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Incidence of lumbar discectomy during pregnancy and within 12 months post-partum in Finland between 1999 and 2017: a retrospective register-based cohort study

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## Manuscript for The Spine Journal

Incidence of lumbar discectomy during pregnancy and within 12 months post-partum in Finland between 1999 and 2017: a retrospective register-based cohort study

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## Abstract

**Background Context:** Both lumbar disc herniation in the general population and lower back pain in the pregnant population are known to be common conditions. The physiological and anatomical of the mother predispose to increased strain of the lumbar disc, while pregnancy may promote caution in physicians contemplating surgical care.

**Purpose:** We aimed to report the incidence of lumbar discectomy during pregnancy and 12 months post-partum in Finland between 1999 and 2017.

**Study Design:** Retrospective register-based cohort study.

**Patient Sample:** Using nationwide data from the Finnish Care Register for Health Care and the Finnish Medical Birth Register, all women aged 15 to 49 years with a lumbar discectomy or pregnancy ending in delivery from 1<sup>st</sup> January, 1999 to 31<sup>st</sup> December, 2017 were included.

**Outcome Measures:** Incidence rates and their 95% confidence intervals were calculated for lumbar discectomy. Incidence rate ratios (IRR) were calculated between the study population and the control population. The effect of smoking on surgery risk was reported using odds ratios.

**Methods:** A retrospective statistical analysis was performed to identify patients undergoing lumbar discectomy during pregnancy or the first 12 months after delivery. Incidence rates were compared to the age-adjusted values of the age-matched female general population. The effect of smoking on the risk of lumbar discectomy was analysed using age-adjusted odds ratios.

**Results:** In total, 91 discectomies were performed during pregnancy and 508 within 12 months post-partum. The total incidence of lumbar discectomy during pregnancy was 11 operations per 100 000 person-years with an incidence rate ratio (IRR) of 0.2

(95% CI 0.1 to 0.2) when compared to the age-adjusted female general population.

Women with active smoking before pregnancy were at a higher risk for lumbar discectomy during pregnancy (OR 2.0, 95% CI 1.2 to 3.2). Caesarean section was more common after lumbar discectomy (22%). No perinatal mortality was observed. During the first year post-partum the rate of lumbar discectomy increased to 47 per 100 000 person-years with an IRR of 0.7 (95% CI 0.6 to 0.8). 90-day reoperation rates were higher than in the general population with an IRR of 1.7 (95% CI 1.1 to 2.7).

**Conclusions:** Lumbar discectomy during pregnancy is rare, but smoking increases the risk. Lumbar discectomy during pregnancy seems to be safe for the neonate. Post-partum incidences increased towards the end of the first year, but remained below the rates in the general population with a higher risk for short-term reoperation.

**Key words:** Disc Herniation, Discectomy, Pregnancy, Post-partum, Epidemiology

## Introduction

Spinal disc herniation is a common condition with the prevalence of lumbar disc syndrome previously reported to be 5% in men and 4% in women.[1–3] For most new lumbar disc syndrome patients, symptoms resolve with conservative treatment and both surgical and non-surgical treatment usually lead to desirable outcomes.[4,5] However, for those patients with symptoms persisting for more than several months, operative treatment with lumbar discectomy has been shown to be an effective form of treatment.[6,7] Some situations, for example cauda equina syndrome caused by lumbar disc herniation, are considered indications for emergency lumbar discectomy.[8]

