The impact of specialised treatment of low back pain on health care costs and productivity in a nationwide cohort

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Summary

Background Low back pain (LBP) is the most common diagnosis responsible for sick leave, long-term disability payments, and early retirements. Studies have suggested that the relatively small proportion of patients referred to a specialist for treatment, either conservative or surgical, accounts for most of the total costs of back pain. However, a complete and long-term picture of the socioeconomic burden associated with these two treatment regimens is lacking.

Methods From a cohort encompassing the entire population in Denmark (5.8 million inhabitants), we identified patients with LBP referred to specialised treatment, either conservative or surgical, during 2007–2016. According to treatment modality, two different cohorts were constructed. Each patient was matched with ten background population controls based on age, sex, region of residency and time of treatment (month and year). Using extensive, nationwide register data, the healthcare costs and loss of productivity from two years before the first intervention until 2018 was investigated.

Findings A total of 56,694 patients underwent surgical treatment, and 72,915 patients conservative treatment. Both cohorts had a significantly higher baseline cost two years before treatment compared with the background population controls. These measures increased sharply during the year after treatment. Five years after treatment, healthcare costs and loss of productivity remained proportionally similarly increased for the two treatment groups compared to the background population. Multiple surgeries had detrimental effects on long term productivity for the patients, and spouses to patients had marginally increased loss of productivity.

Interpretation The results show that patients referred to specialised treatment of LBP display poor socioeconomic prognosis, regardless of conservative or surgical treatment modality. This development was reinforced in patients undergoing multiple surgeries and was also observed among spouses to the patients. Our findings of substantial loss of productivity across subgroups indicate that measures of successful treatment need to be more nuanced.

Keywords: Low Back Pain; cost of illness; nationwide cohort; Socioeconomic

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Research in context

Evidence before this study

For this study, previous relevant randomised controlled trials, comparative studies, observational studies, and systematic reviews were searched with Medline (PubMed) without date restrictions from inception up to November 2020, using free-text terms for [low back pain] and [cost of illness] in combination with [specialised treatment], [surgery] or [conservative]. This search was restricted to English language studies with available abstracts. The evidence suggests that productivity loss is overwhelmingly responsible for the total cost of illness of low back pain. Furthermore, the years lived with disability due to low back pain has been increasing in the last three decades, and in the same time period, there has been a dramatic increase in specialised treatment.

Added value of this study

To our knowledge, this is the first study that investigates the impact of specialised treatment on health care costs and productivity loss in patients with low back pain in a nationwide cohort.

Implications of all the available evidence

Although randomised controlled trials show positive results of specialised treatment for low back pain on function and pain reduction, this change is not correspondingly reflected in developments in consumption of health care costs and productivity loss. Measures of treatment outcomes in future studies need to be more nuanced and the results highlights the need for better stratification and rehabilitation strategies.

Introduction

Low back pain (LBP) has been the leading cause of functional health loss (years lived with disability) the last three decades, and the burden is growing. From 1990 to 2015 there was a 54% increase in years lived with disability.[1,2] Low back pain affects men and women equally, and up to 85% of all people experience back pain at some point in life. Low back pain is the single most common diagnosis responsible for sick leave, long-term disability payments, and early retirements.[3–5] Low back pain is therefore associated with substantial quality of life reductions and an increased economic burden for the society both in terms of productivity (a large number of workdays lost) and health care costs.[6–8] Although the proportion of patients requiring surgery as a treatment for their back pain due to degenerative spine disease is relatively low, the large prevalence of afflicted people results in a high number of surgical procedures being performed. The overall volume of these surgical treatments has increased dramatically during the last decades.[9,10] In the US, back pain is now the third most common cause of surgical procedures.[4] Studies have suggested that the relatively small proportion of patients referred to a specialist for treatment accounts for the majority of total costs of back pain. In most cases, this subgroup is seen to have longer episodes of pain or require more advanced care.[11–16]

Better understanding the magnitude of the socioeconomic burden of LBP and the impact of treatment on objective health and socioeconomic measures is an essential part of the overall evaluation of the current treatment.[17–20] The Danish nationwide health registers, which holds information on all LBP diagnoses and interventions, combined with the comprehensive register-based socioeconomic data for all individuals, represent a unique resource for research into this matter. We used the Danish registers with the aim of investigating the impact of specialised conservative and surgical treatment of low back pain, respectively, on health care costs and productivity loss before and after these interventions, and to compare these with the corresponding costs in the background population. Our secondary aims were to investigate (1) the impact of multiple surgeries on health care costs and productivity loss, and (2) the economic burden on the unpaid caregiver measured by loss of productivity.

Methods

Study design

The study is a population-based, nationwide cohort study using prospectively collected register data. Since this was a register-based study and the decision for treatment was not randomised, we investigated patients surgically and conservatively treated separately and compared them with matched background controls. Thus, two cohorts were constructed, one including patients treated surgically for LBP and the other conservatively treated patients. Both cohorts were matched with ten background population controls per patient.

Data sources

The Civil registration Register contains information on all persons with a permanent residence in Denmark, who are all assigned a unique personal identification number (CPR-number). The CPR-number made it possible to link data across registers such as the National Patient Registry (NPR), Danish National Prescription Registry (DNPR), and The DREAM database which records all individuals on transfer payment with register-based information at an individual level.[21,22] Further information on the different registers is provided in the supplementary material.

