

Prognostic Factors for Return to Work after Intervertebral Disc Displacement Surgery: A Historical Cohort Study in Indonesia

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ABSTRACT

Background. Intervertebral Disc Displacement (IDD) is a prevalent condition in working-age individuals and the leading cause of occupational disability and early retirement. This condition may need interventional surgery. Successful return to work (RTW) is an important outcome following IDD surgery. Not returning to work after surgery has significant financial and social consequences for people and society.

Objective. This study aimed to investigate the proportion and time of successful RTW after IDD surgery and to evaluate the factors that may affect successful RTW after IDD surgery.

Methods. A historical cohort study was undertaken at a national referral hospital in Jakarta, Indonesia, by analyzing data from medical records from 2017 to 2022 on workers who underwent IDD surgery. We analyzed clinical conditions (pain severity after surgery, length of hospital stay, duration of IDD pain until surgery, type of surgery), occupational factors (job type and work support from the employer), and individual characteristics (age, gender, body mass index, education level, smoking habit) from medical records that may be associated with successful RTW. Successful RTW was defined as pain severity after surgery ≤ 4 , no increase in pain intensity, no additional clinic visits other than those scheduled, and no need for increased medication dosage or type.

Results. Data were collected from 145 subjects. Female workers were a little more frequent. The median age of the subjects was 52 years old. The subjects had IDD pain until surgery for about 18 months, with a median postoperative pain level of 2 out of 10. There were 32% of subjects who underwent minimally invasive surgery. Around 59 subjects (40.7%) successfully returned to work within a median of 26 days after hospitalization. Age ($p = 0.04$), gender ($p = 0.046$), education level ($p = 0.04$), and type of surgery ($p = 0.02$) were all substantially associated with returning to work.

Conclusion. Less than 50% of workers who had undergone IDD surgery had successfully returned to work. Age, gender, education level, and type of surgery were the prognostic factors for successful RTW in the workers undergone IDD surgery. It is critical to create a return-to-work strategy even before the patients undergo surgery.

Keywords: intervertebral disc displacement, return to work, prognostic factors, occupational, Indonesia



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INTRODUCTION

Intervertebral Disc Displacement (IDD) is the localized displacement of disc material in the intervertebral space that exceeds its normal limits. The pain pathway arises from the herniated disc impinging on the nerve root, which can cause nerve injury via mechanical and chemical pathways.¹ It remains a morbidity that impairs working productivity.² IDD is prevalent among working-age individuals and is the leading cause of occupational impairment and early retirement.³ The prevalence of intervertebral disc displacement ranges from 1-2% of the population.⁴ Cervical disc herniation affects 1.6% of Danish workers, with a prevalence of 6.9 per 10,000 person-years.⁵ According to data from a national reference hospital in Indonesia, there were approximately 1,766 outpatients and 298 inpatients with intervertebral disc problems from 2017 to 2021.⁶ A decrease in body function due to IDD is associated with a decrease in income and an increase in non-working days, which can reduce productivity in occupational groups.⁷

About 20% of IDD cases require aggressive interventional therapy. In the United States, decompression surgery for displaced or prolapsed discs is the most common orthopedic operation, with nearly 200,000 decompression operations performed each year.³ One of the outcomes of lumbar disc herniation surgery is returning to work after surgery.^{8,9} Return to work (RTW) is the process of returning workers to work or work after determining their disability status.¹⁰ Not returning to work after surgery has significant financial and social consequences for people and society.⁸ Return to work is an outcome to consider while deciding on surgical intervention.⁹ Return-to-work evaluation is a crucial effort for a worker following an injury or illness. This is a planned approach to ensure that workers return to work productively, safely, and sustainably.^{11,12}

Some factors influence an employee's decision to return to work following an injury or illness. Age, gender, body mass index (BMI), pain scale, education, type of work, job satisfaction, doctor's support for returning to work, positive expectation for post-operative recovery, and treatment duration contribute to a higher number of patients returning to work within 6 months of IDD surgery.³ Higher pain intensity was also linked to a delayed return to work.⁸ Pain levels differed before and after 3 and 12 months of surgery, as measured by the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI).¹³

There was no clear gold standard for successful RTW outcomes; however, validated patient reports can reflect clinically significant results to the patient, such as pain severity and disability index.¹⁴ Health facility visits, increased dosage or type of medication, disruption of social activities, and absenteeism can all have an impact on IDD treatment success.¹⁵ The purpose of this study was to investigate the proportion of successful RTW using clinical judgment,

the time of successful RTW, and the associated factors that predict successful return to work after IDD surgery.

