North American Spine Society Journal (NASSJ) 9 (2022) 100106

Contents lists available at ScienceDirect

North American Spine Society Journal (NASSJ)

journal homepage: www.elsevier.com/locate/xnsj

Clinical Studies

The association between sociodemographic characteristics and the event of undergoing first-time, simple lumbar discectomy: A case-control study

Dorthe Schoeler Ziegler[a,b,*], Clara Emilie Westermann[c], Ann Fredsted Aalling[c], Soeren Francis Dyhrberg O'Neill[a,b], Mikkel Oesterheden Andersen[b,d]

[a] Medical Spinal Research Unit, Spine Center of Southern Denmark – part of Lillebaelt Hospital, Oestre Hougvej 55, 5500 Middelfart, Denmark
[b] Department of Regional Health Research, Faculty of Health Sciences, University of Southern Denmark, Winsløwparken 19, 5000 Odense C, Denmark
[c] Faculty of Health Sciences, University of Southern, J.B. Winsløws Vej 19, 5000 Odense C, Denmark
[d] Spine Surgery and Research, Spine Center of Southern Denmark – part of Lillebaelt Hospital, Oestre Hougvej 55, 5500 Middelfart, Denmark

ARTICLE INFO

Keywords:
Lumbar discectomy
Socioeconomic status
Case-control
Spine Surgery
Educational level
Disc herniation
Low-value health care
SES
Sociodemographic

ABSTRACT

Background: In disc herniation, nonsurgical treatments are recommended prior to elective discectomy but are often associated with consultation fees, whereas the discectomy itself may be without user payment. This may affect individual preferences in the choice of treatment. This retrospective case-control study examined the association between socioeconomic characteristics and the event of undergoing a first-time, single-level, simple lumbar discectomy.

Methods: The consecutively formed study population comprised patients undergoing elective lumbar discectomy at a Danish public hospital between 2010 and 2013. A national authority identified three gender- and age-matched controls per case for comparison. Measures investigated in this study were marital status, ethnicity, socioeconomic classification, educational level, the extent of sick leave 52 weeks prior to surgery, personal income, and equivalized disposable household income. All measures were provided by national registries. The associations were examined using uni- and multivariate logistic regression analysis.

Results: In a study population of 888 operated patients (age (SD) 46 (14); ODI (SD) 47 (18); leg pain intensity (VAS) (iqr) 74 (33), EQ-5D (iqr) 0.26 (0.62)) compared to 2664 controls, the probability of undergoing lumbar discectomy was significantly associated with lower vs. higher educational levels ((OR 1.98-2.53), and with periods of sick leave exceeding two weeks within one year prior to surgery (OR 9.47 (95% CI 7.68-11.68)). In the multivariate analysis, the event of undergoing discectomy was insignificantly associated with any other socioeconomic characteristics, whereas the personal income was of significant importance in the univariate analysis.

Conclusion: The event of undergoing free-of-fee elective first-time, single-level, simple lumbar discectomy is more common among individuals with low educational levels and unstable labor market attachment when examined in a case-control study. Being a multifactorial challenge, this calls upon the active engagement of several policy sectors.

Introduction

Among patients with low back pain in primary spine care, radiculopathy is present in 11-12% [1,2], with disc herniation being the most frequent cause [3].

When absolute indications for spine surgery are absent, the first line of treatment for symptomatic lumbar disc herniation (LDH) is nonsurgical. Low-level evidence-recommended nonsurgical treatment includes, among others, adaptation to or normalization of physical activity, supervised exercise therapy, manual joint mobilization, and education about pain mechanisms [4,5]. Nonsurgical prognosis is considered good, and pain relief and improved physical function should be expected within one to two months after symptom debut.

However, if pain or activity-compromising disability persists or worsens despite relevant nonsurgical treatment, clinical guidelines suggest referral for surgical assessment within 12 weeks of symptom debut [4,5]. In such cases, elective discectomy can be offered if the diagnosis is confirmed by magnetic resonance imaging (MRI) or computed tomography (CT).

According to Bush et al. 1992, around 14% of UK patients assessed with symptomatic LDH in primary care undergo discectomy [6]. However, the proportion of individuals with LDH undergoing discectomy could be somewhat higher today because the use of some spine surgery

* Corresponding author.
E-mail address: dorthe.schoeler.ziegler@rsyd.dk (D.S. Ziegler).

https://doi.org/10.1016/j.xnsj.2022.100106
Received 9 January 2022; Received in revised form 20 February 2022; Accepted 21 February 2022
Available online 27 February 2022

procedures has increased. This is without being explained by higher frequencies of spinal disorders [7]. Increased use of private or employment-based private health insurance or changed patient demands seems to be a contributing mechanism behind changed patterns in health care utilization of specialist spinal care, including surgery [8]. The use of private health insurance does not seem to affect the overall use of health care services but is associated with an increased probability of hospital contacts. Thus promoting unequal access to specialized healthcare [8]. Without insurance coverage, user fees or co-payments for services within the healthcare systems may pose a barrier to recommended medical treatments [9]. The scope of this study is however not to examine the consequences of user fees or co-payments.