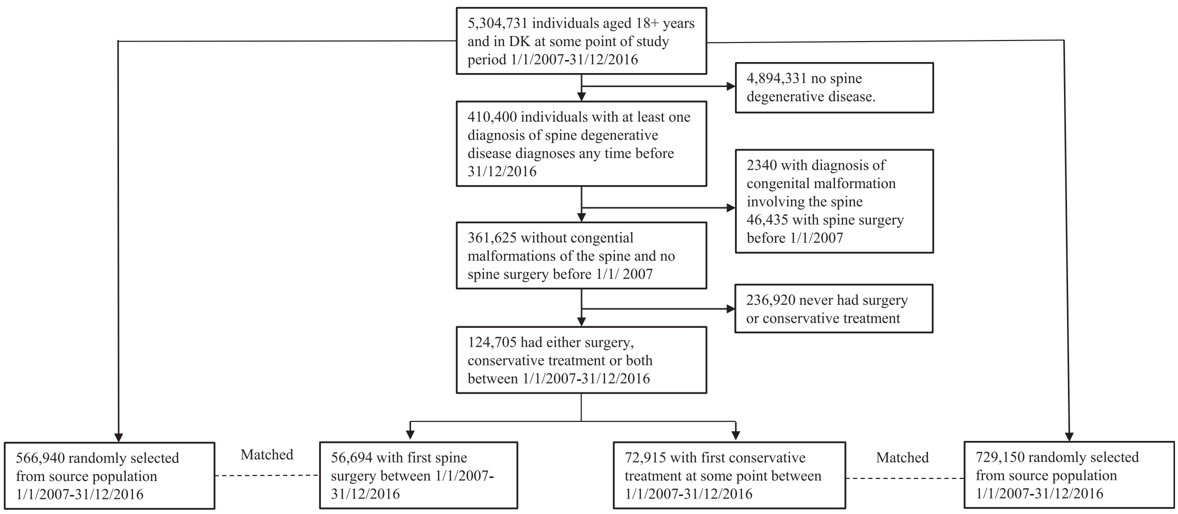

Figure 1. The selection steps of eligible surgically and conservatively treated patients and their respective background population controls.

Study population

Our source population was all individuals aged 18 and older living in Denmark after January 1, 2005. Using the NPR, we identified all patients diagnosed with degenerative spine disease who had not previously undergone spine surgery at the inclusion date January 1, 2007. We used The *International Classification of Disease* (ICD)−10 to identify the relevant diagnoses: Spondylolisthesis (M43.0−1) Degenerative disk disease (M47.1−9, M99.2−9), Spinal stenosis (M48.0−2, M48.8−9), Disc herniation (M51.0−9). Patients who also had a diagnosis of congenital spinal malformation (Q76.0−4) were excluded. Patients that had LBP due to vertebral fractures, spine infection or tumor, were not included. Within this sample we defined two cohorts; a cohort of individuals who underwent surgical treatment and those who received conservative, non-surgical treatment. The two cohorts were constructed from the study population as described below, which is illustrated in Figure 1.

Cohort with surgically treated patients. The cohort undergoing surgery encompassed patients who after receiving one of the above-mentioned ICD-10 diagnoses underwent surgery, according to relevant diagnosis following NOMESCO Classification of Surgical Procedures (NSCP) codes for either decompressive surgery or fusion surgery in the period January 1, 2007 – December 31, 2016. The entry date was the date of surgery. The specific codes are detailed in Supplementary Table 1.

Cohort with conservatively treated patients. The cohort who received conservative treatment was defined as a registered hospital outpatient clinic contact of at least 60 days duration with at least one of the above-mentioned relevant inclusion diagnoses as primary diagnosis during January 1, 2007 – December 31, 2016. Non-surgical treatment of LBP with or without associated radiculopathy in Denmark follow national guidelines. It emphasises an interdisciplinary approach with patient education, guided physical exercise, mechanical diagnosis and therapy as well as manual therapy with or without joint mobilization. Patients who underwent surgery within a year after initially receiving conservative treatment were classified as member of the surgically treated cohort.

Background population controls. For each patient that underwent surgical or conservative treatment ten random controls were selected from the source population matched on age, sex, month and year of the study period as well as region of residence using frequency matching. Parity of socioeconomic status was achieved by selecting controls from each patient's region.

Costs

We investigated the healthcare costs and the indirect costs related to loss off productivity. Furthermore, we investigated the loss of productivity for the patients' spouses to illustrate the economic burden of the unpaid caregiver.

Healthcare costs. The health care costs were defined as the sum of the cost of inpatient contacts, outpatient contacts, primary care contacts, and medication. Inpatient care (hospitalization) and outpatient care were calculated using diagnosis-related group weightings and specific outpatient tariffs. These cost estimates were all based on data from the Danish Ministry of Health. The use and cost of drugs were derived from data from the National Prescription Registry, consisting of the retail price of each drug (including dispensing costs) multiplied by the number of transactions. Finally, the frequency and cost of consultations with general practitioners and other specialists were based on data from the National Health Security.