MATERIALS AND METHODS

A historical cohort study was conducted from June 2022 to December 2023 in a national referral hospital in Jakarta, Indonesia. This study examined data from medical records on patients who had IDD surgery between January 2017 and October 2022. This study had been approved by the Health Research Ethics Committee of the Faculty of Medicine, University of Indonesia, under code KET-212/UN2.F1/ETIK /PPM/00/02/2023. All data analyzed had no identifiable personal information.

Patients aged 18 years or older who underwent IDD surgery by an orthopaedist or neurosurgeon between January 2017 and October 2022 and had a job prior to surgery were eligible for the study. Patients with a history of cancer, infection of the spine and/or other spinal cord disorders, congenital disability or impairment, or being pregnant at the time of surgery were excluded. Subjects with incomplete medical records, such as no data on height, weight, job title, pain severity during the follow-up period (one year after surgery), data of clinical visit, or data of medication after surgery, had also been excluded.

The sample size was estimated using OpenEpi™ software for a cohort study with a minimum of 144 subjects. All subjects who met the inclusion and exclusion criteria were included in the study. Individual factors (age, gender, BMI, education level, smoking status), clinical factors (post-operative pain severity, length of hospital stay, duration of IDD pain until surgery, type of surgery), and occupational factors (job type, work support from employer) were collected from the medical record. Age, post-operative pain severity, length of hospital stay, and duration of IDD pain until surgery were all measured numerically. The time taken for subjects to successfully return to work was measured by the amount of time the subjects were out of the hospital until they met the criteria for successful return to work. The outcome was assessed within one year following surgery.

BMI data were classified into two categories: obese (BMI ≥ 25 kg/m²) and non-obese (BMI < 25 kg/m²). Education levels were classified as high (college graduate or higher), intermediate (junior or senior high school graduate), and low (elementary school or lower). The smoking status was classified as either smoking or not smoking based on the information in the medical record. The type of surgery was classified as minimally invasive (Microlumbar discectomy, microendoscopy, or Biportal endoscopic spinal surgery (BESS) or open surgery (laminectomy decompression, foraminotomy, discectomy with or without pedicle screw fixation, Anterior Cervical Discectomy and Fusion (ACDF), Anterior Cervical Corpectomy/Fusion (ACCF), lumbosacral fusion, Posterior Lumbar Interbody Fusion

(PLIF), Transforaminal Lumbar Interbody Fusion (TLIF), Posterolateral fusion, or open microdiscectomy).¹⁶⁻¹⁸

The intensity of pain was measured by the visual analog scale (VAS) or numeric rating scales ranging from no pain (point 0) to the worst pain imaginable (point 10).¹³ The job type was categorized as either manual or non-manual. The job type is classified primarily based on the job title written in the medical records. Laborers, weight lifting workers, construction workers, couriers, street sweepers, nurses, farmers, fishermen, drivers, technicians, traders, and soldiers were categorized as manual workers.¹⁹ Administration staff, household assistants, shopkeepers, teachers, private employees, government employees, secretaries, and shop owners were categorized as non-manual workers.²⁰ Non-manual jobs were those that required mental toughness with minimum supervision.²⁰ Manual jobs were physically demanding and required more physical strength.¹⁹ Subjects who used national health insurance, corporate insurance, or Public Servant Insurance were considered to have work support from employers. Out-of-pocket funding from subjects was perceived as not having work support from the employer.

The outcome variable in this study was a successful return to work. Success RTW was characterized as meeting all four clinical criteria: (1) pain severity with VAS ≤ 4 , (2) no increase in pain intensity, (3) no additional clinic visits beyond those scheduled, and (4) no increase in dosage or type of drug. If one of the successful RTW criteria were not met, the RTW would be considered unsuccessful. The outcome was evaluated one year following surgery.

The acquired data were examined with descriptive and analytical statistics using SPSS version 25.0 software. The Mann-Whitney U test compared quantitative variables, while the chi-square (χ^2) test compared qualitative variables. Backward stepwise regression was utilized to evaluate the relationships between study variables and outcome factors more thoroughly. A p-value <0.05 was considered statistically significant.

RESULTS

There were 217 subjects hospitalized with a diagnosis of IDD. After reviewing the medical records of all patients, 145 patients who fulfilled the study requirements were selected. A total of 72 patients were removed from the study: 12 were unemployed, 9 had spondylitis tuberculosis, 8 had no IDD surgery, 5 had spine tumors, and 38 had been excluded due to inadequate data (incomplete data of job title, height, weight, or pain severity during follow-up period, data of clinical visit, or data of medication after surgery). Subject selection flow is shown in Figure 1.

