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Clinical Study

Impact of occupational characteristics on return to work for employed patients after elective lumbar spine surgery

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Abstract

BACKGROUND CONTEXT: Low back pain has an immense impact on the US economy. A significant number of patients undergo surgical management in order to regain meaningful functionality in daily life and in the workplace. Return to work (RTW) is a key metric in surgical outcomes, as it has profound implications for both individual patients and the economy at large.

PURPOSE: In this study, we investigated the factors associated with RTW in patients who achieved otherwise favorable outcomes after lumbar spine surgery.

STUDY DESIGN/SETTING: This study retrospectively analyzes prospectively collected data from the lumbar module of national spine registry, the Quality Outcomes Database (QOD).

PATIENT SAMPLE: The lumbar module of QOD includes patients undergoing lumbar surgery for primary stenosis, disc herniation, spondylolisthesis (Grade I) and symptomatic mechanical disc collapse or revision surgery for recurrent same-level disc herniation, pseudarthrosis, and adjacent segment disease. Exclusion criteria included age under 18 years and diagnoses of infection, tumor, or trauma as the cause of lumbar-related pain.

OUTCOME MEASURES: The outcome of interest for this study was the return to work 12-month after surgery.

FDA device/drug status: Not applicable.

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IRB approval/Research Ethics Committee: The QOD project is designated as a non-research, clinical quality improvement effort and base on existing federal guidelines exempted from IRB review.

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METHODS: The lumbar module of QOD was queried for patients who were employed at the time of surgery. Good outcomes were defined as patients who had no adverse events (readmissions/complications), had achieved 30% improvement in Oswestry disability index (ODI) and were satisfied (NASS satisfaction) at 3-month post-surgery. Distinct multivariable logistic regression models were fitted with 12-month RTW as outcome for a. *overall population* and b. the patients with *good outcomes*. The variables included in the models were age, gender, race, insurance type, education level, occupation type, currently working/on-leave status, workers' compensation, ambulatory status, smoking status, anxiety, depression, symptom duration, number of spinal levels, diabetes, motor deficit, and preoperative back-pain, leg-pain and ODI score.

RESULTS: Of the total 12,435 patients, 10,604 (85.3%) had successful RTW at 1-year postsurgery. Among patients who achieved good surgical outcomes, 605 (7%) failed to RTW. For both the overall and subgroup analysis, older patients had lower odds of RTW. Females had lower odds of RTW compared with males and patients with higher back pain and baseline ODI had lower odds of RTW. Patients with longer duration of symptoms, more physically demanding occupations, worker's compensation claim and those who had short-term disability leave at the time of surgery had lower odds of RTW independent of their good surgical outcomes.

CONCLUSIONS: This study identifies certain risk factors for failure to RTW independent of surgical outcomes. Most of these risk factors are occupational; hence, involving the patient's employer in treatment process and setting realistic expectations may help improve the patients' work-related functionality.

Keywords: Return to work; Surgical outcomes; Lumbar surgery; Disability; Satisfaction Complications; Readmissions; Good Surgical Outcomes

Introduction

Low back pain is a leading cause of global disability [1]. Estimated costs of low back pain in the United States (US) are more than $100 billion annually, with two-thirds of the cost directly related to decreased productivity and lost wages [2]. Around 10% of all the acute pain episodes progress to chronic refractory nature and require surgical management in order to reduce their disability and regain meaningful functionality in daily life and in the workplace [3−7]. In recent decades, there has been an exponential rise in the rates of low back surgeries. Deyo et al. reported a 15-fold increase in spinal fusion from 2002 to 2007 [8−12]. Given the increasing prevalence of these procedures and the significant costs they impose on individual patients, payers and the healthcare system as a whole, it is imperative to develop metrics to determine which patients will benefit the most from surgery and identify the modifiable risks.

