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Degenerative Spondylolisthesis is Related to Multiparity and Hysterectomies in Older Women

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Abstract

Study Design—A case-control study

Objective—To determine whether parity and abdominal surgeries are associated with degenerative spondylolisthesis (DS).

Summary of Background Data—DS is considered to be a major cause of low back pain (LBP) in the older population, with greater prevalence of DS among women. Because LBP and impaired abdominal muscle function are common during pregnancy and post-partum, parity-related abdominal muscle deficiency, resulting in poor spinal mechanics, could be a factor in the development of DS in women. Indeed a relationship between the number of pregnancies and DS was reported in one study.

Methods—322 women between the ages of 40 and 80 (149 with DS and 173 controls) filled out a questionnaire providing information about their demographics, the number of full-term pregnancies, the number and types of abdominal surgeries (including cesarean section (CS) and hysterectomies), and age at menopause among other items. A binary logistic regression was used as a multi-variate model to identify the variables associated with DS.

Results—Along with age and body-mass-index as co-variates, the number of full-term pregnancies and the hysterectomy were significant predictors of DS. Other abdominal surgeries,

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CS or the number of years post-menopause were not significant predictors of DS in this regression model after adjusting for all other significant variables.

Conclusions—Each full-term pregnancy seems to be associated with the 22% increase in odds of developing DS. Hysterectomy nearly doubles the odds of DS as compared to women who did not have hysterectomy.

Keywords

degenerative spondylolisthesis; hysterectomy; pregnancy; parity; abdominal muscles; pelvic floor muscles

INTRODUCTION

Degenerative spondylolisthesis (DS) is considered to be one of the major causes of low back pain (LBP) among the older population[1,2]. It is an acquired condition thought to be secondary to disc degeneration and long standing intersegmental instability[3]. DS is characterized by an anterior translation of one vertebra upon another (usually L4 on L5), which results in a deformity that narrows and compresses the spinal canal and may lead to progressive symptoms of lumbo-sacral radiculopathy and spinal stenosis. Spinal surgery is indicated in approximately 15% of DS patients for reducing severe symptoms and restoring function[1,4,5].

DS is between 3 and 9 times more common in females than in males[3,4,6]. Currently there are no universally supported explanations for this gender difference. However, parity-related abdominal muscle deficiency has received some attention as one factor in the development of DS[7,8]. Sanderson and Fraser were the first to identify pregnancy as a factor in the etiology of DS by documenting the higher incidence of DS in multiparous women than nulliparous[7]. The abdominal muscles' ability to stabilize the pelvis and spine decreases as pregnancy progresses and remains compromised post-partum[9,10]. Indeed there are compelling data about the increase in LBP during pregnancy and post-partum on one hand[11,12], and the importance of trunk muscles in maintaining spine stability and function on the other[13].

Low back and pelvic pain are very common during pregnancy with the prevalence between 49 and 72%.[12,14]. Various authors identified several different risk factors, but multiparity was one of the most consistently identified factors correlated to LBP during pregnancy and post-partum[12,14–18]. Multiple pregnancies might logically have an impact on the abdominal muscle's successive recoveries from abdominal stretch, which could cause loss of spine support in multiparous women.

The connection between LBP and muscle dysfunction is supported by the prospective studies that showed decreased risk of low back and pelvic pain during pregnancy with prior physical activity or intervention[19,20]. Indirect evidence consists of observations that muscle function differs between pregnant women with and without LBP[21,22]. There are also reports indicating that the incidence of low back and pelvic pain is 3–4 times more common in post-partum women who have had a cesarean section (CS) as compared to those who have not[23,24]. Surgical incision through the abdominal muscles may have an even more profound effect on abdominal support, related to muscle healing and scarring, as well as some loss of muscle innervation and motor control[25]. Unfortunately, research is sparse in this area and more studies are necessary to draw more definitive conclusions and provide sound recommendations regarding the effects of pregnancy and abdominal surgeries on short- and long-term musculoskeletal health. Therefore, the purpose of this study was to determine whether parity and abdominal surgeries are associated with DS.