In a Danish context, health care services provided by licensed practitioners are generally reimbursed in full or in part by the health authorities. Primary care services other than the services of a general practitioner e.g. the conservative management of spinal disorders are associated with some degree of user fee or co-payments, typically 30-50% of the total expense. Specialized services like spinal surgery are fully reimbursed and thus at no direct cost to the patient. Conversely, hospital services are only accessible upon referral, whereas most primary care services are direct access.

Compensation policies during spine-related sick leave are likewise important for the actions of the individual, such as sickness absence or –presence [10,11]. In Denmark, individuals on sick leave are legally guaranteed sickness benefits. During the study period, the maximum length of sickness benefits allowed by the Ministry of Employment reached 156 weeks [12]. In the sick leave period, the municipality makes person-oriented efforts for a quick return to the labor market to avoid long-term absence and unemployment.

Inequality in health is widely identified and associated with socioeconomic status (SES) that is typically defined by income, educational level, insurance status, race, and labor market attachment [13,14]. The inequalities are evident in both higher rates of morbidity, including chronic diseases and mortality [13]. In previous settings, individuals of low SES more frequently use prolonged free-of-fee hospitalizations, whereas individuals of higher SES to a greater extent use preventive and specialized services with possible user fees or co-payments [9,15,16]. The increased tendency towards the use of low-value treatments among individuals with low SES is an expression of the inequality in health [16,17].

Within the area of musculoskeletal disorders, the societal and health-related consequences of low SES recognized in the literature are extensive (Figure 1), which will complicate clinical evaluation and treatment of LDH, and in general. Moreover, low SES itself is a risk factor for spinal degenerative diseases [16] confounded by factors such as being a smoker or having diabetes [18,19]. These findings could potentially induce inequality in the treatment of LDH.

This case-control study, based on secondary national administrative data, aims to explore whether sociodemographic and -economic characteristics are associated with the likelihood of undergoing first-time, single-level, simple lumbar discectomy at a free-of-fee, public hospital.

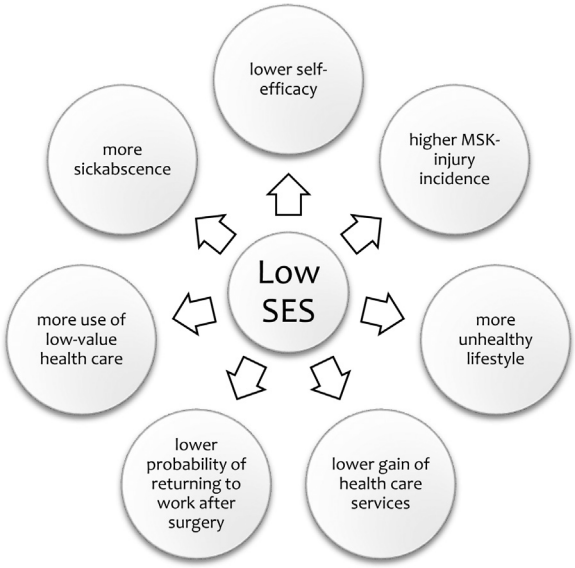

Figure 1. Illustration of societal and health-related consequences to a low socioeconomic status (SES), defined by educational level, income, and labor market attachment when compared to individuals with higher SES

Material and methods

Study design

A retrospective, case-control study based on secondary data from national administrative registers. The study adheres to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [20].

Specification of key study dates and settings

The study population was identified as part of a previous study [21] and comprised a consecutive series of patients who, according to a research database, underwent first-time, single-level, simple lumbar open discectomy or micro-endoscopic discectomy during the inclusion period between June 1, 2010, and December 31, 2013, at a public hospital.

All patients were referred from primary or secondary care after insufficient nonsurgical treatment or otherwise presenting with a specific indication for elective discectomy. The diagnosis was verified by magnetic resonance imaging or computed tomography. Patients were 18 years or older and had minor degrees of comorbidities (American Society of Anesthesiologists (ASA) Classification Score <3 [22]).

Once scheduled for surgery, the patients enrolled in the research database DaneSpine [23], which identified the study population (described below).

Exclusion criteria were previous spine surgery at any level or other spinal pathology at the time of surgery such as malignancy, infection, spondylolysis, spondylolisthesis, inflammatory arthritis, notable scoliosis, or metabolic bone disease.