Return to work (RTW) is a key metric in surgical outcomes, as it has profound implications for both individual patients and the economy at large [13]. The literature identifies around 82% of patients successfully returning to work after elective lumbar spine surgery [14]. A myriad of factors have been reported to impact a patient's likelihood of RTW after surgical management of back related disability. Chief among these are various work-related factors such as occupational intensity and worker's compensation status. However, these predictors for failure to RTW are similar to predictors identified for poor improvement in ODI (Oswestry Disability Index), satisfaction or having an adverse event after surgery and one may argue that the limited improvement in pain related disability or postoperative adverse events put the patients at risk for failure to RTW [12]. There is a paucity of literature on those that do well as measured by legacy metrics yet do not RTW.

In this study, we investigated the factors associated with RTW in patients who achieved otherwise favorable outcomes after lumbar spine surgery. We hypothesized that occupational characteristics will play a major role in determining whether patients return to work after an otherwise successful lumbar surgery.

Methods

Quality outcomes database registry

The Quality and Outcomes Database is a nationwide web-based registry prospectively enrolling patients undergoing surgery for degenerative spine diseases. A standardized enrollment process is used across over 86 participating sites (academic and private, high and low volume) [15]. For this study, we queried the lumbar module and extracted data for patients with complete 12-month follow-up. The average 1-year follow-up for the contributing sites was 78.5%, ranging from 66.7% to 95.3%. Full enrollment information has been previously described [16].

Inclusion and exclusion criteria

The lumbar module includes patients undergoing lumbar surgery for primary stenosis, disc herniation, spondylolisthesis (Grade I) and symptomatic mechanical disc collapse or revision surgery for recurrent same-level disc herniation,

pseudarthrosis, and adjacent segment disease. Exclusion criteria included age under 18 years and diagnoses of infection, tumor, or trauma as the cause of lumbar-related pain.

Cohort characteristics

Data coordinators identify eligible patients by reviewing the operative case log a week before enrollment. The data for patients' race, smoking status, level of education, baseline measures of pain (Numeric Rating Scale), occupational variables (including occupational intensity, employment status, and worker's compensation), education, ambulatory status, and disability (ODI) are collected by phone or in-clinic interview. The occupational intensity is graded according to the description of the employment, as sedentary, light labor, medium labor, or heavy labor. Electronic medical record (EMR) charts are reviewed to extract information for variables including: age, gender, insurance, history of diabetes, anxiety, depression, symptom duration, motor deficits, and number of involved spinal levels. The EMR review is supplemented by patient interview for confirmation or any missing data.

RTW and good outcomes

We focused only on patients that were either "employed and working" or "employed but short-term disability/leave" at the time of surgery. We excluded patients who were either unemployed or were a student at the time of surgery. The Quality and Outcomes Database follow-ups with patients at 3-month and 12-month postsurgery to record various safety and outcomes measures; and the patients who are employed at time of surgery are followed-up for their RTW at 3-month postsurgery. Patients who fail to RTW at 3-month are asked the same question at 12-month postsurgery to note their RTW. We looked into the overall RTW including both 3- and 12-month postoperative data.

Three-month readmissions and complications were prospectively captured through EMR review and self-reported outcome questionnaires. History and physicals, daily progress notes, laboratory and culture results, and discharge summaries were all included in the EMR review. Readmissions to the primary surgical facility were identified via EMR review and readmissions or complications to outside facilities were recorded via patient-reported questionnaires. The "Good outcomes cohort" was defined as patients who had no adverse events (readmissions/complications), had achieved 30% improvement in ODI and were satisfied at 3-month postsurgery.

Statistical analysis

This is an evidence level-II study. Mean and standard deviation for continuous variables and frequencies for categorical variables were calculated for prospectively collected data. Distinct multivariable logistic regression models were fitted with RTW at 12 months postsurgery as the outcome of interest in (1) the overall population and (2) specifically those patients with otherwise good outcomes.

The variables included in the models were age, gender, race, insurance type, education level, occupation type, currently working/on-leave status, workers' compensation, ambulatory status, smoking status, anxiety, depression, symptom duration, number of spinal levels, diabetes, motor deficit, and preoperative back-pain, leg-pain, and ODI score. We assumed smooth relationships for continuous variables and used restricted cubic regression splines with five knots for age, and five knots for preoperative ODI score. The remaining variables were included as binary or categorical. The effects of predictors on the likelihood of patients' RTW were reported as odd ratios (OR) and the corresponding confidence intervals (CI) were calculated using Wald statistic. The ORs were based on interquartile ranges for continuous variables. The importance of individual predictors on RTW status was determined using Wald chi-square values, from which the predictors' respective degrees of freedom were subtracted. The higher the value the more important the covariate is for predicting the outcome of interest.