METHODS

This was a case-control study, in which 322 women between the ages of 40 and 80 (149 with DS and 173 controls without DS) filled out an extensive questionnaire providing information about their parity and past abdominal surgeries among other items. Women in the DS group were recruited from electronic medical record searches, direct mailers, or from several local orthopedic clinics when presenting with a complaint of LBP. Control women were recruited from the local population through advertisement. The majority of group assignment was verified on a lateral x-ray, but 22 DS and 19 control subjects were classified based on their MRI records. When imaging studies were not already available from the medical records, lateral standing x-rays were obtained in one of the collaborating orthopedic spine clinics. The criterion for inclusion in the DS group was a minimum of 5% anterior slip measured in the lumbar region[26]. This measurement method had excellent reliability among the three surgeons in our study reading 30 x-rays (16 DS and 14 No DS) (98% concordance, kappa = 0.93–1.00). When a control subject was detected with DS, she was assigned to the DS group. Because DS is a progressive, degenerative-type disease, the presence of clinical symptoms was not necessary to classify a participant as a DS subject. The exclusion criteria were previous spinal surgery, traumatic injury, and not being independently ambulatory. The study was approved by the institutional review board. All subjects read and signed an informed consent form.

The eligible participants filled out a 28-item, online questionnaire developed by our research team (see Appendix), as well as the modified Oswestry Disability Index (ODI)[27], and Health Assessment Questionnaire (HAQ)[28]. In addition to the demographics, primary variables of interest included the number of full-term pregnancies, the number and types of abdominal surgeries (including CS and hysterectomies), and age at menopause. Initially, Pearson’s Chi-square, or independent t-tests were used to identify variables that differed between the groups as potential predictors for a multi-variate model. These variables were then entered in a step-wise manner into a binary logistic regression model constructed to predict group assignment (DS or control). Significance level of 0.05 was used as a threshold for the predictor variables inclusion into or exclusion from the model. Minitab statistical software (v. 13.32, State College, PA: Minitab, Inc.) was used for all statistical analyses.

RESULTS

The key characteristics of participants are presented in Table 1. In the DS group, one woman had a slip at L2-L3, 14 at L3-L4, 121 at L4-L5, and 13 at L5-S1 lumbar levels. Four women had another level involved in addition to L3-L4 (three at L4-L5 and one at L5-S1). In general, women with DS were significantly older, had higher body-mass index (BMI), and suffered more pain and disability as measured by the ODI and HAQ scores (Table 1).

The initial group comparisons of potential predictor variables pertinent to our hypothesis revealed a significantly higher proportion of hysterectomies, other abdominal surgeries, and full-term pregnancies among women with DS. However, the percentage of CS did not differ significantly between the groups (Table 1). Along with age and BMI as co-variates, the number of full-term pregnancies and the hysterectomy resulted in a binary logistic regression model producing 73% of concordant observations (Table 2). Of note are the 22% greater odds of developing DS for each full-term pregnancy. Hysterectomy nearly doubled the odds of developing DS (98% increase) as compared to women who did not have hysterectomy. Once parity, hysterectomy, age and BMI were included, other abdominal surgeries, CS or the number of years post-menopause were not significant predictors of DS in this regression model.

DISCUSSION

In this study, we have found a significant association between the number of pregnancies and hysterectomies, and DS. These results support our hypothesis that the number of full-term pregnancies might be a risk factor for developing DS later in life. However, a history of abdominal surgeries or CS was not associated with DS. Instead, we found that having had hysterectomy was a significant predictor of DS. Therefore, based on these results, it is difficult to conclude that DS is mediated by impaired abdominal muscle function. Two possibilities with which our results would be consistent are hormonal effects and impaired function of pelvic floor muscles.

Both pregnancies and hysterectomies lead to hormonal changes that could affect the degenerative process. The suggestion of hormonal effects in the development of DS is based on the observation of a 3 times greater incidence of DS in oophorectomised than non-oophorectomised women[29]. However, this hypothesis is not consistent with the lack of estrogen receptors in facet joint capsules[30] and the lack of association between osteoporosis and osteopenia, which are hormonally-related, and the presence of DS[3]. In addition, similar to Jacobsen et al.[6], we found no association between the number of years post-menopause (corrected for age as a covariate) and the presence of DS. Finally, other studies that failed to find an association between DS and oophorectomies[31,32] make the hormonally-mediated development of DS a tenuous hypothesis.