Productivity loss. The illness-related indirect costs were based on figures from the DREAM database and was defined as the days of sick leave and or disability pension, and therefore we choose to refer to these costs as loss of productivity. The analysis of productivity loss was restricted to individuals not yet retired. The analysis of spouse productivity loss was further restricted to individuals with a recorded spouse. The differentiated components of sick leave in Denmark and details of the analysis are described in the supplementary material methods section.

Statistical analyses

Statistical analyses were conducted using SAS 9.4. The direct yearly health care costs and the productivity loss were estimated each year for five years after index year (year of surgery/conservative treatment/ matched year) compared to two years before the index year. Bootstrapping was used to obtain standard errors.

Ethics

The study was approved by the Danish Data Protection Agency. Data handling and presentation was anonymous, so individual and ethical approval was not required according to Danish law. Results were presented as aggregated data only, ensuring no personal information of the cohort members could be identified. The data is presented according to the RECORD statement reporting guideline.

Funding

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Results

We identified a total of 410,400 individuals with at least one of the relevant ICD-10 diagnoses of degenerative spine disease, no congenital malformations, and who had not undergone previous spine surgery. Of these, we identified 56,694 patients who underwent surgery for degenerative spine disease in the study period January 1, 2007-December 12, 2016. In addition, we identified 72,915 patients that underwent conservative treatment with a specialist at an outpatient clinic with at minimum 60-day duration in the same period. From the source population, 566,940 background population controls matched on age, sex and geographic region were randomly selected for the surgically treated patients and 729,150 for the conservatively treated patients.

The characteristics of the two cohorts are presented in Table 1. Among the surgically treated patients 51·5% were females, and the mean age was 56·6 (15·6). Among the conservatively treated there were 52·3% females and the mean age was 53·2 (15·3).

Surgically treated patients

Health care costs. The changes in healthcare costs before, during, two and five years after the surgical treatment are presented in detail in Table 2 and illustrated in Figure 2. Two years before the first treatment, the direct costs among the surgically treated patients were substantially higher than the background population controls. There was a dramatic increase in cost in the year of treatment, which was mitigated during the first year after surgical treatment. The costs stabilised afterwards, and there was not a substantial change from two to five years. Interestingly, the differences in health care costs among the surgically treated patients and the background population controls were substantially more pronounced after two- and five-years follow-up than two years before treatment. Furthermore, the healthcare costs were higher among the surgically treated patients at both two and five years of follow-up than two years before the surgical treatment. When healthcare costs were differentiated, the mean number of out-patient visits, primary care services, and medicine consumption all had the same development with a sharp increase in the year of treatment with some mitigation before stabilizing at a higher level than before treatment. Meanwhile, mean inpatient contacts per patient had a sharp increase at initial treatment but stabilised at a level more similar to the background controls (Supplementary material Table 2).

Productivity loss. The difference between the surgically treated patients and the background controls at baseline was even more pronounced for productivity loss two years before initial treatment. This is illustrated in Figure 2. We observed a sharp increase in productivity loss among the patients before initial surgical treatment, whereas the background population controls continued their stable and modest increase. The surgical treatment only mitigated the increasing productivity loss, which continued to rise until one year after the initial treatment, where it stabilised with a continued modest increase

		Surgically treated patients		Conservatively treated patients	
		Treatment group	Matched controls	Treatment group	Matched controls
Total number of subjects		56,694	566,940	72,915	729,150
Characteristics at entry					
Entry year	2007−2009	16,547 (29·2%)	165,470 (29·2%)	20,518 (28·1%)	205,180 (28·1%)
	2010−2012	18,502 (32·6%)	185,020 (32·6%)	22,150 (30·4%)	221,500 (30·4%)
	2013−2016	21,645 (38·2%)	216,450 (38·2%)	30,247 (41·5%)	302,470 (41·5%)
Entry month	January-March	15,243 (26·9%)	140,482 (24·8%)	18,438 (25·3%)	179,765 (24·7%)
	April-June	13,565 (23·9%)	141,776 (25·0%)	18,261 (25·0%)	182,039 (25·0%)
	July-September	12,986 (22·9%)	142,708 (25·2%)	17,153 (23·5%)	183,810 (25·2%)
	October-December	14,900 (26·3%)	141,974 (25·0%)	19,063 (26·1%)	183,536 (25·2%
Sex	Male	27,493 (48·5%)	274,930 (48·5%)	34,788 (47·7%)	347,880 (47·7%)
	Female	29,201 (51·5%)	292,010 (51·5%)	38,127 (52·3%)	381,270 (52·3%)
Age at treatment	18−29	2435 (4·3%)	24,340 (4·3%)	4541 (6·2%)	45,410 (6·2%)
	30−39	6885 (12·1%)	68,850 (12·1%)	10,244 (14·0%)	102,440 (14·0%)
	40−49	10,257 (18·1%)	102,570 (18·1%)	16,148 (22·1%)	161,480 (22·1%)
	50−59	10,792 (19·0%)	107,920 (19·0%)	16,210 (22·2%)	162,100 (22·2%)
	60−69	12,559 (22·2%)	125,590 (22·2%)	13,576 (18·6%)	135,760 (18·6%)
	70−79	10,708 (18·9%)	107,080 (18·9%)	9347 (12·8%)	93,470 (12·8%)
	80+	3059 (5·4%)	30,590 (5·4%)	2849 (3·9%)	28,490 (3·9%)
Region of residence	Hovedstaden	16,248 (28·6%)	162,480 (28·6%)	23,023 (31·6%)	230,230 (31·6%)
	Midtjylland	12,558 (22·2%)	125,580 (22·2%)	14,224 (19·5%)	142,240 (19·5%)
	Nordjylland	4530 (8·0%)	45,300 (8·0%)	7229 (9·9%)	72,290 (9·9%)
	Sjælland	8788 (15·5%)	87,880 (15·5%)	9029 (12·4%)	90,290 (12·4%)
	Syddanmark	14,570 (25·7%)	145,700 (25·7%)	19,410 (26·6%)	194,100 (26·6%)
Education	Short	18,308 (32·8%)	172,828 (31·1%)	22,680 (31·8%)	204,977 (28·6%)
	Intermediate	27,385 (49·1%)	258,456 (46·5%)	34,483 (48·3%)	339,606 (47·4%)
	Long	10,086 (18·1%)	125,125 (22·5%)	14,221 (19·9%)	171,653 (24·0%)
Cohabitation	No spouse	17,658 (31·2%)	190,744 (33·6%)	23,449 (32·2%)	241,289 (33·1%)
	Married/spouse	39,036 (68·8%)	376,196 (66·4%)	49,466 (67·8%)	487,861 (66·9%)