Statistics Denmark, a government authority described below, identified the control population as a random sample of the Danish population, with three controls per surgical patient, matched by gender, age (month and year of birth), and the municipality of residence at the time of surgery [24]. The control population was not a clinical population, and having, by chance, undergone LDH surgery according to the Danish National Patient Register [25] disqualified for participation in the control cohort.

The identification of the controls was based on the Danish Civil Registration System, which stores current and historical personal information on all Danish residents based on a personal identification number [26].

Data sources

The Danish research database DaneSpine is maintained by the Danish Society of Spine Surgeons. It holds Patient-Reported Outcome Measures (PROMs) and clinical data prospectively collected pre-, peri- and postoperatively [23].

Within the study period, 98-99% of the patients who underwent lumbar discectomy at the public hospital enrolled in the database according to estimates based on data provided by the Danish society of Spine Surgeons and the National Patient Register.

Statistics Denmark is an independent governmental authority that collects and publishes statistics on the Danish society based on civil reg-

istration numbers and related data collected from several national authorities and registers. Of particular interest to this study are data on employment and social payment transfers at individual levels retrieved from the Danish Register Based Evaluation of Marginalization (DREAM) database [27,28]. The DREAM database is described in the Appendix.

Variables

The outcome of interest was the event of undergoing lumbar discectomy.

The following variables retrieved from the DaneSpine database described the surgical group: age, body mass index (BMI), gender, smoking habits, duration of leg and back pain, intensity of leg and back pain (Visual Analogue Scale (VAS)) [29], mental and physical health (Short Form Health Survey version 1 (SF-36)) [30], functional disability (Oswestry Disability Index (ODI)) [31,32] and health-related quality of life (EuroQoL (EQ-5D)) [33].

Sociodemographic variables of interest retrieved from Statistics Denmark included weekly data on employment within one year prior to surgery and data on ethnicity, marital status, highest educational level, annual personal and equivalent disposable family income, and socioeconomics. Functional disabilities related to the disc herniation at the time around surgery are likely to affect labor market attachment as evidenced by changes in income and socioeconomic classification. Thus, the values of these variables are included as recorded one year prior to surgery to describe placement in the labor market unaffected by the disease.

See the Appendix for a detailed description and definition of the socioeconomic variables and the initial data management.

Statistical analysis methods

Normally distributed variables were described using means and standard deviations, and non-parametric data were described using medians and interquartile ranges. Categorical data were expressed as proportions. Independent variables were tested for intercorrelation, and variables with moderate or strong correlation ($R^2 > .5$) were excluded from further analysis.

The associations between the event undergoing lumbar discectomy and the independent variables were estimated using univariate logistic regression analysis. All associations expressed as Odds Ratio (OR).

Using stepwise backward elimination based on a Likelihood ratio test, all variables were further tested in a multivariate regression analysis. All estimates were reported with a 95% confidence interval (CI).

Valid CIs and p values were ensured using the Hosmer and Lemeshow rule of thumb; the number of events (operated patients) exceeded the suggested 10 per independent variable [34]. Bootstrapping (1000 reps) further computed bias-corrected CIs and p-values [35].

Few missing observations were expected due to the overall completeness of the datasets as described in the Data Sources section. Therefore no handling was planned except assessing and presenting the completeness of data per variable in the Results section.

Analyses were performed using Stata 16 (StataCorp, College Station, Tx, USA). An alpha level of .05 was used in all tests.

Ethics and Data Control

National agencies being the Danish Health Safety Authority (#3-3013-1174/1), and the Danish Data Protection Agency (#14/26345) approved the study. According to Danish law, ethical approval from the Regional Scientific Ethics Committee for Southern Denmark was not required [36]. When completing the DaneSpine questionnaires, the patients gave written informed consent for the use of their data in research. All data were stored following the Danish Open Administration Act, the Danish Act on Processing of Personal Data, and the Health Act.

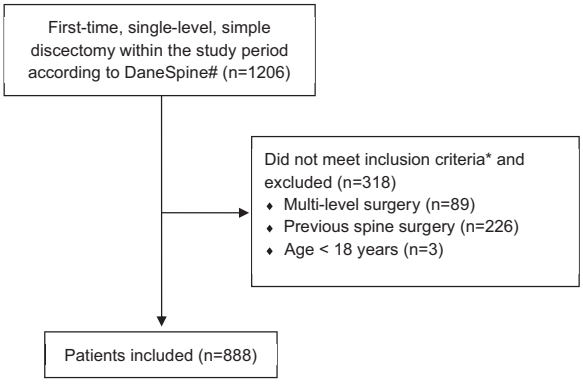

Figure 2. Flowchart describing the selection of the study population

Results

Participants

According to the research database DaneSpine, 1206 patients underwent first-time lumbar discectomy within the study period. However, a survey of the electronic medical records revealed inaccurate notation in the research database as 318 patients did not fulfil the inclusion criteria, leaving 888 patients and subsequently 2664 controls in the final study population (Figure 2). In particular, previous spine surgery or surgery at more levels disqualified from participation. Sociodemographic and clinical baseline characteristics describing the operated cohort are presented in Table 1.