Although hormonal effects should not be dismissed entirely in a multi-factorial model of DS, our results are more consistent with the possibility that both multiparity and hysterectomy resulted in some deficit of the pelvic floor muscles, leading to the development of DS. Impaired function of these muscles has been identified as a contributing factor to LBP, and treatment emphasizing pelvic floor training has been shown to decrease LBP[22,33–35]. Along with the trunk muscles (abdominal and back) and diaphragm, pelvic floor muscles contribute to the stability of the spine by allowing for intra-abdominal pressure to be generated[36]. Considering vaginal childbirth and hysterectomy surgery have been shown to negatively affect pelvic floor structures and functions[37–43], it is conceivable that impaired pelvic floor muscles may be, in part, responsible for diminished control of the lumbar spine. Decreased ability to maintain intra-abdominal pressure that helps trunk muscles to stiffen the spine may lead to DS in the long-term.

There are several limitations to this study. There could have been a selection bias, because cases and controls were recruited by different means (medical record search versus general advertisement for DS and control subjects, respectively). Because it was a survey-based study, all data was self-reported, which may have introduced recall bias. We do not have the exact information about the type of hysterectomies (full, partial, with or without oophorectomy, etc.) or hormonal status. Similarly, we do not know the details of abdominal surgeries (incision or laparoscopic). Age at menopause has to be treated as approximate. Because of various sources of imaging, they were not standardized, and we were unable to measure pelvic incidence, pelvic tilt, or facet sagittalization, which are often-reported risk factors for DS[26,44–46]. As a result, these radiographic variables were not included in our statistical model. Finally, considering DS can be missed on MRI imaging in a recumbent position[47], there is a possibility that some of the 19 control subjects, for whom the MRI records were used to rule out DS, could constitute false negative cases.

Notwithstanding these limitations, our study had a large sample size, which increases the statistical power of the results. To our knowledge, this is the first report that identifies hysterectomy as a potential risk factor for DS, adding to our understanding of the etiology of this disease. Future studies should explore hysterectomy, pelvic floor muscle deficit, and hormonal effects in greater detail in a multivariate model to further elucidate the role of these factors in DS.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Demographic characteristics of women with and without degenerative spondylolisthesis (DS). Candidate predictor variables are listed (counts or means and standard deviations in parenthesis) with appropriate statistical comparisons (proportion, Chi-square, or t-tests).

	Controls n=173	DS n=149	Z- or t-value	p-value
Age [years]	61.1 (7.1)	64.9 (6.9)	−4.78	0.000
African-American [n]	3	6	−1.27	0.204
Height [cm]	163.5 (6.3)	161.4 (6.6)	2.89	0.004
Weight [kg]	72.4 (17.7)	80.3 (20.2)	−3.70	0.000
Body-Mass Index [kg/m^2]	27.1 (6.6)	30.6 (7.9)	−4.31	0.000
Anterolisthesis [% slip]	0.1 (0.6)	17.7 (6.6)	−3.02	0.000
Oswestry Disability Index [%]	13.4 (15.3)	26.9 (18.3)	−7.06	0.000
HAQ-Disability	0.35 (0.50)	0.74 (0.62)	−6.05	0.000
HAQ-Pain	21 (27)	45 (31)	−7.22	0.000
HAQ-Health	28 (34)	40 (34)	−3.06	0.000
Full-Term Pregnancies	1.67 (1.23)	2.13 (1.46)	−3.02	0.003
Cesarean Sections	0.29 (0.71)	0.26 (0.67)	0.44	0.658
Hysterectomies [%]	23.1	41.6	−3.59	0.000
Other Abdominal Surgeries [%]	42.2	54.4	−2.19	0.028
Time Post-Menopause [years]	12.3 (7.8)	18.3 (10.5)	−5.64	0.000

Table 2

The binary logistic model with number of full term pregnancies, and hysterectomy as predictor variables of DS and age and BMI as co-variates.

Predictor	Coefficient	SE Coeff.	Z	P-value	Odds Ratio	95% CI Lower	95% CI Upper
Constant	−7.372	1.309	−5.63	<0.001			
Full-Term Pregn.	0.20003	0.09712	2.06	0.039	1.22	1.01	1.48
Hysterectomy (Y/N)	0.6840	0.2626	2.60	0.009	1.98	1.18	3.32
Age	0.07485	0.01815	4.12	<0.001	1.08	1.04	1.12
BMI	0.06594	0.01740	3.79	<0.001	1.07	1.03	1.11