Lower back pain is a frequent symptom during pregnancy that is reported in up to 50% of women, most typically between the 5<sup>th</sup> and 7<sup>th</sup> month of pregnancy.[9–11] During pregnancy, the mother's pelvis tilts anteriorly, which contributes to increased lumbar lordosis and the axial load of the spine.[12] These changes, together with the effects of hormones such as relaxin and oestrogen loosening the connective tissues, could place an increased strain on the lumbar disc annulus and the posterior longitudinal ligament, increasing the risk for disc herniation.[13–15] The surgical treatment of lumbar disc herniation with discectomy is associated with known risks for complications and reoperations.[16–18] Patient selection for surgical treatment is difficult when the risks for increased disc herniation are weighed against reports that over 85% of pregnant women with lumbar disc syndrome report symptom relief within 6 weeks. Opting for surgical treatment is further complicated when the prone position for spine surgery (and left lateral tilt in the third trimester) as well as the effects of anaesthesia on the foetus are considered.[19–22]

The incidence of lumbar disc herniation during pregnancy has previously been reported to be 0.1 per 100 000 pregnancies in a single-centre study, which is lower than the reported figure for the general population of the same age.[23] However, reliable nationwide values of lumbar discectomy have not previously been published. In the present study, we hypothesize that the incidence of lumbar discectomy during pregnancy and the first 12 months post-partum remains lower than in the general population and analysed all occurrences of lumbar discectomy surgery in Finland between 1999 and 2017 to provide nationwide incidences.

## Methods

Data for this nationwide retrospective register-based cohort study were obtained from the Finnish Health and Social Data Permit Authority (FinData).[24] We combined data from the Finnish Care Register for Health Care and the Medical Birth Register. The Finnish Care Register includes hospital inpatient data as well as data from day surgeries and specialised outpatient care. The coverage and accuracy of the register regarding diagnoses and discharges has been proven to be excellent, although information regarding patient comorbidities is lacking. [25–27] The Medical Birth Register contains information on all pregnancies ending in delivery after gestational week 21+6 or foetal weight over 500 grams. The validity and coverage of the register is excellent and has been estimated to cover 100% of newborns in Finland.[28]

Our study period was from 1<sup>st</sup> January, 1999 to 31<sup>st</sup> December, 2017. Patients were selected from the Care Register using all surgery codes for discectomy of the cervical, thoracic and lumbar disc coded with the Finnish version of the Nordic Medico-Statistical Committee (NOMESCO) classification (ABC01, ABC04, ABC07,

ABC10, ABC13, ABC16, ABC17, ABC20, ABC23, ABC26).[29] All female patients aged 15 to 49 years at the time of injury, defined as reproductive-aged by the World Health Organization, were included in the study.[30]

The registers were combined after the individuals were pseudonymised by FinData, who also retained the pseudonymisation key. None of the authors had access to the key. FinData provided a safe, remote-controlled environment in which all files could be analysed. Using information on date of birth and pregnancy duration from the Medical Birth Register, we were able to isolate incidents that occurred during or after pregnancy. In this study, the primary outcome was spine discectomy surgery. The formation of the study cohort is described in Figure 1.

This study was granted research permission from the Finnish Health and Social Data Permit Authority FinData, permission THL/1756/14.02.00/2020. Our study was formatted according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational studies (Supplementary file 1).[31]

### Statistical analysis

Yearly incidence rates were calculated for lumbar discectomy. Separate calculations were made for surgeries performed during pregnancy and for those performed during the 12 months following delivery. Incidences are reported as operations per 100 000 person-years both during and after pregnancy. Incidences of lumbar discectomy during pregnancy were calculated using yearly delivery rates and an estimated pregnancy length of 39 weeks. As a control population, surgery incidences were

calculated for the age-matched general population of women using yearly age-specific population values in Finland. Incidence rates for the control population were age-adjusted by the age distribution of pregnant and post-partum women. Due to Finnish legislature regarding patient anonymity, counts under five are not further specified. The surgery rates of pregnant and post-partum women were compared to those of the control population using incidence rate ratios (IRR) and 95% confidence intervals (CI). Poisson regression was used to calculate incidence rates. IRRs for revision surgery were calculated for both groups. Continuous variables were presented as median with interquartile range (IQR) or as mean with standard deviation (SD) based on the distribution of the variable. Multivariable logistic regression was used to assess the age-adjusted effect of smoking on lumbar discectomy. Results are reported as odds ratios (OR) with 95% CIs. If a patient underwent multiple operations with an identical operation code during the follow-up period, the first operation was considered the primary operation and the time between the operations was calculated. Surgery was considered as a revision operation when the time between the second and primary operation was less than 90 days. For surgery during pregnancy, relevant variables of delivery were calculated. A Kaplan-Meier survival analysis was performed to visualise the timing of surgery, relative pregnancy duration and the number of months after delivery. Statistical analyses were performed using R version 4.0.3.[32]