Study Subject Characteristics

There was a total of 145 subjects involved in this study (Table 1). The median age of the subjects was 52 years. The majority of the subjects were women, obese, and did not

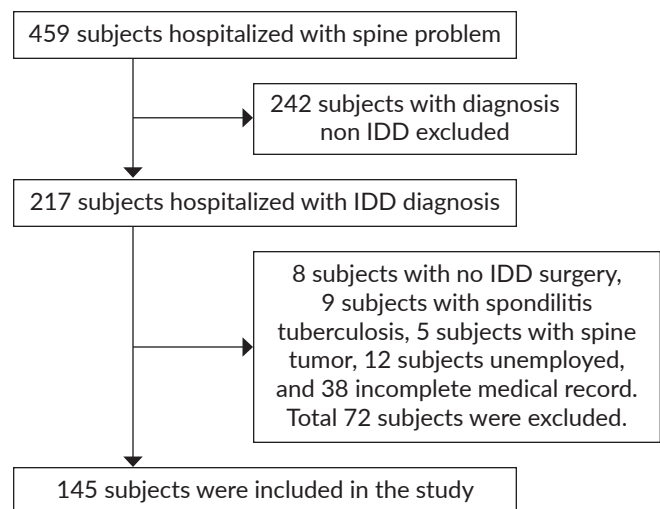


Figure 1. Subject selection flow.

Table 1. Socio-demographic Characteristics of the Subjects

Variables	n (%)	Median (Q1-Q3)
Age (years)		52 (41-61.5)
Gender		
Male	65 (44.8)	
Female	80 (55.2)	
Education level		
High	54 (37.3)	
Intermediate	66 (45.5)	
Low	25 (17.2)	
Body Mass Index		
Non Obese	62 (42.8)	
Obese	83 (57.2)	
Smoking status (n = 99)		
Not smoking	83 (83.8)	
Smoking	16 (16.2)	
Postoperative pain severity		2 (1-3)
Length of hospital stay (days)		5 (4-6)
Duration of IDD pain until operation (days)		548 (187-1097)
Location of IDD		
Lumbosacral	113 (77.9)	
Cervical	23 (15.9)	
Thoracal	3 (2.1)	
Mixed	6 (4.1)	
Type of surgery		
Minimally Invasive	46 (31.7)	
Open surgery	99 (68.3)	
Job type		
Non-manual	118 (81.4)	
Manual	27 (18.6)	
Work support from employer		
Yes	145 (100)	
No	0 (0)	
Successful Return to Work		
Yes	59 (40.7)	
No	86 (59.3)	

smoke. The education level of the subjects was mostly at the intermediate education level. Smoking data was only shown for 99 subjects since 46 subjects had no smoking status data available. The post-operative pain severity was 2 (1-3). IDD mostly occurs in the lumbosacral region. Approximately 81,4% of subjects had non-manual work. Work support from employers existed in all of the subjects. The outcome variables in this study were determined using clinical criteria. All of the individuals had never had a return-to-work evaluation and assessment from a clinician or occupational medicine specialist. The proportion of successful RTW was 40.7% while the proportion of unsuccessful RTW was 59.3%. The time of successful return to work was shown in 54 subjects with a median of 26 days (11-66 days).

Bivariate Analysis

Successful RTW was more frequent in males, non-obese individuals, those with a low education level, smokers, those

who underwent minimally invasive surgery, and those who had a non-manual job type. The median age of the successful RTW group was significantly lower ($p < 0.05$). Patients who had minimally invasive surgery had significantly greater RTW success rates. Intermediate education level was linked to unsuccessful RTW ($p < 0.05$). Duration of IDD pain until surgery was also lower in the successful RTW group, with a median of 487 days (177-1097 days) vs in the unsuccessful RTW group, with a median of 700 days (238-1289 days). There were no differences between post-operative pain severity and length of hospital stay in successful and unsuccessful RTW groups. Successful RTW likely occurred in a non-manual job type. Because all study subjects expressed support for returning to work, the relationship between work support from the employer and successful RTW could not be examined. The bivariate analysis results are shown in Table 2.