The model discrimination was measured by a concordance index (c-index). A c-index of value 1 suggests perfect discrimination by the model whereas 0.5 suggests random prediction. All statistical analyses were performed using the R statistical program (version 3.1.2), Vienna, Austria [17].

Results

Of the total 12,435 patients that were employed at the time of surgery, 9,768 (78.6%) returned to work at 3-month and an additional 836 (6.7%) returned to work at 12-month follow-up. A total of 10,604 (85.3%) returning to work at 1-year postsurgery; 69.7% of the patients had good surgical outcomes and had no adverse events (readmissions/complications), had achieved 30% improvement in ODI and were satisfied at 3-month postsurgery, whereas 30.3% had poor surgical outcomes. Among patients who had poor surgical outcomes at the 3-month post-surgery mark, 32.5% failed to RTW and in those with good outcomes, 7% failed to RTW at the 12-month postsurgery mark (Fig. 1). Table summarizes the characteristics of our patient cohort. The average age of the cohort was 51±12.31 years, and the patients who successfully returned to work were younger compared with those who failed to RTW (50.99 vs. 52.03 years). Of the total, 7,027 (57.7%) patients had college or postcollege education. Majority of the patients had symptoms duration of longer than 3-months and on average the preoperative ODI-score was 46.60±16.52.

Fig. 2 present the two logistic regression models for RTW—one for overall RTW and the other for RTW in patients who otherwise good outcomes postsurgery. The blue bars represent the OR (and its 95% CI). The two vertical dashed lines represent OR of one. The odds are considered

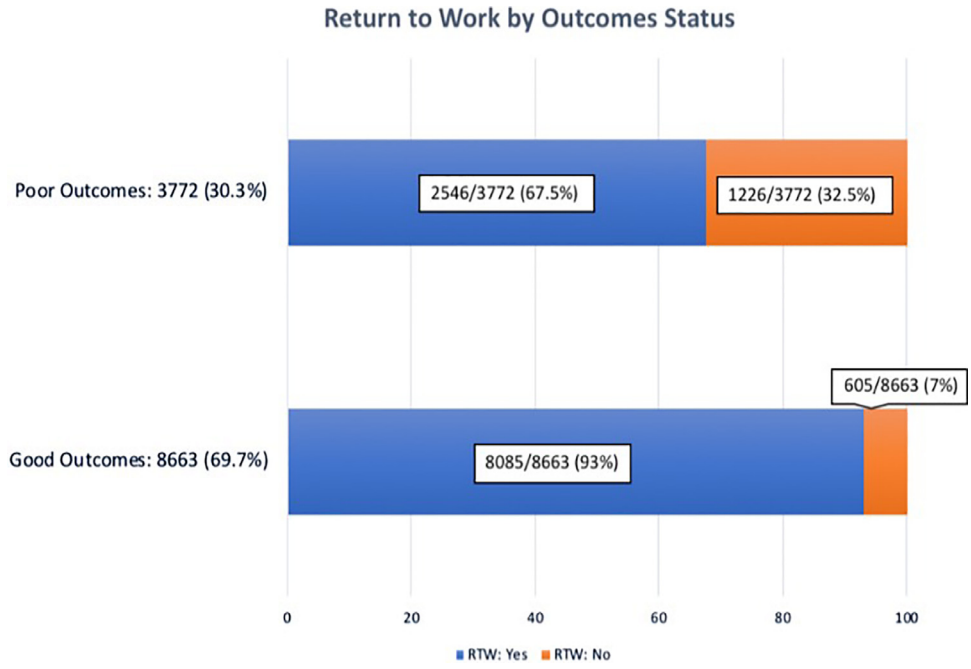

Fig. 1. Return to work by outcomes status.

statistically significant if the 95% CI (blue horizontal bar) lies on either side of the vertical dashed line; on the contrary, if the blue horizontal bar lies on the dashed vertical line the odds are statistically insignificant. The c-indices of the models were 0.790 and 0.771 for the overall RTW and RTW in those with good outcomes, respectively, indicating good discriminative power of the two models. Fig. 3 identify the predictors' adjusted importance and significance for the overall (a) patient population and in those with good outcomes (b). The predictors importance are calculated using adjusted chi-square minus degree of freedom ($\chi 2 - \mathrm{df}$) and the variable importance are then plotted in descending order for each distinct model in the Fig. 3.