## Results

### Total operations

In Finland, a total of 91 lumbar discectomy operations were performed during pregnancy and 508 within 12 months post-partum between the years 1999 and 2017.

The mean (SD) age of the patients who underwent lumbar discectomy during pregnancy was 30.6 (5.1) years and 31.3 (4.8) years for those patients who underwent lumbar discectomy within 12 months post-partum. During the follow-up period, yearly incidence rates remained stable. Moreover, fewer than 5 discectomy operations for thoracic and cervical disc herniations were observed during the entire study period. For our control population the mean (SD) age was 37.2 (8.0) years.

### Lumbar discectomy during pregnancy

The total 19-year incidence of lumbar discectomy during pregnancy was 11 operations per 100 000 person-years (CI 9 to 14). Yearly incidence rates varied greatly between 5 and 21 per 100 000 person-years (Figure 2). For the control population, the total incidence rate was 69 operations per 100 000 person-years (CI 68 to 70), yielding an IRR of 0.2 (CI 0.1 to 0.2). For women who underwent discectomy during pregnancy, 90-day reoperation rates were lower (1.1%) than those in the control population (2.2%) with an IRR of 0.5 (95% CI 0.1 to 3.5).

Most lumbar discectomies were performed during the first 2 trimesters of pregnancy with a mean pregnancy duration of  $15^{+3}$  weeks at the time of surgery (Figure 3). Only 12% of operations were performed in the third trimester. For women who underwent discectomy during pregnancy, no foetal mortality was observed (Table 1). Caesarean section was more common after lumbar discectomy during

pregnancy (22%) when compared to pregnant women without (17%). Mean (SD) duration of pregnancy was 39<sup>+5</sup> (+- 1) gestational weeks, with 36% of women being primiparous. Mean birthweight (SD) was 3592 (+- 544) grams. In fewer than 5 cases, caesarean section was performed during the same hospitalisation period as the discectomy. Of those women who underwent lumbar discectomy during pregnancy, 27% were active smokers before pregnancy (n=24/89). For all pregnant women during our study period the respective figure was 17%. Furthermore, those women who were active smokers before pregnancy were at higher risk for lumbar discectomy during pregnancy (OR 2.0, CI 1.2 to 3.2).

#### Lumbar discectomy within 12 months post-partum

In our 19-year follow-up period, the total incidence of lumbar discectomy during the first 12 months after delivery was 47 operations per 100 000 person-years. Yearly incidence rates varied greatly between 29 and 81 per 100 000 person-years during our follow-up period (Figure 4). The IRR between lumbar discectomy within the first 12 months post-partum and the control population was 0.7 (CI 0.6 to 0.8).

When compared to the control population, the 90-day reoperation rate for women within 12 months post-partum was 3.7% with an IRR of 1.7 (CI 1.1 to 2.7). The incidence of discectomy slowly increased towards the end of the first year following delivery, with a mean operation occurrence at 6.8 months post-partum (Figure 5). Of those women who underwent lumbar discectomy within the first 12 months following delivery, 18% were active smokers before becoming pregnant (n=86/481). The risk for lumbar discectomy in women who were active smokers before pregnancy was similar to that of non-smokers (OR 1.1, CI 0.9 to 1.4).

However, there was a higher odds for revision during the first 90 days following delivery with an OR of 2.0, but results were not statistically significant (CI 0.6 to 5.4).