The association between sociodemographic characteristics and undergoing first-time, single-level, simple lumbar discectomy

Overall, very few data were missing, less than 10% depending on the variables assessed (Table 1 and 2), and they were considered of no significance to the results [37].

Among categorical variables, small cell sizes ($n \leq 5$) were addressed using aggregation to secure statistical reliability. For further description of initial data handling, see the Appendix.

Testing for intercorrelation between independent variables led to no exclusions as no moderate or strong correlations were found ($R^2 < 0.5$).

Results from the univariate and multivariate analysis are presented in Table 2. For the latter, both uncorrected and bias-corrected CIs are reported.

In univariate analysis, being on sick leave for more than two weeks within one year prior to the outcome event was associated with an 8.7 OR (95% CI 7.2 - 10.5) of undergoing discectomy. Also, educational level and personal income were statistically significantly associated with the outcome. As such, patients with lower levels of education and patients with a low income were 2-3 times and around 1.5 times, respectively, more likely to undergo discectomy than patients with the highest educational level and personal income. The lower the educational level, the higher OR compared to the highest level of education with OR=1.

The independent variables marital status, ethnicity, duration of sick leave, educational level, socioeconomic classification, and personal income constituted the final model in the stepwise backward multivariate analysis, which included all variables in the initial model. Sick leave for more than two weeks within one year prior to the outcome event and educational levels remained statistically significantly associated with the event of undergoing discectomy. This with ORs largely unchanged.

The resampling through bootstrapping did not indicate multiplicity. The size of CIs reflected the uneven variation of both the educational

Table 1
Sociodemographic and clinical characteristics for patients undergoing first-time, single-level, simple lumbar discectomy (n=888).

Mean (SD)	
Age, n=888[a]	46 (13.70)
n (%)	
Male, n=888	477 (54)
Married/Cohabiting, n=888	491 (55)
Smoker, n=888	295 (33)
Ethnicity, n=887	
Danish	827 (93)
Immigrant/descendant	60 (7)
Educational level, n=871	
Primary and lower secondary school	265 (30)
Higher general and preparatory examination programs	419 (48)
Short- and medium cycle higher education	167 (19)
Long-cycle higher education	20 (2)
Pre-operative sick leave, n=888	
≤2 weeks	511 (58)
>2 weeks	377 (43)
Socioeconomic classification[b], n=888	
Employer	38 (4)
Employee	581 (65)
Receiving social benefits	269 (30)
Equivalent disposable family income [bc], n=796	
1st quintile	258 (32)
2nd quintile	184 (23)
3rd quintile	153 (19)
4th quintile	124 (16)
5th quintile	77 (10)
Personal income [bd], n=870	
1st quintile	311 (36)
2nd quintile	193 (22)
3rd quintile	156 (18)
4th quintile	127 (15)
5th quintile	83 (10)
Duration of back pain, n=888	
No pain	69 (8)
Pain <3 months	144 (16)
Pain 3 months till <12 months	372 (42)
Pain ≥ 1 year	303 (34)
Duration of leg pain, n=888	
No pain	10 (1)
Pain <3 months	240 (27)
Pain 3 months till <12 months	473 (53)
Pain ≥ 1 year	165 (19)
Mean (SD)	
Body Mass Index, n=882	27 (5)
Mental health (SF-36 MCS), n=882	27.75 (7.34)
Physical health (SF-36 PCS), n=882	40.55 (11.94)
Disability (ODI), n=876	47.29 (18.24)
Median (iqr)	
Quality of life (EQ-5D), n=884	0.26 (0.62)
Back pain intensity (VAS), n=880	50 (50.5)
Leg pain intensity (VAS), n=881	74 (33)

SD, standard deviation; iqr, Interquintile range; SF-36 MCS, The Short Form Health Survey version 1, mental health score; SF-36 PCS, The Short Form Health Survey version 1, physical health score; EQ-5D, European Quality of life – 5 Dimensions.

[a] age range: 18-87 years

[b] as assessed one year prior to surgery

[c] Income range in Danish kroners: 0-2.599.181 DKK

[d] Income range in Danish kroners: 0-1.250.712 DKK

levels with less highly educated individuals and the duration of sick leave. Estimates of the statistically significant associations found should therefore be used cautiously.

Discussion

This study, based on secondary national administrative data, aimed at exploring whether sociodemographic and -economic characteristics were associated with the likelihood of undergoing first-time, single-level, simple lumbar discectomy at a free-of-fee, public hospital.

