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A matched national cohort study of 6,096 patella fractures

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ABSTRACT

Introduction: The modern literature includes only limited information regarding mortality rates and cumulative survival following patella fractures. The aim was to report the 30-day, six-month, and one-year mortality of patients with patella fractures and compare this to the mortality of a matched reference population.

Methods: All patients who sustained a patella fracture in Denmark between 1996 and 2000 were included in the study. The survival status of these patients was monitored until 2015. We compare the mortality with a ten-fold reference population matched on age and gender without a prior patella fracture.

Results: 6096 patients were treated for 6114 patella fractures. The mean age of patients was 48.9 years. The overall mortality rates at 30 days, six months, and one year were 0.7%, 1.8%, and 2.8%. The mortality rates for patients > 65 years at 30 days, six months, and one year were 1.3%, 3.9%, and 6.2%. The mortality rates for patients at ≤ 65 years at 30 days, six months, and one year were 0.4%, 0.9%, and 1.3%. Compared to the matched reference population, the relative risk of mortality in patients > 65 years at 30 days, six months, and one year were 1.9 (95% CI 1.2-2.9), 1.0 (95% CI 0.8-1.3), and 0.9 (95% CI 0.7-1.1).

Conclusion: The overall one-year mortality rate of patella fractures was 2.8% and this was increased to 6.2% in patients older than 65 years. In elderly patients above 65 years, the relative risk of death was 0.9, indicating that patella fractures in elderly patients were not associated with an increased mortality rate.

Key words: Mortality; survival; patella fracture

INTRODUCTION

Increased risk of mortality in elderly patients following femoral neck fractures have been extensively studied [1–3]. However, mortality following other common fractures of the lower extremities is less reported. Somersalo et al. [4] report increased mortality after lower extremity fractures in patients older than 65 years of age, supported by Center et al. [5] reporting that all major types of fractures were associated with increased mortality.

A classic fragility fracture of the lower extremities is a fracture of the patella with an incidence of 13.1/100,000/year [6]. The 90-days and one-year mortality in elderly patients following patella fractures have been reported in a single study with a relative risk of 1.7 and 1.1, respectively [7]. However, the modern literature includes only limited information regarding mortality rates following patella fractures from large, complete, and national populations including all age groups.

The primary aim of the present study was to report the 30-day, six-month, and one-year mortality following patella fractures and compare this to the 30-day, six-month, and one-year mortality rates from a matched reference population. The secondary aim was to report the long-term cumulative survival rate in patients with a patella fracture compared to a matched reference population.

METHODS

Study design

The study design was a matched cohort study including prospectively collected registry data from the Danish National Patient Register [8].

All patients who sustained a patella fracture in Denmark between 1 January 1996 and 31 December 2000 were included and monitored with regard to survival status until 31 December 2015.

Danish law requires that all patient contacts with hospital and outpatient clinics in Denmark are registered in the Danish National Patient Register [8]. All citizens of Denmark are registered in the Civil Registration System and information regarding emigration and death, along with other health related variables, is recorded [9]. This offers researchers a complete and valid record of all health-related data from the complete Danish population [10].

The Local Ethics Committee determined that the study design does not need notification. The study was approved by the Danish Data Protection Agency (J. nr. 2008-58-0028, Id: 2016-176). The reporting of the study complies with The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement [11].

Study population and data retrieval

Patients with a patella fracture were identified through a retrospective review of all Danish patients diagnosed with a patella fracture between 1 January 1996 and 31 December 2000. All patients who were registered regardless of contact type with the ICD-10 diagnosis code for 'patella fracture' (S82.0) were identified in the Danish National Patient Register. Patients were included at the time they first reported a patella fracture to the Danish National Patient Register. For subgroup analyses patients were divided into two groups based on age (above or below 65 years of age).

The matched reference population consisted of individuals identified from the Civil Registration System matched based on age and gender. For each patient with a patella fracture, we included 10 citizens who had not experienced a patella fracture prior to the inclusion date.

All patients were censored in case of emigration from the country or at the end of follow-up.

Statistical methods

Normal distribution was checked by Q-Q plots. Mean values and ranges are given for continuous variables. Percentages and frequencies are given for categorical data.

The relative risk of 30-day, six-month, and one-year mortality was calculated by a Generalised linear model (GLM). The cumulative survival rates were plotted using Kaplan-Meier analysis throughout the mean 9.2-year observational period. The log rank test was used to compare survival distribution between groups. A cox proportional hazards regression model was run to analyses the effect of age and gender on survival.

All analyses were performed using Stata statistical software (StataCorp LP).