***Table 1*: Characteristics of the two cohorts; surgically and conservatively treated patients and their respective background population controls matched by age, sex, year, and region of residence.**

from the two-year follow-up until the five-year follow-up. The difference in productivity loss between those that were surgically treated, and the background controls was substantially increased at two- and five years post index treatment compared to baseline (Table 2 and Figure 2). When investigating productivity loss more closely, we observed that the surgically treated patients were far more prone to be removed entirely from the labor market than background population controls, e.g., patients registered with 52 weeks of sick leave or went on disability pension. This group increased by 71% from two years before treatment to five years of follow up compared to 8% among the background controls.

Conservatively treated patients

Health care costs. The changes in healthcare costs before, during, and five years after conservative treatment are presented in Figure 3 and Table 3. The healthcare costs among the conservatively treated patients were substantially higher at baseline two years before treatment compared with their background controls. We observed a sharp increase one year before index treatment, declining during the first post-treatment year. The costs then stabilised without any substantial change from two- to five years after treatment. The stabilised direct costs post-treatment was higher than the baseline level before the index treatment. Compared to the background population controls, the healthcare costs were higher at baseline and remained higher post-treatment. When healthcare costs were differentiated, we saw the same development as for surgically treated patients compared to background controls for mean outpatient visits, primary care services, cost of medicine and inpatient contacts, but with a more modest increase in index treatment year for mean inpatient contacts per patient which stabilised at a level closer to the respective background controls. See Table 2 in supplementary material.

Productivity loss. The productivity loss was more pronounced among conservatively treated patients than

	Surgically treated patients				Matched background population controls			
	2 years before treatment	Year of treatment	2 years after treatment	5 years after treatment	2 years before treatment	Year of treatment	2 years after treatment	5 years after treatment
Total number of subjects	56694	56694	55294	37479	566940	566940	547154	368612
Healtcare costs								
Total direct costs	3097 (3044-3154)[***]	14698 (14603-14798)	5364 (5269-5455)	5253 (5139-5368)	2252 (2233-2270)	2786 (2764-2808)	2986 (2961-3009)	3187 (3157-3217)
Inpatient treatment	1211 (1173-1251)	11366 (11285-11453)	2696 (2621-2769)	2556 (2469-2651)	974 (960-988)	1259 (1243-1277)	1345 (1326-1365)	1460 (1436-1483)
Outpatient treatment	1071 (1047-1097)	2260 (2232-2289)	1658 (1624-1695)	1646 (1597-1700)	721 (713-728)	919 (909-929)	1028 (1018-1037)	1101 (1089-1114)
Primary care	1824 (1803-1844)	2615 (2593-2636)	2306 (2278-2335)	2393 (2357-2431)	1271 (1265-1277)	1430 (1423-1436)	1527 (1519-1534)	1598 (1589-1608)
Medication costs	559 (549-568)	703 (693-713)	684 (674-695)	627 (551-722)	379 (377-382)	407 (403-412)	397 (395-400)	387 (377-400)
Productivity loss								
Number of subjects	35888	33728	31205	20216	358312	335809	312086	201722
Weeks on sick leave/disability pension[*]	10•1 (9•9-10•3)	21•7 (21•5-21•9)	15•0 (14•8-15•2)	15•9 (15•6-16•2)	6•9 (6•9-7•0)	7•3 (7•2-7•3)	7•4 (7•3-7•4)	7•5 (7•5-7•6)
Number of subjects	22486	22235	21583	14504	218248	216058	209550	141648
Spouse weeks on sick leave/disability pension [**]	5•4 (5•2-5•6)	6•1 (5•9-6•3)	6•6 (6•4-6•8)	7•1 (6•8-7•4)	4•4 (4•4-4•5)	5•0 (4•9-5•0)	5•4 (5•4-5•5)	5•8 (5•7-5•9)

***Table 2*: Mean health care costs in € with standard errors, and productivity loss in mean weeks of sick leave/disability pension for the surgically treated patients with low back pain and the control group drawn from the background population, matched by age, sex, year, and region of residence.**

* Restricted to individuals aged 60 at surgery/conservative treatment.