Compared to an age-, gender- and municipality-matched control having not undergone spine surgery, the event of undergoing lumbar discectomy (n=888) was statistically significantly associated with educational levels and the duration of preoperative sick leaves.

The lower the educational levels and the longer duration of the sick leaves, the higher probability of discectomy. This is in line with the results of Lurie et al., who found preferences towards discectomy compared to nonsurgical care in patients with lower levels of education and higher levels of unemployment [38].

Table 2
Associations between patient socioeconomics and the probability of undergoing first-time, single-level, simple lumbar discectomy (n=888) compared to the control cohort (n=2664), N=3552. Associations presented as Odds Ratios with the 95% confidence intervals.

	Univariate analysis	Multivariate analysis	
	OR (95% CI)	**OR**	**95% CI**
Marital status (vs. Married/Cohabiting), N=3443			
Single/Non-cohabiting	1.06 (0.91-1.23)	1.10	(0.93-1.31) N(0.94-1.31) BC
Ethnicity (vs. Danish), N=3542			
Immigrant/Descendant	0.80 (0.60-1.08)	0.72	(0.48-1.10) N(0.47-1.08) BC
Highest completed educational level (vs. Long-cycle higher education), N=3431			
Primary and lower secondary school	**3.06 (1.88-4.98)**	**2.53**	**(1.46-4.39)** N**(1.52-4.47)** BC
Higher general and preparatory examination programs	**2.70 (1.67-4.35)**	**2.01**	**(1.17-3.47)** N**(1.26-3.59)** BC
Short- and medium cycle higher education	**2.44 (1.49-4.01)**	**1.98**	**(1.14-3.47)** N**(1.20-3.63)** BC
Socioeconomic classification[c] (vs. Employer), N=3523			
Employee	1.13 (0.78-1.64)	0.92	(0.58-1.46) N(0.60-1.50) BC
Receiving social benefits	1.28 (0.87-1.88)	1.47	(0.91-2.37) N(0.91-2.42) BC
Sick leave (vs. ≤2 weeks), N=3543			
>2 weeks	**8.68 (7.15-10.54)**	**9.47**	**(7.68-11.68) N(7.67-11.58) BC**
Equivalent disposable family income [a] (vs. 5th quintile), N=3190			
1st quintile	1.25 (0.96-1.62)		
2nd quintile	**1.37 (1.06-1.77)**		
3rd quintile	1.25 (0.96-1.62)		
4th quintile	1.07 (0.82-1.40)		
Personal income[b] (vs. 5th quintile), N=3435			
1st quintile	**1.34 (1.04-1.74)**	1.12	(0.81-1.54) N(0.81-1.57) BC
2nd quintile	**1.59 (1.23-2.04)**	1.00	(0.73-1.37) N(0.74-1.39) BC
3rd quintile	**1.55 (1.20-1.99)**	1.00	(0.75-1.33) N(0.77-1.34) BC
4th quintile	**1.46 (1.13-1.89)**	1.14	(0.86-1.52) N(0.85-1.51) BC

OR, Odds Ratio; CI, Confidence Interval; N, Normal confidence interval; BC, Bias-corrected confidence interval
Bold indicates p values<0.05.

[a] In Danish kroners as assessed one year prior to surgery, 1st quintile: <161.410, 2nd quintile: 161.410-200.570, 3rd quintile: 200.570-243.920, 4th quintile: 243.920-300.300, and 5th quintile: >300.300.

[b] In Danish kroners as assessed one year prior to surgery, 1st quintile: <131.770, 2nd quintile: 131.770-184.400, 3rd quintile: 184.400-235.920, 4th quintile: 235.920-310.710, and 5th quintile: >310.710.

[c] As assessed one year prior to surgery

Workability can be regarded as a proxy for the balance between functional capacity and physical work demands, and individuals with low educational levels and more physically demanding work are likely to be less able to adapt to functional disabilities, e.g. when afflicted by LDH [39,40]. This may negatively affect workability. A preference for care that immediately results in an ability to remain attached to the labor market could further be anticipated. Moreover, for individuals with a low education level, which is associated with lower income [41], user fees or co-payments for primary care health services are previously established as a significant barrier towards high-value health care [17].

In this study, we had no access to data on the degree of primary care health services used, and the presence of a low-value pattern should therefore not be presumed. Future studies should focus on retrieving data on both primary and secondary health care services to more fully describe the pattern of health care use among patients with LDH.