Comparing the two models, we identified unique patient characteristics that were associated with failure to RTW, even if the patient achieved good surgical outcomes. These included older age, females compared with males, those with higher back pain, higher disability (ODI-score) and longer duration of preoperative symptoms. Additionally, the occupational predictors of failure to RTW included more physically demanding occupation types, those that filed a worker's compensation claim and those who were on leave or had short term disability leave at the time of surgery.

In addition, comparison of the models identified other variables whose influence was dependent on whether the patient achieved a favorable outcome postsurgery. Namely, African Americans had a lower likelihood of RTW overall. However, if the African Americans achieved good outcomes postsurgery their odds of RTW became equal to that of Caucasians. Similarly, insurance status, education level, ambulatory status, smoking status, positive history of depression, and variation in the number of involved spinal levels did not impact the RTW in patients who achieved good outcomes after their spine surgery.

Discussion

Surgical management of lumbar pathology has been proven to effectively improve functionality and allow patients to RTW. However, around 25% of the surgically managed patients report minimal improvement in quality of life and up to 10% experiences a major complication or hospital readmission postsurgery [18–21]. In the present age of patient-centered care and detailed emphasis on patient-reported outcomes, postsurgical RTW has been identified as an important metric. Previous studies have noted the risk factors for failure to RTW in surgical spine patients [22,23]. Return to work is certainly influenced by the other metrics of surgical success, that is, the postsurgery satisfaction, back-related disability, quality of life, readmissions, and complications [22–24]. However, there exist a nontrivial number of patients who would be considered to have a good outcome by these metrics yet fail to RTW. In the present study, we utilized robustly-collected national-scale data from across the US to identify the risk factors for failure to RTW preadjusting for the legacy metrics of surgical success.

The present analysis examined the risk factors for failure to RTW in the general population undergoing lumbar surgery and also in those that were considered to have a good outcome yet did not RTW. Among the risk factors dependent on surgical outcomes, we identified that patients who are African American, those with insurance other than private, education less than college, nonambulatory, current smokers, those with depression, and surgeries with a higher

Table
Patient characteristics (general cohort)