** Restricted to individuals aged 60 at surgery/conservative treatment and with a registered partner.

*** Numbers are given with bootstrapped 95% confidence intervals.

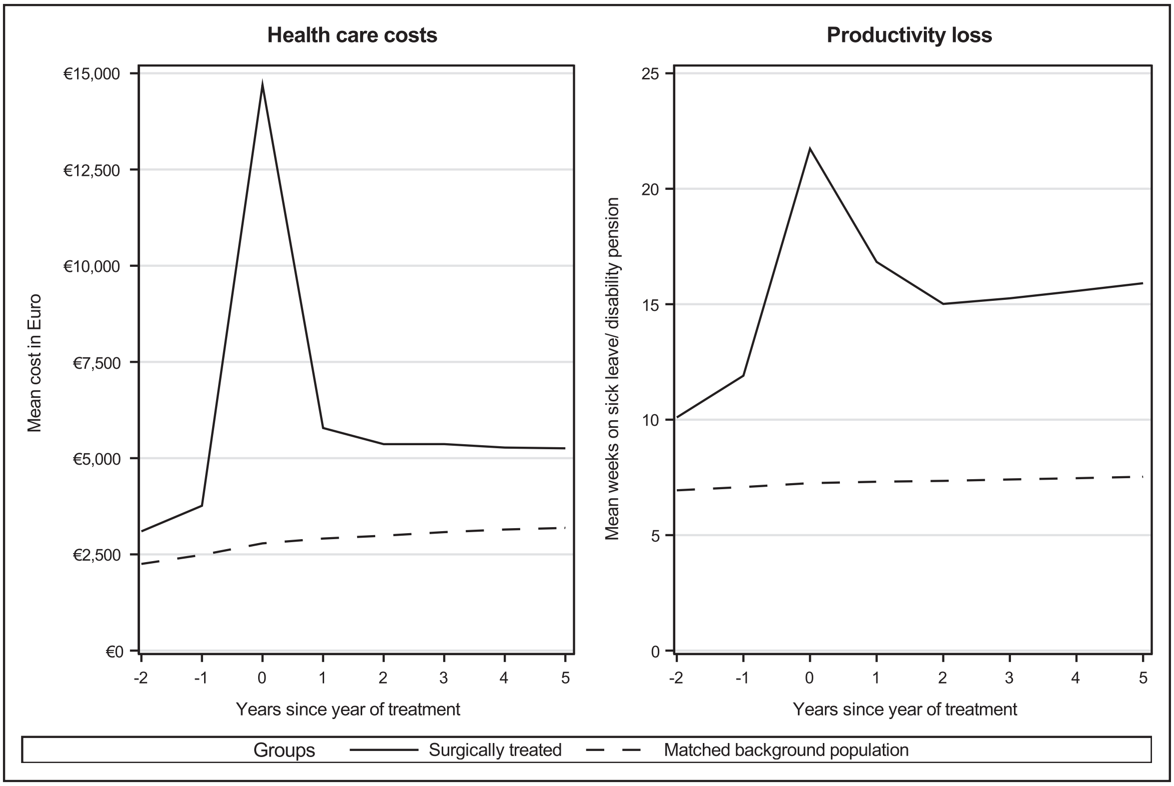

Figure 2. Healthcare cost and productivity loss among patients who underwent first-time surgical treatment for low back pain in Denmark 2007−2016, compared to matched background population-controls.

among background population controls at baseline, two years before the treatment. Figure 3 illustrates this difference. As for the direct costs, the treatment only mitigated the otherwise increasing productivity loss. After having stabilised, the level remained substantially higher than the productivity loss among background controls, and even displaying a modest increase towards the end of follow-up. We also found that the conservatively treated patients were more prone to be removed entirely from the labor market before treatment than their background controls, with a substantial increase of 79% compared to 16% in the respective background controls at five years follow-up.

Additional analyses

Influence of multiple surgeries on healthcare costs and productivity loss. Figure 4 shows an analysis within individuals who had five years follow-up after treatment year and illustrates that the patients who underwent multiple surgical procedures or who needed surgery after initial conservative treatment had substantially higher health care costs than the background population. The increase compared to background controls is also markedly higher for the productivity loss, where the discrepancy is most pronounced among the patients treated with multiple surgeries. The health care cost and productivity loss were also markedly higher for these patients compared to those who underwent a single surgical treatment and those who just underwent conservative treatment, respectively. After the interventions, the costs for both groups decreased, but substantially less compared to the subgroups who only needed one surgery or just conservative treatment. However, the patients who only underwent one surgical procedure or only conservative treatment also had markedly higher health care costs at five years follow-up compared to the background population.