Table 2. Association between Individual, Clinical, and Occupational Factors and Successful Return to Work

Variables	Return to work		Bivariate Analysis		
	Successful	Unsuccessful	OR	CI 95%	P
	Median (Q1-Q3), n (%)				
Age (years)	45 (37-58)	55 (47-64)			<0.001*
Gender					
Male	29 (44.6)	36 (55.4)	1.343	0.69-2.614	0.386
Female	30 (37.5)	50 (62.5)	1.000	reference	
Body Mass Index					
Non-obese	27 (43.5)	35 (56.5)	1.229	0.63-2.4	0.545
Obese	32 (38.6)	51 (61.4)	1.000	reference	
Education Level					
High	24 (44.4)	30 (55.6)	0.629	0.242-1.633	0.341
Intermediate	21 (31.8)	45 (68.2)	0.367	0.143-0.943	0.037*
Low	14 (56)	11 (44)	1.000	reference	
Smoking status (n = 99)					
Not smoking	33 (39.8)	50 (60.2)	0.513	0.174-1.513	0.227
Smoking	9 (56.3)	7 (43.7)	1.000	reference	
Clinical Factors					
Postoperative pain severity	2 (1-3)	2 (1-3)			0.321
Length of hospital stay (days)	5 (3-6)	5 (4-6)			0.457
Duration of IDD pain until operation (days)	487 (177-1097)	700 (238-1289)			0.416
Type of surgery					
Minimally invasive	24 (52.2)	22 (47.8)	1.995	0.98-4.058	0.057
Open surgery	35 (35.4)	64 (64.6)	1.000	reference	
Occupational Factors					
Job type					
Non-manual	14 (51.9)	13 (48.1)	0.572	0.247-1.328	0.194
Manual	45 (38.1)	73 (61.9)	1.000	reference	
Work Support from Employer					
Yes	59 (40.7)	86 (59.3)	NA	NA	NA
No	0 (0)	0 (0)	1.000	reference	

Numerical data analysis used the Mann-Whitney U test, and categorical data analysis used the Chi-Square test. Q1-Q3 = quartile 1-quartile 3. * $p < 0.05$

Table 3. Multivariate Analysis of the Association between Study Variables and Outcome Variables

Variables	β	SE	aOR	CI 95%	p
Age	-0.470	0.023	0.954	0.911-0.999	0.044
Gender (Male)	0.995	0.499	2.704	1.016-7.193	0.046
Education level					
High	-1.331	0.647	0.264	0.074-0.938	0.040
Intermediate	-1.856	0.639	0.156	0.045-0.547	0.004
Type of surgery (Minimally invasive)	1.603	0.683	4.970	1.303-18.957	0.019

Multivariate Analysis

The bivariate analysis of variables predicting successful RTW revealed that age and education level had a significant association with successful RTW. Using the backward step-wise regression approach, multivariate analysis was performed, yielding an adjusted R^2 of 28.5%. The age, gender, education level, and type of surgery were factors that significantly influenced successful RTW (Table 3). An increase of one year of age will decrease the probability of successful RTW by 5%. The likelihood of men successfully returning to work was 2.7 times higher compared to females. The likelihood that someone will successfully return to work is decreased by 74% for high education levels and by 85% for intermediate education levels. A successful return to work was increased 4.9 times by minimally invasive surgery ($p < 0.05$).

DISCUSSION

The current study aimed to determine the proportion of successful RTW in patients who underwent IDD surgery, the time of successful RTW, and factors associated with successful RTW. Time to successfully return to work was shown in 54 subjects with a median of 26 days (11-66 days). According to a study by Atarod et al., the average time to return to work without considering age, pain intensity, and post-operative disability was 56 days.⁸ Time to return to work can vary from less than 7 days, 15 days, 30 days, 3 months, 6 months, 1 year, or 3 years.^{3,8,21-23} Sports athletes returned to work in 8.7 months, whereas military personnel returned to work in 26 months after surgery.⁹

There were four predictors identified for successful RTW in this study, which were age, gender, education level, and type of surgery. Laasik et al. found that people under 40 were 1.4 times more likely to return to work.²⁴ According to Seyedmehdi, persons over the age of 40 were 3.3 times less likely to return to work within a year and 2.52 times less likely to return to work within six months ($p < 0.05$).³ Huysmans et al. stated that return to work after lumbar surgery was influenced by job ownership, the absence of comorbidities, younger age, male gender, and shorter duration of preoperative symptoms.⁹ The presence of inability makes older patients reduce their chances of returning to work.³ Age was also linked to a lower rate of mental health improvement following surgery.²⁵ The male was linked with a successful RTW. Jensdottir et al. in 2007 also showed that more women

did not return to work and received compensation.^{24,26} Household duties hindered the return to work among women.³ Obesity was still debated due to its role as a predictor of RTW. Obesity was a strong risk factor for experiencing herniation after sequesterectomy within three months after surgery.²⁷ In our study, non-obese patients were more likely to be in the successful RTW group, but the difference was not significant. Laasik also observed that there was no association between BMI and return to work in one year following lumbar disc herniation surgery.²⁴