## Discussion

In our nationwide study, the incidence of lumbar discectomy, both during pregnancy and within 12 months post-partum, remained lower than in the control population of the same age. During pregnancy, the incidence for immediate reoperation was lower than in the control population with an IRR of 0.5, but higher during the first 12 months after pregnancy with an IRR of 1.7. In total, 88% of lumbar discectomies were performed during the first two trimesters. The rate of caesarean section was higher in women who underwent lumbar discectomy during pregnancy when compared to the whole study population. Only isolated cases of cervical and thoracic discectomies were performed during pregnancy and within 12 months post-partum.

There are no pre-existing reports regarding the incidence of lumbar discectomy during pregnancy or the period following delivery. We are therefore unable to compare our results to those of previous studies. However, whole-population values of lumbar discectomy have been previously reported to be between 170 and 220 per 100 000 person-years in the USA and approximately 20 per 100 000 person-years in Sweden.[33,34] In a recent study by Ponkilainen et al. using data from the same registers as the present study, the total incidence of lumbar discectomy in male and female patients aged between 18 and 35 years in Finland was reported to have declined from 73 to 59 per 100 000 person-years between 1997 and 2018. This corresponds to our findings regarding young females in the general population.[18] Moreover, 90-day reoperation rates after lumbar discectomy for patients aged 18 to 39

years has previously been reported to be between 1.4% and 2.0%.[16] These rates are slightly below our reported figures of 2.2% for the general young female population but support our findings of a higher 90-day reoperation rate of 3.7% post-partum. During pregnancy, 90-day reoperation rates were lower at 1.1%. The national rate of caesarean section has previously been reported to be 16.6% in Finland, which is slightly lower than the rate revealed for women undergoing lumbar discectomy during pregnancy in the present study.[35] Our reported rate of smoking (27%) for these women was higher than in the general female population of the same age (17%). Moreover, those women with a previous history of smoking were at higher risk for lumbar discectomy.[36]

The lower incidence of lumbar discectomy during pregnancy reported in the present study is in line with our hypothesis and the findings of previous reports. Anatomical and hormonal changes during pregnancy predispose the mother to increased lumbar disc instability. There are, however, several concerns that require multidisciplinary planning when operating on a pregnant woman.[37] Technically, the implementation of lumbar discectomy during pregnancy differs in both patient positioning and the management of anaesthesia.[20,22] In the first and early second trimesters, the prone position is possible. During the late second and third trimesters, however, left lateral tilt positioning is recommended.[20,38] With well advanced pregnancies, caesarean section immediately before discectomy can also be considered.[20] These considerations, in conjunction with the low level of evidence, could very well lead to a reluctance to operate as the pregnancy progresses. This could also partly explain the lower reoperation rates in pregnant women. While we are unable to specify patients' specific indications for surgery, the lower incidences of lumbar discectomy during pregnancy and the first year post-partum are possibly

attributable to prolonged conservative treatment in milder cases of disc herniation. Our results revealed a slight reduction in the rate of lumbar discectomy after the first trimester, with an even greater reduction when progressing to the third trimester, where surgery might be limited to emergency scenarios only. In our study, no foetal mortality was observed. Apgar scores and gestational age were also normal for newborns after lumbar discectomy during pregnancy

Smoking has previously been shown to be a risk factor for lumbar disc herniation and our finding of a higher risk for lumbar discectomy for mothers with a history of smoking before pregnancy is in line with these findings.[39] Smoking has also previously been described as an independent risk factor for reoperation, which is also supported by our results.[40]

After pregnancy, limitations on surgery due to the foetus are lifted, but the effects of anaesthesia need to be considered during lactation. In Finland, it is recommended that mothers exclusively breastfeed for the first 4 months followed by complimentary breastfeeding up to 12 months after delivery.[41] The connective tissue metabolism modifying hormone relaxin also persists in the mother's body after delivery.[42] This could at least partially explain the lower incidences of lumbar discectomy during the first months after delivery, and which seem to rise towards the end of the first year. The effects of relaxin and increased lumbar movement could also be a factor in the increased reoperation rates observed post-partum.