		Return to work	
	Total (N=12435)	Yes (N=10,604)	No (N=1,831)
Age	51.141±12.31	50.992±12.41	52.028±11.65
Gender			
Female	5,086 (40.9%)	4,276 (40.3%)	810 (44.2%)
Male	7,347 (59.1%)	6,326 (59.7%)	1,021 (55.8%)
Race			
Caucasian	11,016 (89.9%)	9,503 (90.9%)	1,513 (84.0%)
African American	886 (7.2%)	649 (6.2%)	237 (13.2%)
Other	353 (2.9%)	302 (2.9%)	51 (2.8%)
Insurance			
Private	10,403 (83.9%)	8,948 (84.6%)	1,455 (79.9%)
Medicare/Medicaid/VA/Govt	1,872 (15.1%)	1,548 (14.6%)	324 (17.8%)
Uninsured	128 (1.0%)	87 (0.8%)	41 (2.3%)
Education			
GED or up to high school	5,144 (42.3%)	4,076 (39.3%)	1,068 (59.3%)
College or postcollege	7,027 (57.7%)	6,295 (60.7%)	732 (40.7%)
Occupation type			
Sedentary	3,903 (31.5%)	3,608 (34.2%)	295 (16.2%)
Light	2,879 (23.3%)	2,559 (24.2%)	320 (17.6%)
Medium	3,025 (24.5%)	2,500 (23.7%)	525 (28.9%)
Heavy	2,565 (20.7%)	1,887 (17.9%)	678 (37.3%)
Workers compensation	775 (6.3%)	455 (4.3%)	320 (17.8%)
Current smoker	2,282 (18.5%)	1,802 (17.2%)	480 (26.4%)
Ambulation			
Independent	11,251 (92.8%)	9,676 (93.6%)	1,575 (88.0%)
With assistive device	872 (7.2%)	658 (6.4%)	214 (12.0%)
Diabetes	1,564 (12.6%)	1,272 (12.0%)	292 (16.0%)
Anxiety	1,793 (14.5%)	1,449 (13.7%)	344 (18.8%)
Depression	2,006 (16.2%)	1,607 (15.2%)	399 (21.9%)
Symptom duration			
Less than 3month	1,902 (15.6%)	1,695 (16.3%)	207 (11.5%)
≥ 3month	10,318 (84.4%)	8,723 (83.7%)	1,595 (88.5%)
Motor deficit	3,250 (26.2%)	2,738 (25.8%)	512 (28.1%)
Employment status			
Currently working	9,888 (79.5%)	8,941 (84.3%)	947 (51.7%)
On leave/ short-term disability	2,547 (20.5%)	1,663 (15.7%)	884 (48.3%)
Number of involved Levels	1.826±0.808	1.813±0.789	1.903±0.906
Baseline ODI	46.596±16.52	45.360±16.45	53.756±15.02
Baseline back pain	6.318±2.754	6.135±2.791	7.377±2.250
Baseline leg pain	6.796±2.631	6.725±2.657	7.207±2.437
Outcomes*			
Good	8,663 (69.7%)	8,058 (76.0%)	605 (33.0%)
Poor	3,772 (30.3%)	2,546 (24.0%)	1,226 (67.0%)

Categorical variables: n (%).
Continuous variables: Mean±Standard Deviation.

number of vertebral levels were at a higher risk of not returning to work. Similar risk factors have been previously reported [20–22,25–27]. However, the impact of these variables was nullified in the subset analysis for patients who achieved good surgical outcomes. We identified a set of risk factors for failure to RTW that were independent of the surgical outcomes. Females are at a higher risk of failure to RTW even in cases when they are otherwise satisfied and have good outcomes from the surgery. In a very similar manner, patients with higher baseline disability, higher preoperative back pain and higher duration of symptoms are at higher risk of failing to RTW. Such patients may require a certain level of safety assurance, physical therapy, and behavioral intervention in order to help them build on their improved functionality. Patients with severe preoperative symptoms may improve significantly; however, the improved state of postoperative disability may not allow them to return to their previous occupation. Therefore, setting realistic expectations in the preoperative setting may improve their willingness to RTW.

The results of this study identified certain occupational risk factors for failure to RTW, and to no surprise most of the occupational risk factors remained independent of how the patient performed on metrics of surgical success. Patients with physically more demanding jobs were at higher risk of failing to RTW. Such patients may require