Smoking status did not differ significantly between the successful and unsuccessful RTW groups. These results were under the study results of Seyedmehdi, Atarod, and Laasik, which showed there was no effect of smoking status on return to work.^{3,8,24} In this study, education at the high and intermediate levels had a statistically significant effect on RTW success. Workers with low education levels prioritized job security over workers with high education levels. The income and savings of workers with low education levels were usually limited due to the illnesses they experienced. One-third of low-income workers usually come from low-income families and are extremely economically susceptible; thus, they must work to maintain economic stability.²⁸

This study found that the postoperative pain scale, length of hospital stay, and duration of IDD pain until surgery did not differ between the successful and unsuccessful RTW groups. This was consistent with Kim et al.'s research, which found no significant effect of symptom duration or pain severity on return to work within 3 months after cervical spine surgery.²⁹ Takeuchi et al. found no significant differences in the severity of low back pain, leg pain, and leg numbness in groups of patients who returned to work quickly and late after Transforaminal full-endoscopic spine (TF-FES) surgery.²¹ Meanwhile, Atarod et al. discovered that higher postoperative pain intensity (pain severity 3,6) was associated with a return to work after more than three months. The more intense the pain, the longer it takes to return to work.⁸ The median duration of IDD pain until surgery in the successful return to work group was 487 days, while in the unsuccessful return to work group was 700 days. This may not be statistically significant, but it was clinically important because there was a difference of around 213 days between the two groups, with successful return to work being higher in those with a shorter duration of IDD pain until surgery. This can be a consideration for patients and doctors

so as not to delay surgery if it is indicated. Surgery performed within six months after leg pain and less than two months of sick leave often shows good postoperative outcomes.³⁰

Huysmans, in his systematic review, stated that minimally invasive surgical methods would result in a higher return to work than open surgery.⁹ This followed our study, which showed that minimally invasive surgery increased 4.97 times successful RTW. Ahn et al. found that patients who had Percutaneous Endoscopic Lumbar Discectomy (PELD) had lower pain levels, shorter duration of surgery, shorter hospital stays, and a faster return to work than those who had microdiscectomy.³¹ Minimally invasive surgery using a surgical technique to widen soft tissue and retractors without damaging paraspinal soft tissue, resulting in less muscle degeneration. Minimally invasive surgery had a better short-term effect, but its long-term efficacy was not superior to that of open surgery.³²

This study also showed that successful RTW was more prevalent in the non-manual work group. This was similar to the findings of Seyedmehdi and Laasik.^{3,24} Manual workers were substantially more likely to have delayed RTW ($p < 0.05$).³ The patient's fear of recurrent low back pain and feelings of inability to do manual work make returning to work delayed or not at all.³ There were more workers who successfully RTW in non-manual work and low-level education. Men with low-level education had left the labor force early due to health-related factors (long-term sickness absence or granted disability pension), long-term unemployment, or early old-age pension with or without income.³³ There were more female subjects in this research. According to data from the Central Bureau of Statistics (Indonesia), there were 55.11% female workers who worked in non-manual work and 44.89% in manual work.³⁴ Social economic analysis of health facilities in West Java, Indonesia, shows that more patients have low levels of education.³⁵ Workers with a low level of education place greater importance on job security than workers with a high level of education. The income and savings of workers with low education are usually limited due to the illnesses they experience. One-third of workers with low incomes usually come from low-income families and are very economically vulnerable, so they need to work to maintain economic stability.²⁸

Seyedmehdi stated that insurance support was not related to a higher frequency of RTW.³ In this study, work support from the employer could not be analyzed for its association with a successful return to work because all subjects had work support in the form of insurance to cover their medical expenses. Increasing teamwork among orthopaedic surgeons, neurosurgeons, and occupational medicine doctors can result in a more effective RTW program for patients. Patients with older age, women who underwent open surgery, and those with a high or intermediate education level need extra focus on RTW following IDD surgery.