The main strength of our study is the excellent national coverage of operated lumbar discectomies, including all operations performed in both public and private hospitals.[25,27] Combined with the exceptional national coverage of the Medical Birth Register, we were able to collect nationwide data on lumbar discectomies in young reproductive-aged women with minimal selection bias. A secondary strength of

our study is our long follow-up period of 19 years. The main limitation of our data is that only surgical operations are included, and we were unable to analyse those patients treated conservatively. As a secondary limitation, we are also unable to adjust for patients' comorbidities in our analyses.

## Conclusion

Our results suggest that lumbar discectomy is rarely performed during pregnancy with an incidence of 11 operations per 100 000 person-years. Moreover, operative treatment is seemingly safe for neonates. Operations are primarily performed during the first two trimesters of pregnancy with smoking as a risk factor. Operation rates slowly normalise towards the end of the first year post-partum, but reoperation rates remain higher than those in the general reproductive-aged female population.

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**Conflicts of Interest:** None were declared

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Journal Pre-proof

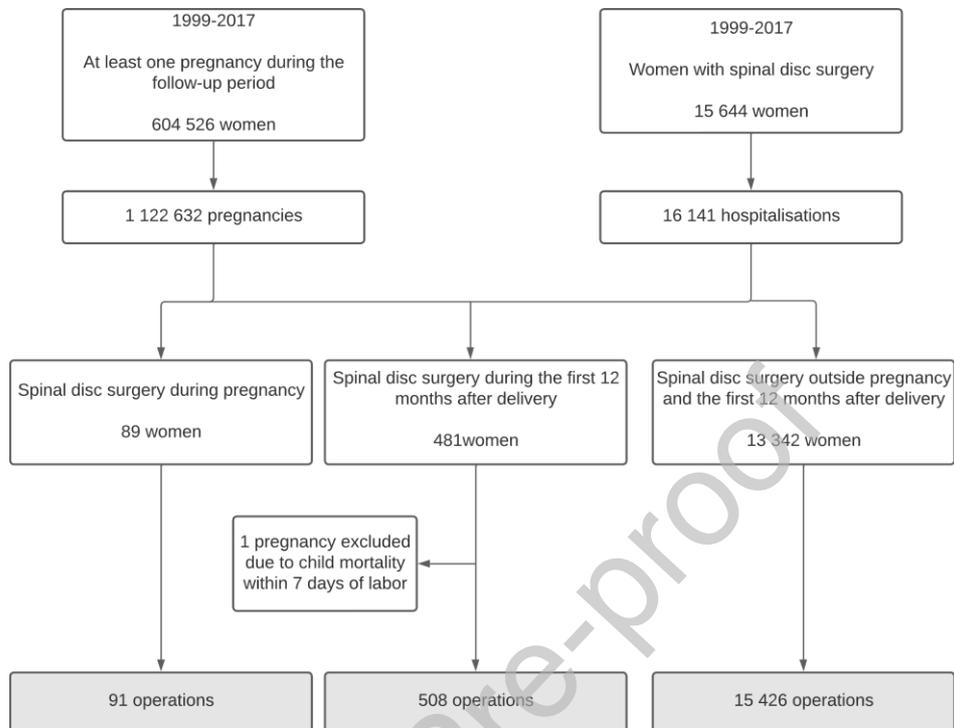
**Table 1:** Characteristics of women undergoing lumbar discectomy during pregnancy and neonatal outcomes in these pregnancies/deliveries.