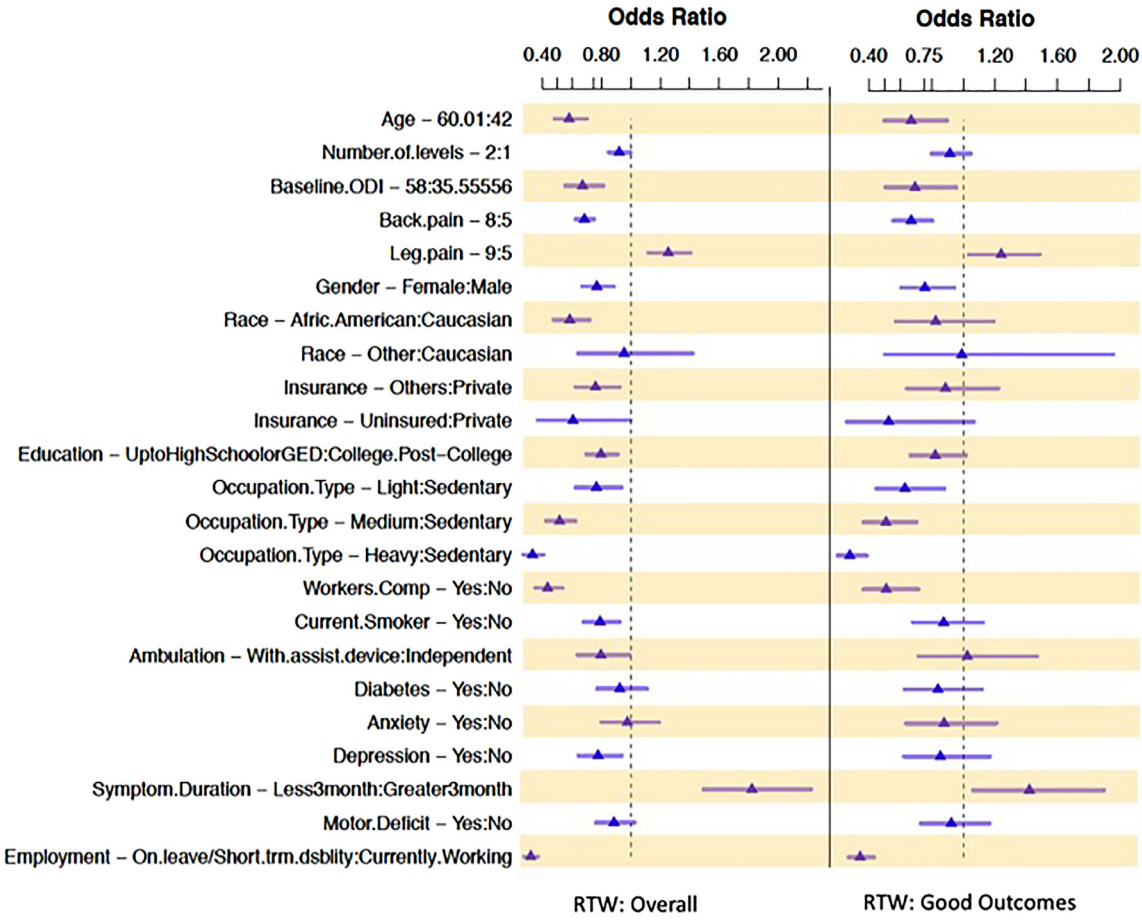

Fig. 2. Logistic regression models predicting odds of RTW in overall (general) population and patients with good outcomes post-surgery. The figure shows adjusted effect of predictors of RTW estimated using a multivariable logistic regression models in overall population and patients with good outcomes. For continuous predictors such as age, number of levels, pain score, and baseline ODI the odds ratio was computed when the variable was set to its 75th percentile vs. its 25th percentile. The variable was not binned in the model; rather predictions were made at two points on the continuous relationship.

cognitive and physical therapy, as well as employer involvement to formulate a job duties plan. Another occupational risk factor that our result identified, which remained independent of the surgical outcomes, was worker's compensation. Patients with work related injury may fear hurting their backs again if they return to work, which most certainly necessitates an active discussion with the employer to change the job type or reduce the physical labor for such patients.

Patients who were not working actively and were on leave or short-term disability have a lower likelihood of RTW. The fact that such patients are at the highest risk of failing to RTW necessitates identifying them preoperatively and keeping them involved even if it means altering their job duties and or work hours. Lee et al. in a very recent study reported a higher likelihood of RTW in nonworker's compensation patients who remained actively employed at least 3-month before surgery [23,28].

Any predictive model is limited by the variables included in fitting the model. The models presented in this study emphasize the occupational variables predicting RTW in the preoperatively employed patients. There are certain characteristics which impact a patient's successful RTW, however, any real-world prospective registry is limited by the feasibility of recording such granular information. Likely drivers of RTW that were not collected for the present study include the employer-employee relationship, working environment, and availability of a modified duty for these surgical candidates. Another possible driver for RTW among older patients might be how early they planned retirement and what their retirement goals are. In spite of the aforementioned limitations, the present study provides information for employer-employee discussion and helps as a starting point for their involvement in decision making when it comes to surgical management of back-related disability in employed patients. The patient population included in this analysis was associated with a wide variety of spine practices across the country, which suggests that the results presented here can be generalized to a reasonable degree.