Low SES is associated with fewer psychosocial resources for coping with work conditions and medical issues [17,40]. Navigating treatments and labor market attachment while being in pain or disabled might be difficult and of possible importance to treatment preferences. ORs associated with the socioeconomic classification as presented in table 2 may illustrate these relationships. Within the area of lumbar spine surgery, the PREPARE study found that pre-surgical psychosocial interventions, such as a fear-avoidance-reducing approach, had a positive effect on self-efficacy [42]. Psychosocial resources are thus modifiable and of evident relevance to interventions targeted the non-medical conditions that may influence treatment preferences.

The magnitude of the association between income and the outcome event (discectomy or not) is modest, although significant, in the univariate analysis (OR 1.34-1.59), and without significance in the multivariate analysis. The ORs are of almost similar magnitudes regardless of the quintiles compared to the highest quintile. Denmark, like most other Nordic countries, has a low degree of income inequality compared to other European countries [43], but mechanisms, such as employer-paid health insurance, complicate the interpretation of the associations found. We suggest that in a Danish context, the educational level will be a better estimate of the SES than income, as the educational value is more stable over time [44], but this may be context-specific.

Lurie et al. found that the disease-related factors such as patient-reported pain and disability levels were important to the surgery preference in favor of nonsurgical treatment [38]. In clinical guidelines, the duration of symptoms, and by extension, the likelihood of extended sick leave, is included as indicators for considering surgical evaluation. As such, the positive association between extended sick leaves and undergoing discectomy found in this study was expected.

As described in the Appendix, the cut point of two weeks was estimated from a heavily right-skewed histogram. Due to limitations in the national administrative data (see the Appendix), only sick leaves exceeding the employer-paid period (3-4 weeks within the study period) are included in the study. This affects the cut point. Including sick leaves of shorter duration would affect the distribution within the variable and likely the cut point. Such conditions are particular to a Danish context, and extrapolation should not be uncritical. Durations of sick leaves are, however, strongly associated with SES [45] and should be accounted for and should be accounted for during clinical assessment.

Immigrants or descendants were found less likely to undergo lumbar discectomy. The finding reflects the clinical perception of immigrants/descendants being less willing to undergo discectomy in the surgical department participating in the study. This although surgery is offered which possibly illustrates cultural differences. This relationship seems of greater importance to the probability of undergoing discectomy, than does the negative labor market attachment otherwise associated with this population.

Strengths and limitations

A clear strength of the study was the use of comprehensive secondary data from national registries.

Since 1968, all individuals living in Denmark have been registered in the Danish Civil Registration System and assigned a unique personal identification number at birth or upon immigration to Denmark, allowing accurate cross-reference between all national registries and datasets [26]. This permits register studies that typically have high degrees of data completeness and minimal risks of selection bias. However, as a single-center study, the validity and generalizability of the results are limited and the findings should be replicated in other and extended populations, and wide confidence intervals found call upon larger study samples.

The exclusion of patients with an increased degree of comorbidity (ASA classification score ≥ 3) might have led to an underestimation of the association of SES and surgical preference because high comorbidity is associated with low SES [16], including an underrepresentation in the labor market [46]. However, a stable labor market attachment at the time around spine surgery predicts good outcomes after surgery [21,47] and may dilute the effect of excluding high-comorbidity patients by affecting the decision-making disfavouring surgery.

The increasing use of health insurance has offered many patients the possibility to circumvent waiting times for treatments at public hospitals. As a result, more discectomies are conducted at private hospitals, and on the shorter duration of symptoms [48]. The present study did not include the patients who underwent lumbar discectomy at private hospitals, therefore it might overestimate the association between SES and the outcome event, as the surgical group examined is likely less educated and attached to the labor market when compared to surgical patients at private hospitals [48]. Thus, an extrapolation of the present results should be adjusted for the framework of local health care systems. However, as the scope of this study was explorative towards whether sociodemographics and -economics was of importance to the probability of surgical treatment of symptomatic LDH, the free-access tax-financed health care system is suitable. But limits, however, the comparison of the present results with findings in private supplementary or employment-based private health insurance-driven health care systems.

The study population was identified for previous research, hence the aging data from 2010-2013. However, neither the basic structures within the health care system nor the guidelines for the treatment of lumbar disc herniation have changed significantly within the last decade.

Conclusion

This explorative case-control study found associations between socioeconomic factors and the probability of undergoing first-time, single-level, simple lumbar discectomy at a public free-of-fee hospital.

Compared to an age- and gender-matched non-clinical control population, the ORs of undergoing discectomy among 888 operated patients increased from 1.98 to 2.53 with decreasing educational levels compared to the highest educational level. Likewise, sick leaves exceeding two weeks within one year prior to surgery showed a statistically significant association with an increased probability of undergoing surgery (OR 9.47 (95% CI 7.68-11.68)).

Although the associations should be tested in larger samples and data on the use of non-surgical health care should be included, the findings indicate patterns of low values healthcare use among individuals holding low socioeconomic status. The treatment of LDH-related pain and disabilities should be recognized by authorities and health care providers for its complexity among patients with low SES.