	During pregnancy (n = 91)
Maternal age, mean (SD)	31 (5)
Primipara, n (%)	33 (36%)
Gestational age, weeks (mean + SD)	39+5 ± 1
Vaginal delivery (n + %)	71 (78%)
Epidural analgesia (n + %)	39 (43%)
Weeks at time of surgery (mean)	15+3 ± 10
Perinatal mortality (n + %) <sup>1</sup>	0 (0%)
Birthweight (mean + SD)	3592g ± 544g
Apgar score (median + IQR) <sup>2</sup>	9 [9, 9]
Maternal smoking (n + %)	15 (16%)

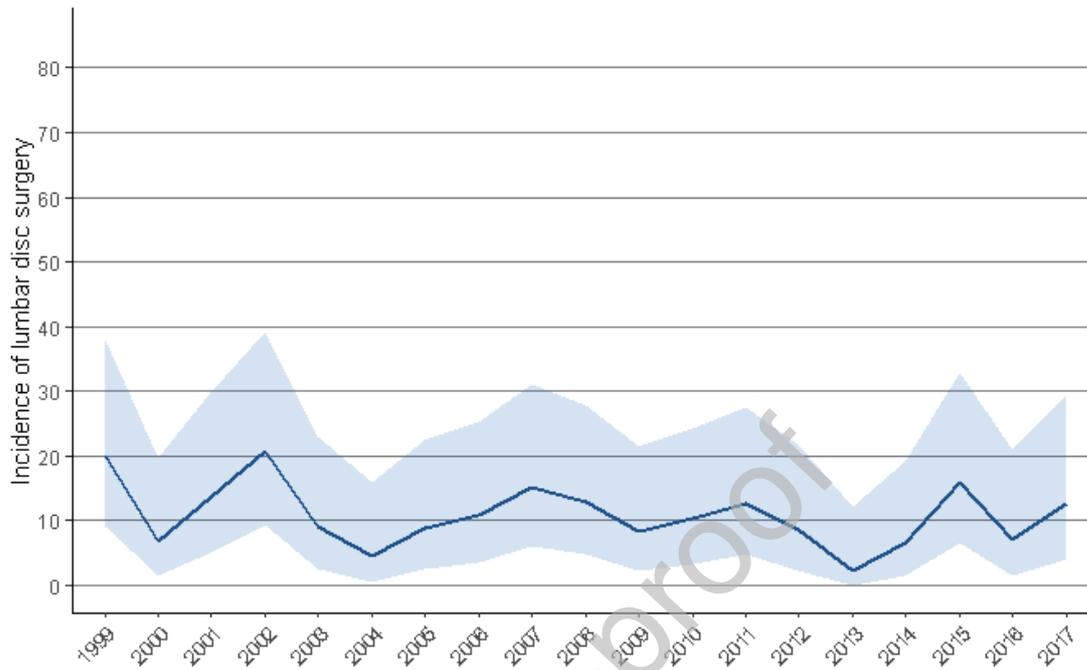
<sup>1</sup> Stillbirths and deaths before age of 7 days, <sup>2</sup> One-minute Apgar Score

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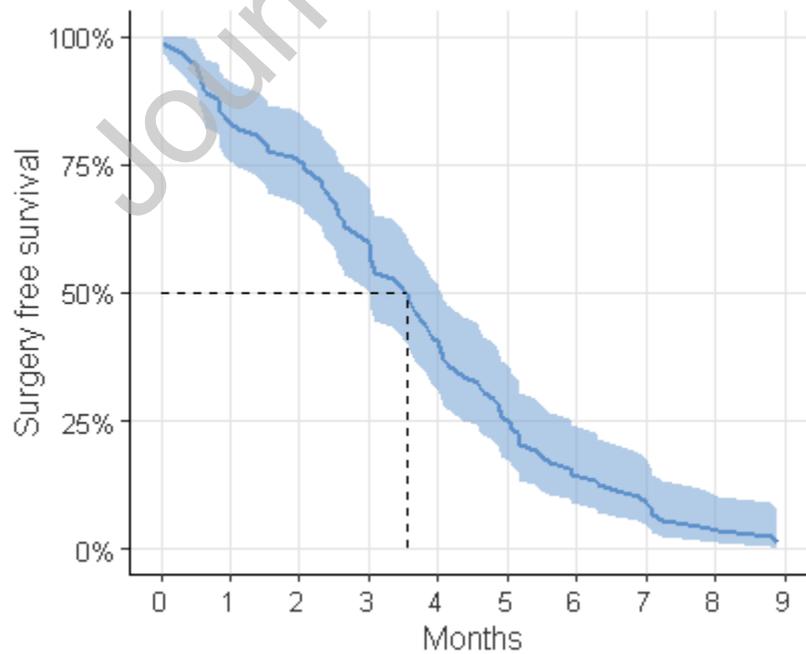
## Figure Legends