Conclusions

This study identifies two sets of risk factors for failure to RTW—those that are dependent on the outcomes and safety

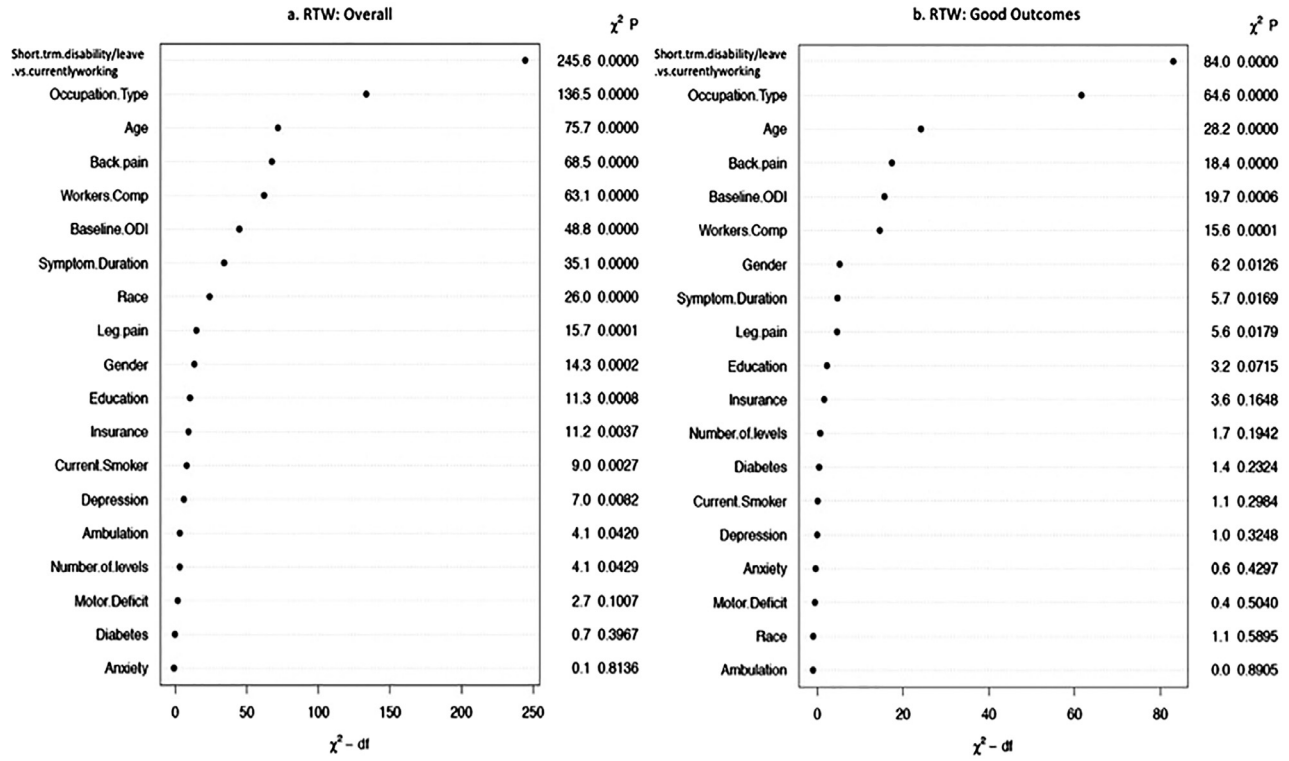

Fig. 3. Predictors importance for logistic regression models predicting RTW. The importance of each independent variable for RTW is measured by Wald chi-square value minus the degree of freedom of the predictor, based on multivariable models.

profile of the surgery and those that are independent of those factors. Most of the occupational risk factors identified are independent of patient reported outcomes of surgical success. Patients who were not working actively and were on leave or short-term disability, those within more physically demanding jobs, and those who had filed for worker's compensation before their spine surgery had lower odds of RTW even if their surgical outcomes were otherwise favorable. Therefore, involving the patient's employer in the treatment process and setting realistic expectations may help improve patients' work-related functionality and hence return to work.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.spinee.2019.08.007.

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