In relation to the outcome variables, specifically, the finding of an R-squared value was 28.5%. The predictors

significant in this research were from non-occupational factors. The prediction of successful return to work can be increased by analyzing other predictors that can affect return to work such as positive expectation from surgery, work satisfaction, lower preoperative sick leave, lower preoperative pain severity, lower working hours, physical activities more than once a week, non formal job, lower Oswestry disability index, job ownership, the absence of comorbidities, light or medium work, no compensation, no depression, and physical rehabilitation.^{3,8,9,21,23,36,37}

Strengths and Limitations

This study investigated the successful return to work after IDD surgery in occupational group patients, an area where little research has been conducted in Indonesia. This study also included all subjects who underwent IDD surgery within the last six years at national referral hospitals in Indonesia. This research analyzed several aspects of individual, clinical, and occupational factors, including surgical technique. However, there were still limitations in this research. This study evaluated a limited follow-up period of one year after IDD surgery. This study also used secondary data from medical records, which was still limited in Indonesia. Therefore, return-to-work outcomes were dependent on clinical assessment and not adjusted from the occupational data of RTW, such as sick leave duration. There was also incomplete data on smoking status in this study due to incomplete medical records. There were other occupational factors such as work satisfaction, working hours, formal non-formal job, job ownership, heaviness of work and non-occupational factors such as expectation from surgery, preoperative sick leave, preoperative pain severity, physical activities, disability index, comorbidities, compensation, psychosocial aspects, and physical rehabilitation that were also relevant factors, but it was not investigated in this study due to limitation of data from medical records. All of these factors can be investigated further to determine a wider range of parameters related to return to work after IDD surgery.

CONCLUSION

Our study found that it was critical to identify patients who may be at risk of unsuccessful RTW. Less than half of the patients who underwent IDD surgery were able to return to work. Younger age, male gender, low-level education, and minimally invasive IDD surgery were associated with higher successful RTW. Appropriate strategies and collaboration among patients, surgeons, physiatrists, occupational medicine specialists, and employers may improve RTW. It is critical to create a return-to-work strategy for patients even before they undergo the surgery.

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Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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REFERENCES