**Figure.1** Flow chart of study cohort formation

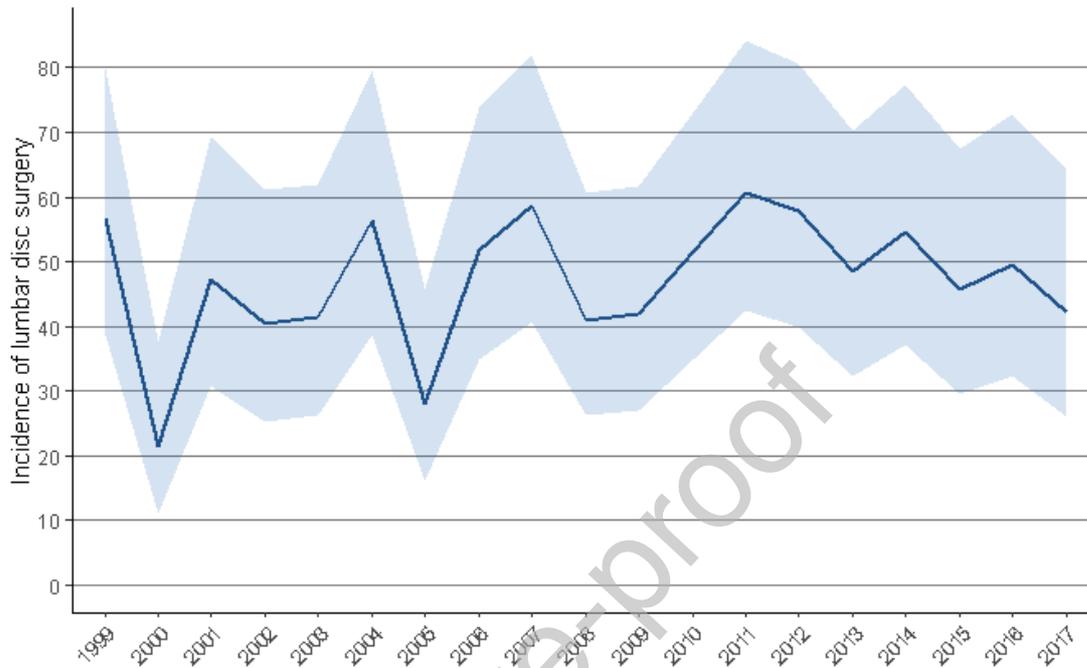
**Figure 2** Incidence (per 100 000 person-years) of lumbar discectomy during pregnancy in Finland between the years 1999 and 2017 with 95% confidence intervals.



**Figure 3** Temporal occurrence of lumbar discectomy during pregnancy visualised by a Kaplan-Meier survival graph.



**Figure 4** Incidence (per 100 000 person-years) of lumbar discectomy within the first 12 months post-partum in Finland between the years 1999 and 2017 with 95% confidence intervals.



**Figure 5** Temporal occurrence of lumbar discectomy within 12 months post-partum visualised by a Kaplan-Meier survival graph.