Unpaid caregiver. The spouses of both surgically and conservatively treated patients had a higher average of weeks away from work due to sick leave (surgery 5·4 (0·1) vs controls 4·4 (0·0), and conservative 5·7 (0·1) vs control 4·2 (0·0)) two years before treatment. During follow-up, we observed a with the average stabilizing with a more substantial gap compared to respective background controls (surgery 7·1 (0·1) vs controls 5·8 (0·0), and conservative 8·1 (0·1) vs control 5·7 (0·0)). The most pronounced change, when investigating degree of productivity loss, was for the spouses entirely removed from the labor market with 52 weeks of

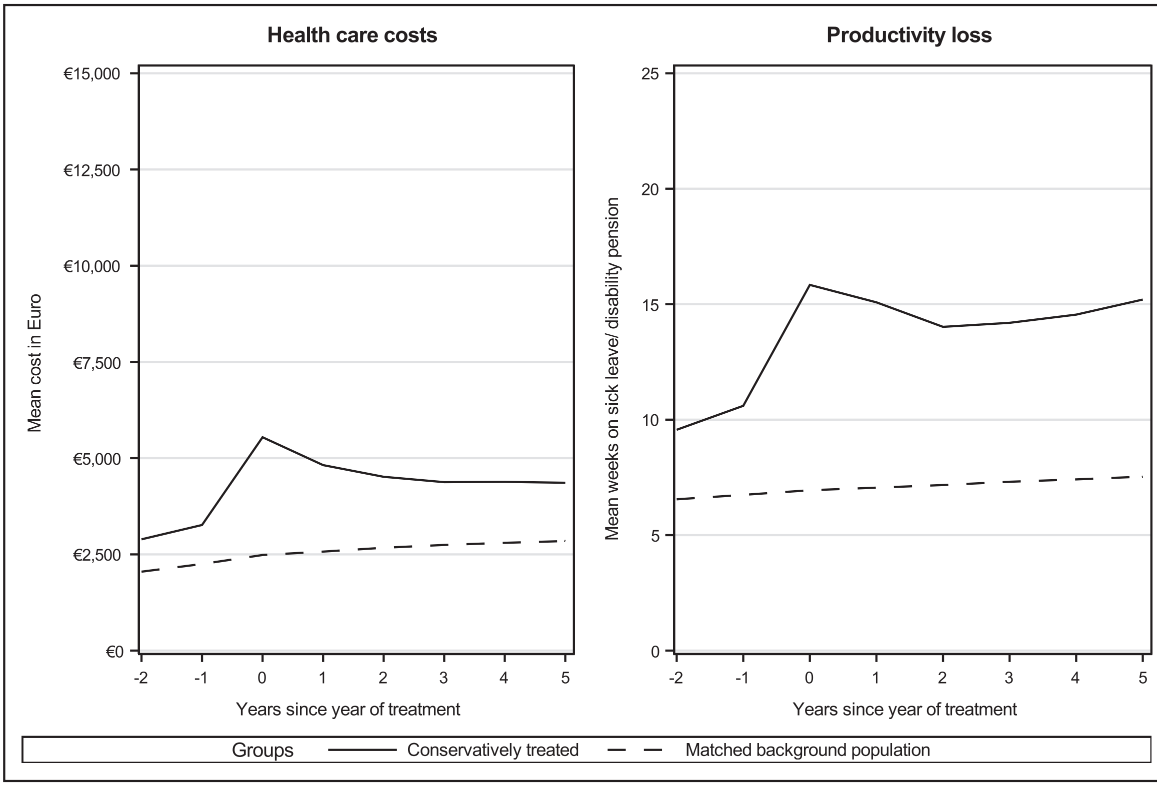

Figure 3. Healthcare cost and productivity loss among patients who underwent first-time conservative treatment for low back pain in Denmark 2007–2016, compared to matched background population-controls.

registered sick leave in the conservatively treated cohort (8·0% (n = 2652) two years prior, and 10·6% (n = 2281) at five years follow-up). Further details can be found in Supplementary Material Table 3.

Discussion

The results of this nationwide cohort study show that patients receiving specialised treatment for LBP due to degenerative spine disease generally have a higher long-term consumption of health services and lower productivity on the labor market than background population controls, a progressing negative development beginning before referral. The treatment does mitigate the rise in costs. However, the differences in healthcare costs and productivity loss remain markedly above the matched background population controls, even five years after the intervention. This development affects the unpaid caregiver as well. The negative development was even more pronounced among the subgroups of patients undergoing multiple surgeries.

Previous studies have indicated that the main component of the socioeconomic burden from LBP is indirect costs due to sick leave and early retirement, and contribute > 80% of total costs.[6,22,23] This compares well with the overall picture of this study, although we did not calculate a total cost estimate. Total cost was not part of our analysis, and this was intentional since the many methodological differences in the cost of illness studies regarding LBP have been shown to give a heterogenous total cost estimate.[6] We chose instead to examine the change in healthcare costs and productivity loss from a societal perspective in connection to treatment and compare the elevated costs in patients with LBP to a representative background population, which, to our knowledge, has not been done in a nationwide cohort before. As mentioned previously, we did see a mitigation of the increased burden, but even at five years post initial treatment the differences compared to the background population was substantially increased. This is in line with previous findings that showed that self-reported work limitations, social limitations, and functional limitations were worse among the people surveyed in 2005 compared to 1997 despite of a substantial rise in costs related to treatment.[24]

The substantial increase in years lived with disability from 1990 to 2015 (54%) and that fact that LBP continues to be the single most common diagnosis responsible for sick leave, long-term disability payments, and early retirements,[1,2] corresponds well with our finding that productivity loss due to not being able to work is substantially increased despite treatment in the entire follow-up period. This is a stark contrast, to other conditions where effective prevention and treatment have

