoking with Lumbar Degenerative Spine Disease." *The Open Neurosurgery Journal*, Vol. 6, 2013, pp. 6-12.
- [17] Uei, Hiroshi, et al. "Gene expression changes in an early stage of intervertebral disc degeneration induced by passive cigarette smoking." *Spine*, Vol. 31, No. 5, 2006, pp. 510-14.
- [18] Goldberg, Mark S., Susan C. Scott, and Nancy E. Mayo. "A review of the association between cigarette smoking and the development of nonspecific back pain and related outcomes." *Spine*, Vol. 25, No. 8, 2000, pp. 995-1014.
- [19] Iwahashi, Masaki, et al. "Mechanism of intervertebral disc degeneration caused by nicotine in rabbits to explicate intervertebral disc disorders caused by smoking." *Spine*, Vol. 27, No. 13, 2002, pp. 1396-1401.
- [20] Dafina, Ibrahimikacuri, et al. "Low Back Pain and Obesity." *Medical Archives*, Vol. 69, No. 2, 2015, pp. 114-16.
- [21] Fanuele, Jason C., et al. "Association between obesity and functional status in patients with spine disease." *Spine*, Vol. 27, No. 3, 2002, pp. 306-12.

- [22] Dario, Amabile B., et al. "The relationship between obesity, low back pain, and lumbar disc degeneration when genetics and the environment are considered: a systematic review of twin studies." *The Spine Journal*, Vol. 15, No. 5, 2015, pp. 1106-17.
- [23] American Diabetes Association. "Standards of Medical Care in Diabetes-2017: Summary of Revisions." *Diabetes Care*, Vol. 40, No. 1, 2016, pp. S4-S5.
- [24] Flegal, Katherine M., et al. "Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999-2010." *JAMA*, Vol. 307, No. 5, 2012, pp. 491-97.
- [25] Fogelholm, R. R., and A. V. Alho. "Smoking and intervertebral disc degeneration." *Medical Hypotheses*, Vol. 56, No. 4, 2001, pp. 537-39.
- [26] Vo, Nam, et al. "Differential effects of nicotine and tobacco smoke condensate on human annulus fibrosus cell metabolism." *Journal of Orthopaedic Research*, Vol. 29, No. 10, 2011, pp. 1585-91.
- [27] Asadian, Leila, et al. "Diabetes mellitus, a new risk factor for lumbar spinal stenosis: a case-control study." *Clinical Medicine Insights: Endocrinology and Diabetes*, Vol. 9, 2016, pp. 1-5.