- Yoon WW, Koch J. Herniated discs: when is surgery necessary? *EFORT Open Rev.* 2021 Jun;6(6):526–30. doi: 10.1302/2058-5241.6.210020. PMID: 34267943; PMCID: PMC8246101.
- Koenig L, Dall TM, Gu Q, Saavoss J, Schafer MF. How does accounting for worker productivity affect the measured cost-effectiveness of lumbar discectomy? *Clin Orthop Relat Res.* 2014 Apr;472(4):1069–79. doi: 10.1007/s11999-013-3440-6. PMID: 24385039; PMCID: PMC3940738.
- Seyedmehdi M, Attarchi M, Ghaffari M, Mohammadi S, Darnahal M, Sadeghi Z. Prognostic factors for return to work after low-back disc herniation surgery. *Asia Pac J Public Health.* 2015 Mar;27(2):NP1775–84. doi: 10.1177/1010539512471072. PMID: 23293315.
- Fithri AN. Gambaran faktor risiko pada pasien herniasi nukleus pulposus di Rumah Sakit Umum Pusat Haji Adam Malik. Medan: FK Universitas Sumatera Utara;2017. pp. 1–113.
- Petersen JA, Brauer C, Thygesen LC, Flachs EM, Lund CB, Thomsen JF. Prospective, population-based study of occupational movements and postures of the neck as risk factors for cervical disc herniation. *BMJ Open.* 2022 Feb;12(2):e053999. doi: 10.1136/bmjopen-2021-053999. PMID: 35228284; PMCID: PMC8886406.
- Rekam Medis RSUPN Dr. Cipto Mangunkusumo. Data rekam medis pasien hernia nukleus pulposus RSUPN Dr. Cipto Mangunkusumo tahun 2017–2021. Jakarta; 2022.
- Virtanen IM, Karppinen J, Taimela S, Ott J, Barral S, Kaikkonen K, et al. Occupational and genetic risk factors associated with intervertebral disc disease. *Spine (Phila Pa 1976).* 2007 May;32(10):1129–34. doi: 10.1097/01.brs.0000261473.03274.5c. PMID: 17471097.
- Atarod M, Mirzamohammadi E, Ghandehari H, Mehrdad R, Izadi N. Predictive factors for return to work after lumbar discectomy. *Int J Occup Saf Ergon.* 2021 Jun;27(2):517–22. doi: 10.1080/10803548.2019.1600890. PMID: 31112066.
- Huysmans E, Goudman L, Van Belleghem G, De Jaeger M, Moens M, Nijs J, et al. Return to work following surgery for lumbar radiculopathy: a systematic review. *Spine J.* 2018 Sep;18(9):1694–714. doi: 10.1016/j.spinee.2018.05.030. PMID: 29800705.
- Schultz IZ, Stowell AW, Feuerstein M, Gatchel RJ. Models of return to work for musculoskeletal disorders. *J Occup Rehabil.* 2007 Jun;17(2):327–52. doi: 10.1007/s10926-007-9071-6. PMID: 17286211.
- Soemarko DS, Sulistomo A, Zamziar NE. Penatalaksanaan kembali kerja dari aspek kedokteran okupasi, 1st ed. Jakarta: Perhimpunan Dokter Spesialis Kedokteran Okupasi Indonesia; 2019. pp. 7–10.
- Kementerian Kesehatan Republik Indonesia. Peraturan Menteri Kesehatan Republik Indonesia Nomor 56 tahun 2016 tentang Penyelenggaraan Pelayanan Penyakit Akibat Kerja. Jakarta: Kementerian Kesehatan Republik Indonesia; 2016. pp. 1–28.
- Wu X, Fan G, Gu X, Guan X, He S. Surgical outcome of two-level transforaminal percutaneous endoscopic lumbar discectomy for far-migrated disc herniation. *Biomed Res Int.* 2016 Dec;4924013. doi: 10.1155/2016/4924013. PMID: 28070509; PMCID: PMC5192305.
- Mjaset C, Zwart JA, Goedmakers CMW, Smith TR, Solberg TK, Grotle M. Criteria for success after surgery for cervical radiculopathy—estimates for a substantial amount of improvement in core outcome measures. *Spine J.* 2020 Sept;20(9):1413–21. doi: 10.1016/j.spinee.2020.05.549. PMID: 32502657.
- Azharuddin A, Aryandono T, Magetsari R, Dwiprahasto I. Predictors of the conservative management outcomes in patients with lumbar herniated nucleus pulposus: A prospective study in Indonesia. *Asian J Surg.* 2022 Jan;45(1):277–83. doi: 10.1016/j.asjsur.2021.05.015. PMID: 34384675.
- Thomas J. Dowling; Sunil Munakomi; Thomas J. Dowling. Microdiscectomy [Internet]. 2023 [cited 2024 June]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK555984/>.
- Choi CM. Biportal endoscopic spine surgery (BESS): considering merits and pitfalls. *J Spine Surg.* 2020 Jun;6(2):457–65. doi: 10.21037/jss.2019.09.29. PMID: 32656383; PMCID: PMC7340825.
- McClelland S, Goldstein JA. Minimally invasive versus open spine surgery: what does the best evidence tell us? *J Neurosci Rural Pract.* 2017 Apr-Jun;8(2):194–8. doi: 10.4103/jnrp.jnrp_472_16. PMID: 28479791; PMCID: PMC5402483.
- Nordin F, Lewis S, O'Donnell P, Crosbie P, Booton R, Agius R, et al. Manual work and lung cancer risk in high-risk populations. *J Occup Saf Heal.* 2014;11(1):5–14.
- Heron R, Unger L. Glossary of labour administration and related terms. 1st ed. Bangkok: ILO Regional Office for Asia and the Pacific. 1999. pp. 23.
- Takeuchi M, Yamashita K, Hashimoto A, Takamatsu N, Sugiura K, Manabe H, et al. Return to the original work activity following the full-endoscopic lumbar surgery under the local anesthesia. *Neurol Med Chir (Tokyo).* 2021 Feb;61(2):144–51. doi: 10.2176/nmc.0a.2020-0204. PMID: 33390418; PMCID: PMC7905301.
- Protzer LA, Glassman SD, Mummaneni PV, Bydon M, Bisson EF, Djurasovic M, et al. Return to work in patients with lumbar disc herniation undergoing fusion. *J Orthop Surg Res.* 2021 Aug;16(1):534. doi: 10.1186/s13018-021-02682-1. PMID: 34452617; PMCID: PMC8393463.
- Andersen M, Ernst C, Rasmussen J, Dahl S, Carreon LY. Return to work after lumbar disc surgery is related to the length of preoperative sick leave. *Dan Med J.* 2017 Jul;64(7):A5392. PMID: 28673379.
- Laasik R, Lankinen P, Kivimäki M, Neva MH, Aalto V, Oksanen T, et al. Return to work after lumbar disc herniation surgery: an occupational cohort study. *Acta Orthop.* 2021 Dec;92(6):638–43. doi: 10.1080/17453674.2021.1951010. PMID: 34269643; PMCID: PMC8635580.
- Komatsu J, Iwabuchi M, Endo T, Fukuda H, Kusano K, Miura T, et al. Clinical outcomes of lumbar diseases specific test in patients who undergo endoscopy-assisted tubular surgery with lumbar herniated nucleus pulposus: an analysis using the Japanese Orthopaedic Association Back Pain Evaluation Questionnaire (JOABPEQ). *Eur J Orthop Surg Traumatol.* 2020 Feb;30(2):207–13. doi: 10.1007/s00590-019-02574-5. PMID: 31595359; PMCID: PMC7000494.
- Jensdottir M, Gudmundsson K, Hannesson B, Gudmundsson G. 20 years follow-up after the first microsurgical lumbar discectomies in Iceland. *Acta Neurochir (Wien).* 2007 Jan;149(1):51–8; discussion 57–8. doi: 10.1007/s00701-006-1068-y. PMID: 17180308.
- Andersen SB, Smith EC, Støttrup C, Carreon LY, Andersen MO. Smoking is an independent risk factor of reoperation due to recurrent lumbar disc herniation. *Glob Spine J.* 2018 Jun;8(4):378–81. doi: 10.1177/2192568217730352. PMID: 29977723; PMCID: PMC6022954.
- Hoefsmits N, Houkes I. Return to work of employees with low levels of education: The employers' role and perspective. *Work.* 2022;73(4):1189–202. doi: 10.3233/WOR-205233. PMID: 36093655; PMCID: PMC9837685.
- Kim EJ, Chotai S, Wick JB, Khan I, Sivaganesan A, Bydon M, et al. Factors associated with return-to-work following cervical spine surgery in non-worker's compensation setting. *Spine (Phila Pa 1976).* 2019 Jul; 44(13):903–7. doi: 10.1097/BR5.0000000000002978. PMID: 31205165.