	Conservatively treated patients				Matched background population controls			
	2 years before treatment	Year of treatment	2 years after treatment	5 years after treatment	2 years before treatment	Year of treatment	2 years after treatment	5 years after treatment
Number of subjects	72,915	72,915	71,229	47,427	729,150	729,150	708,908	471,412
Healthcare costs								
Total direct costs	2891 (28,412–2944)***	5544 (5477- 5607)	4515 (4441- 4590)	4359 (4270- 4454)	2050 (2035–2066)	2483 (2465–2501)	2672 (2653–2691)	2846 (2821–2872)
Inpatient treatment	1173 (1137–1213)	2240 (2186–2290)	2102 (2042–2162)	1963 (1896–2036)	870 (859–882)	1097 (1083–1110)	1167 (1153–1182)	1241 (1223–1260)
Outpatient treatment	1001 (979–1025)	2394 (2369–2421)	1538 (1507–1568)	1511 (1473–1547)	680 (674–686)	842 (835–850)	951 (943–960)	1036 (1024–1050)
Primary care	1745 (1728–1761)	2484 (2465–2504)	2169 (2145–2193)	2200 (2167–2231)	1186 (1182–1191)	1323 (1318–1329)	1410 (1404–1416)	1470 (1463–1478)
Medication costs	471 (463–479)	561 (553–570)	570 (561–580)	516 (465–582)	334 (333–336)	359 (356–363)	355 (353–357)	345 (333–360)
Productivity loss								
Number of subjects	53,578	51,051	47,922	30,995	533,433	508,287	478,799	308,989
Weeks on sick leave/disability pension*	9·6 (9·4–9·7)	15·8 (15·7–16·0)	14·0 (13·8–14·2)	15·2 (14·9–15·4)	6·6 (6·5–6·6)	6·9 (6·9–7·0)	7·2 (7·1–7·2)	7·5 (7·5–7·6)
Number of subjects	33,147	32,861	32,030	21,519	328,433	325,689	317,269	212,802
Spouse weeks on sick leave/disability pension**	5·7 (5·5–5·8)	6·5 (6·3–6·6)	7·2 (7·0–7·3)	8·1 (7·9–8·4)	4·2 (4·2–4·3)	4·8 (4·7–4·8)	5·2 (5·1–5·2)	5·7 (5·6–5·7)

***Table 3*: Mean health care costs cost in € with standard errors, and productivity loss in mean weeks of sick leave/disability pension for patients receiving specialised conservative treatment for low back pain and the control group drawn from the background population, matched by age, sex, year, and region of residence.**

* Restricted to individuals aged ≤ 60 at surgery/conservative treatment.