Data availability

Access to data may be obtained by contacting the corresponding author.

Declaration of Competing Interest

None.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.xnsj.2022.100106.

References

[1] Deyo RA, Tsui-Wu YJ. Descriptive epidemiology of low-back pain and its related medical care in the United States. Spine 1987;12(3):264–8.
[2] Hartvigsen L, Hestbaek L, Lebouef-Yde C, Vach W. Kongsted A. Leg pain location and neurological signs relate to outcomes in primary care patients with low back pain. BMC musculoskeletal disorders 2017;18(1):133.
[3] Koes BW, van Tulder MW, Peul WC. Diagnosis and treatment of sciatica. BMJ (Clinical research ed) 2007;334(7607):1313–17.
[4] Danish Health Authority. National Clinical Guideline for the Non-Surgiccal Treatment of Recent Onset Lumbar Nerve Root Compresssion (Lumbar Radiculopathy). Copenhagen 2016.
[5] Kreiner DS, Hwang SW, Easa JE, Resnick DK, Baisden JL, Bess S, et al. An evidence-based clinical guideline for the diagnosis and treatment of lumbar disc herniation with radiculopathy. The spine journal : official journal of the North American Spine Society 2014;14(1):180–91.
[6] Bush K, Cowan N, Katz DE, Gishen P. The natural history of sciatica associated with disc pathology. A prospective study with clinical and independent radiologic follow-up. Spine 1992;17(10):1205–12.
[7] Rajaee SS, Bae HW, Kanim LE, Delamarter RB. Spinal fusion in the United States: analysis of trends from 1998 to 2008. Spine 2012;37(1):67–76.
[8] Kiil A. Does employment-based private health insurance increase the use of covered health care services? A matching estimator approach. Int J Health Care Finance Econ 2012;12(1):1–38.
[9] Diderichsen F.A.I., Manuel, C.. Ulighed i Sundhed – årsager og indsatser. Copenhagen: Danish Health Autorithy; 2011.
[10] Anema JR, Schellart AJ, Cassidy JD, Loisel P, Veerman TJ, van der Beek AJ. Can cross country differences in return-to-work after chronic occupational back pain be explained? An exploratory analysis on disability policies in a six country cohort study. J Occup Rehabil 2009;19(4):419–26.
[11] Asher AL, Devin CJ, Archer KR, Chotai S, Parker SL, Bydon M, et al. An analysis from the Quality Outcomes Database, Part 2. Predictive model for return to work after elective surgery for lumbar degenerative disease. J Neurosurg Spine 2017;27(4):370–81.
[12] Employment MoThe importance of the sickness benefit reform for the case handling in the municipalities. Styrelsen for Arbejdsmarked og Rekruttering 2014:1–13.
[13] Mackenbach JM, WJ; Kunst AE. Economic implications of socio-economic inequalities in health in the European Union. Rotterdam, The Netherlands: Erasmus MC, Department of Public Health; 2007.
[14] Mueller KJ, Patil K, Boilesen E. The role of uninsurance and race in healthcare utilization by rural minorities. Health Serv Res 1998;33:597–610 3 Pt 1.
[15] Mackenbach JP, Meerding WJ, Kunst AE. Economic costs of health inequalities in the European Union. J Epidemiol Community Health 2011;65(5):412–19.
[16] Udesen C.H.S.C.; Petersen, M..N..S.; Ersbøll, A..K.. Social ulighed i sundhed og sygdom. 2020.
[17] Kangovi S, Barg FK, Carter T, Long JA, Shannon R, Grande D. Understanding why patients of low socioeconomic status prefer hospitals over ambulatory care. Health Aff (Millwood) 2013;32(7):1196–203.
[18] Shiri R, Karppinen J, Leino-Arjas P, Solovieva S, Viikari-Juntura E. The association between smoking and low back pain: a meta-analysis. Am J Med 2010;123(1) 87.e7-35.
[19] Ferreira PH, Beckenkamp P, Maher CG, Hopper JL, Ferreira ML. Nature or nurture in low back pain? Results of a systematic review of studies based on twin samples. Eur J Pain 2013;17(7):957–71.
[20] von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol 2008;61(4):344–9.
[21] Ziegler DS, Jensen RK, Thomsen GF, Carreon L, Andersen MO. Returning to Work Within Two Years After First-Time, Single-Level, Simple Lumbar Discectomy: A Multifactorial, Predictive Model. J Occup Rehabil 2020;30(2):274–87.
[22] American Society of Anesthesiologists. ASA Physical Status Classification System American Society of Anesthesiologists web site. Available from: https://www.asahq.org/standards-and-guidelines/asa-physical-status-classification-system.
[23] Danish Society of Spinal Surgery. Om DaneSpine 2016. Available from: http://drksdanespine.dk/wm419475.
[24] Statistics Denmark. About us: Statistics Denmark; 2018. Available from: https://www.dst.dk/en/OmDS.
[25] Lynge E, Sandegaard JL, Rebolj M. The Danish National Patient Register. Scand J Public Health 2011;39:30–3 7_suppl.
[26] Pedersen CB. The Danish Civil Registration System. Scand J Public Health 2011;39:22–5 7 Suppl.
[27] Hjollund NH, Larsen FB, Andersen JH. Register-based follow-up of social benefits and other transfer payments: accuracy and degree of completeness in a Danish in-