30. Silverplats K, Lind B, Zoega B, Halldin K, Rutberg L, Gellerstedt M, et al. Clinical factors of importance for outcome after lumbar disc herniation surgery: long-term follow-up. *Eur Spine J*. 2010 Sep; 19(9):1459–67. doi: 10.1007/s00586-010-1433-7. PMID: 20512513; PMCID: PMC2989281.
31. Ahn SS, Kim SH, Kim DW, Lee BH. Comparison of outcomes of percutaneous endoscopic lumbar discectomy and open lumbar microdiscectomy for young adults: a retrospective matched cohort study. *World Neurosurg*. 2016 Feb; 86:250–8. doi: 10.1016/j.wneu.2015.09.047. PMID: 26409086.
32. Wang HL, Lu FZ, Jiang JY, Ma X, Xia XL, Wang LX. Minimally invasive lumbar interbody fusion via MAST Quadrant retractor versus open surgery: a prospective randomized clinical trial. 2011 Dec;124(23): 3868–74. PMID: 22340311.
33. Thern E, Falkstedt D, Almroth M, Kjellberg K, Landberg J, Bodin T, et al. Educational qualification differences and early labor market exit among men: the contribution of labor market marginalization measured across the working life. *BMC Public Health*. 2022 May; 22(1):1015. doi: 10.1186/s12889-022-13397-1. PMID: 35590290; PMCID: PMC9121573.
34. Rizaty MA. Mayoritas perempuan indonesia bekerja sebagai tenaga penjualan [Internet]. 2022 [cited 2024 Jul]. Available from: <https://databoks.katadata.co.id/ketenagakerjaan/statistik/07f2da09e1b6f15/mayoritas-perempuan-indonesia-bekerja-sebagai-tenaga-penjualan>
35. Rabbaniyah F, Nadjib M. Analisis sosial ekonomi dalam pemanfaatan fasilitas kesehatan untuk berobat jalan di provinsi Jawa Barat: analisis data Susenas tahun 2017. *Media Kesehatan Masyarakat Indonesia*. 2019 Mar;15(1):73–80. doi: 10.30597/mkmi.v15i1.5888.
36. Khan I, Bydon M, Archer KR, Sivaganesan A, Asher AM, Alvi MA, et al. Impact of occupational characteristics on return to work for employed patients after elective lumbar spine surgery. *Spine J*. 2019 Dec;19(12):1969–76. doi: 10.1016/j.spinee.2019.08.007. PMID: 31442617.
37. Filiz M, Cakmak A, Ozcan E. The effectiveness of exercise programmes after lumbar disc surgery: a randomized controlled study. *Clin Rehabil*. 2005 Jan;19(1):4–11. doi: 10.1191/0269215505cr836oa. PMID: 15704503.