** Restricted to individuals aged ≤ 60 at surgery/conservative treatment and with a registered partner.

*** Numbers are given with bootstrapped 95 confidence interval.

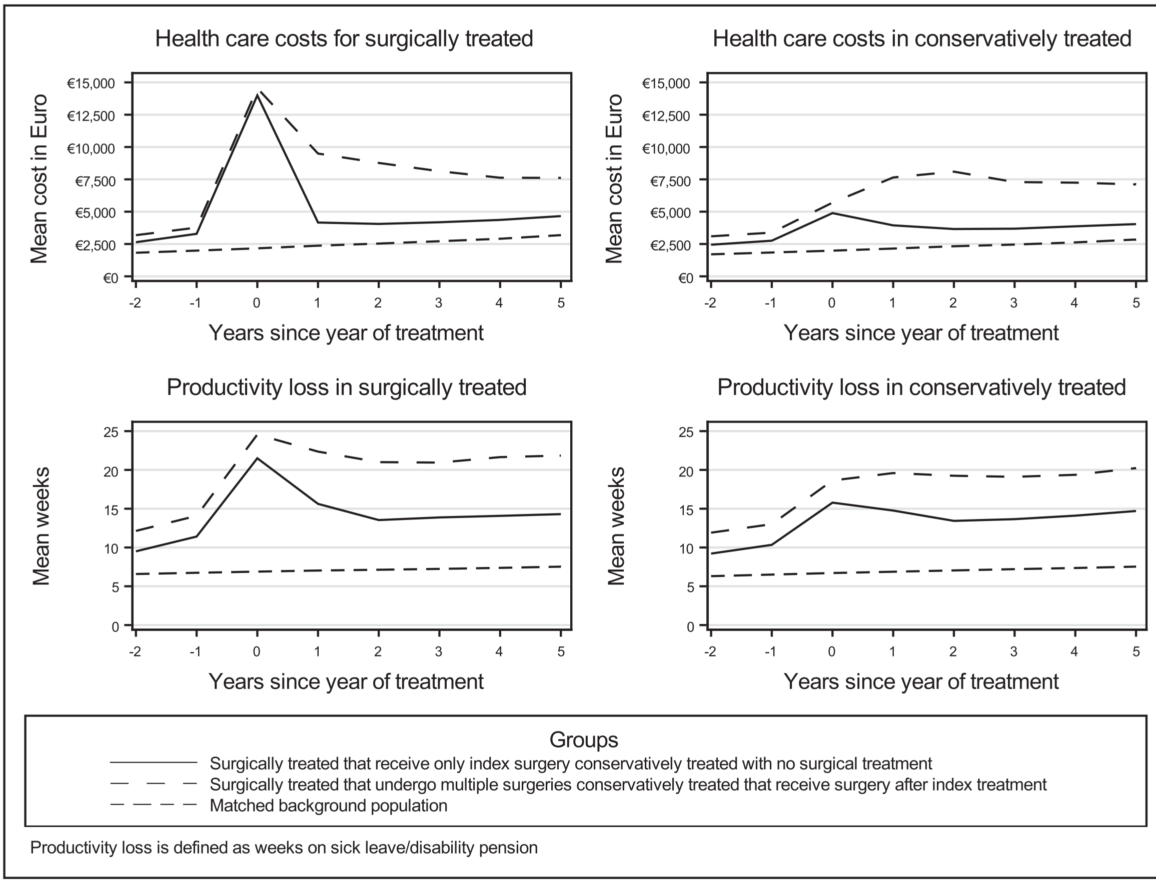

Figure 4. Healthcare cost and productivity loss among both patients initially surgically treated that later undergo multiple surgeries, and patients initially conservatively treated that over a year after initial index treatment for lower back pain end up receiving surgery Both groups are compared to matched background population-controls. The analysis is restricted to individuals who had five years of follow-up after treatment year.

emerged, such as circulatory and respiratory diseases, and the proportion of disabled beneficiaries have decreased.[25] Even though RCT studies have shown positive results of specialised treatment on function and pain reduction in the same patient groups included in our study,[17–20] our findings of substantial loss of productivity across subgroups indicates that measures of successful treatment need to be more nuanced. The paradoxical discrepancy in some of these RCT studies between surgical treatment deemed a success based on PRO data, but no significant change in work participation underlines this argument.[26,27] Put in context with studies that have shown that, e.g., applied work interventions have a significant impact on return to work,[28] we would argue that our results show that there is a need for more research into how to optimize complete treatment care pathway for these patients. Just increasing the proportion receiving treatment either surgically or conservatively as have been done does not seem to reduce the loss of productivity or the health care costs.

Both the direct cost of health care and the productivity loss was higher among those of the surgically treated patients who underwent multiple surgeries. We observed similar findings among the conservatively treated patients who later received surgery. That the healthcare cost would be higher among these patients seems intuitive given the added cost of treatment that surgery leads to both in-hospital, outpatient, and prescription pain medication, but that the difference when compared to the background population was also substantial for patients only requiring one surgical procedure or only conservative treatment was more surprising. Before treatment the patients with multiple surgeries had a slightly increased baseline for healthcare costs than background controls, but the difference was not of a proportion that would suggest that this group was significantly more comorbid. Productivity loss stabilised at a much higher degree when compared to background controls among patients that received multiple surgeries, than among patients that initially underwent conservative treatment and then needed surgery; which in turn was markedly higher than the background population. This may have multiple explanations, but it does support the notion that more surgery does not increase work participation. For patients in the conservative cohort, it illustrates that there is a group of patients that show poor response to both extended conservative treatment and additional surgical treatment.

We found that the degree of absence from work among the spouses of patients undergoing both surgical and conservative treatment was higher than in the respective background controls both two years before treatment and throughout the follow-up. We did not see any increase in work participation from the spouses to compensate for the loss of productivity of their partners, but actually, the degree of sick leave increased for the spouses compared to the background controls. This increased productivity loss was more pronounced for the spouses of patients undergoing conservative treatment. One could hypothesize that a protracted care pathway could lead to elevated strain and burden over time for the spouses of patients, but many possible confounders could influence the difference we found, and further sub-analysis examining the reason was beyond the scope of this study.

In Denmark, the state welfare system provides financial support for people suffering from illness in the form of social transfer payments, and every citizen is provided with medical and hospital care. This financial security net may inflate the utilization and cost of medical care. However, as we chose to describe the change in socioeconomic burden as the use of health care services and productivity loss, the results apply to many countries throughout the world with comparable living standards and levels of health care. As this is a top-down approach we had limited clinical information, and a more detailed stratification of patient was therefore not possible. The main strength of our study was the completeness of data, with a nationwide unselected cohort of patients as the source, which allowed us to compare the healthcare costs and productivity loss with representative background controls on a large scale. The inclusion of only the patients which had the combination of patient diagnosis and treatment diagnosis/coding minimised missing data and misclassification.

The results of this nationwide cohort study with long-term follow-up show that patients referred to specialised treatment of LBP display poor socioeconomic prognosis, disregarding conservative, or surgical treatment modality. This development was reinforced in the subgroup of patients undergoing multiple surgeries and was also observed among spouses to the patients. Our findings of substantial loss of productivity across subgroups indicates that measures used to ascertain if a treatment is successful need to be more nuanced.

Contributors

SS conceived the study and SS, GP and TNM designed the study. SS, GP and TNM had access and accept full responsibility for all data associated with this study. GP did the analyses, with input from SS, JK, MM and TNM. SS wrote the first draft of the paper. GP, JK, MM and TNM provided critical input in revising the manuscript. All authors contributed to writing, reviewing, and editing multiple versions of the manuscript and the decision to submit the manuscript for publication.

Data sharing statement

Regulations from the Danish Data Protection Agency prohibits making the underlying Danish national register data freely available.

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Declaration of interests

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.eclinm.2021.101247.

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