terdepartmental administrative database compared with a population-based survey. Scand J Public Health 2007;35(5):497–502.
[28] Stapelfeldt CM, Jensen C, Andersen NT, Fleten N, Nielsen CV. Validation of sick leave measures: self-reported sick leave and sickness benefit data from a Danish national register compared to multiple workplace-registered sick leave spells in a Danish municipality. BMC public health 2012;12:661.
[29] Huskisson EC. Measurement of pain. Lancet (London, England) 1974;2(7889):1127–31.
[30] McHorney CA, Ware JE Jr, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. Med Care 1993;31(3):247–63.
[31] Fairbank JC, Couper J, Davies JB, O'Brien JP. The Oswestry low back pain disability questionnaire. Physiotherapy 1980;66(8):271–3.
[32] Lauridsen H.H., Hartvigsen J., Manniche C., Korsholm L., Grunnet-Nilsson N.. Danish version of the Oswestry Disability Index for patients with low back pain. Part 1: Cross-cultural adaptation, reliability and validity in two different populations. European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society. 2006;15(11):1705-16.
[33] Group EuroQoL. EuroQol–a new facility for the measurement of health-related quality of life. Health Policy 1990;16(3):199–208.
[34] Vittinghoff E, McCulloch CE. Relaxing the rule of ten events per variable in logistic and Cox regression. Am J Epidemiol 2007;165(6):710–18.
[35] Streiner DL. Best (but oft-forgotten) practices: the multiple problems of multiplicity-whether and how to correct for many statistical tests. Am J Clin Nutr 2015;102(4):721–8.
[36] The Regional Scientific Ethics Committee for Southern Denmark. The Scientific Ethics Committees: The Region of Southern Denmark; 2016. Available from: https://komite.regionsyddanmark.dk/wm428123.
[37] Dong Y, Peng CY. Principled missing data methods for researchers. SpringerPlus 2013;2(1):222.
[38] Lurie JD, Berven SH, Gibson-Chambers J, Tosteson T, Tosteson A, Hu SS, et al. Patient preferences and expectations for care: determinants in patients with lumbar intervertebral disc herniation. Spine 2008;33(24):2663–8.
[39] de Breij S, Huisman M, Deeg DJH. Work characteristics and health in older workers: Educational inequalities. PLoS One 2020;15(10):e0241051.
[40] Matthews KA, Gallo LC. Psychological perspectives on pathways linking socioeconomic status and physical health. Annu Rev Psychol 2011;62:501–30.
[41] Jacobsen K.F.., Befolkningens uddannelsesniveau Copenhagen: Statistics Denmark, 2004.
[42] Lindbäck Y, Tropp H, Enthoven P, Abbott A, Öberg B. PREPARE: presurgery physiotherapy for patients with degenerative lumbar spine disorder: a randomized controlled trial. The spine journal : official journal of the North American Spine Society 2018;18(8):1347–55.
[43] eurostat. Living conditions in Europe. 2018 edition. European Union; 2018.
[44] Galobardes B, Shaw M, Lawlor DA, Lynch JW, Davey Smith G. Indicators of socioeconomic position (part 1). J Epidemiol Community Health 2006;60(1):7–12.
[45] Allebeck P, Mastekaasa A. Swedish Council on Technology Assessment in Health Care (SBU). Chapter 5. Risk factors for sick leave - general studies. Scand J Public Health Suppl 2004;63:49–108.
[46] Statens Serum Institut. Few people with multi-disease on the labor market. Statens Serum Institut, Sundhedsanalyser Af; 2015.
[47] Than KD, Curran JN, Resnick DK, Shaffrey CI, Ghogawala Z, Mummaneni PV. How to predict return to work after lumbar discectomy: answers from the NeuroPoint-SD registry. J Neurosurg Spine 2016;25(2):181–6.
[48] Grotle M, Solberg T, Storheim K, Laerum E, Zwart JA. Public and private health service in Norway: a comparison of patient characteristics and surgery criteria for patients with nerve root affections due to discus herniation. European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society 2014;23(9):1984–91.