RESULTS

Throughout the observational period 6096 patients were treated for 6114 patella fractures in Denmark. The mean age of patients at the time of fracture was 48.9 years with a range between 2.1 and 99.0 years. The mean age for males was 40.4 years (2.1-99.0). The mean age for females was 57.3 years (2.3-98.6). The gender distribution was 49.9% females and 50.1% males.

Of the 6096 patients included, 168 patients died during the first 12 months after the fracture. The mean age of deceased patients was 68.7 years (10.6-.97.4).

The overall mortality rates and relative risk of death after a patella fracture at 30 days, six months, and one year for all patients and patients divided into above and below 65 years of age are present in Table 1.

The cumulative survival is presented in Figure 1, showing that patients with a patella fracture presented with an increased cumulative risk of death throughout the observational period compared to the age- and gender matched reference population (P<0.001). Furthermore, the analysis shows that patients above 65 years presented with a small but significant increased cumulative survival rate compared to the age- and gender matched reference population (P<0.001) (Figure 2). Patients below 65 years of age presented with increased cumulative risk of death throughout the observational period compared to the age- and gender matched reference population (P<0.001) (Figure 3).

The cox proportional hazard model showed that an increase in age by one year was associated with increased risk of death by 3% in the patella fracture group (HR:1.003 95%CI: 1.025-1,026). Moreover, male gender was associated with increased risk of death by 14% in the patella fracture group (HR:1.14 95%CI: 1.12-1.16).

DISCUSSION

This large-scale epidemiological cohort study assessed the mortality rate in patients following a patella fracture based on a complete national population including all patella fractures in Denmark over a five-year period. We compare the mortality rate with a ten-fold reference population matched on age and gender without a prior patella fracture. Following a patella fracture the overall one-year mortality rate was 2.8% and this was increased to 6.2% in patients older than 65 years of age. To the best of the author's knowledge, this study presents the largest group of patients with patella fractures analysed for one-year mortality and cumulative survival rate in the literature.

The modern literature includes very little information regarding survival rates following patella fractures. A single study by Barret el al. [7] reports the 90-day mortality rate

following patella fractures as 1.9% in elderly patients aged older than 65 years. Compared to the present study reporting the six-month and one-year mortality rates as 3.9%, and 6.2% in patients older than 65 years, this figure is considerably lower. This difference may be due to differences in available registry data between the two studies and a gap of two decades between the observational periods. Moreover, the study by Barret et al. [7] does not report information regarding the validity of the data taken from the annual Medical denominator files.

In patients above 65 years of age the short-term one-year relative risk of death was 0.9, indicating an almost equal risk of death compared to the reference population. This is supported by Barret et al. [7] reporting a relative risk of 1.1 at one year following a patella fracture. The findings indicate that patella fracture in elderly patients are not associated with an increase in mortality at short-term follow-up, which is in contrast to other lower extremity fractures [4].

Surprisingly, the analysis of the one-year relative risk of death and cumulative survival rate in patients below 65 years of age, showed that patients presented with a one-year relative risk of death of 1.6 and an increased cumulative risk of death throughout the observational period compared to the age- and gender matched reference population. This may be explained by the generally low rate of mortality in younger patients in the general population. As a consequence, even the small number of deaths in the younger patients with patella fractures will have a significant impact on the relative risk and the long-time cumulative survival rate. Moreover, the present study did not include data on critical illness and other traumatic injuries sustained at the time of fracture or later in the observational period. The distribution between critical illness and major injuries between young patients with a patella fracture and the reference population without a patella fracture may be skewed. Resent research suggests that younger patients who sustain a patella fracture are more likely to be involved in high energy trauma [6], which might increase the risk of

other major fractures and death. Supported by Court-Brown et al. [12], it is likely that the risk of sustaining a fracture is increased in patients with lower socioeconomic status. This might suggest a general increased risk of death from major trauma and increased presence of lifestyle-associated risk factors in younger patients with fractures compared to younger patients in the reference population. The authors suggest that these factors all seem more likely explanations of the increased relative risk and cumulative risk of death in younger patients sustaining a patella fracture, than the patella fracture itself. It was not possible to include data on high energy trauma, trauma mechanism and socioeconomic status in the present study and hence it is not possible to draw conclusions or make associations regarding these factors.

Strength and limitations

The main strength of the present study is the inclusion of a five-year national complete population including all patella fractures in Denmark. Another significant strength of this study is the ten-fold national reference population matched on age and gender. Using the Danish National Patient Register is required by law in Denmark, and this register is widely accepted as one of the world's most valid health registries [10]. However, several limitations exist in the present study. Data from the DNPR was collected prospectively but was used for this study retrospectively by data extraction. The use of retrospective data may influence the quality of the data as the researcher is not able to monitor data quality continuously. Moreover, the database consists of data from a large number of facilities and doctors with might introduce a limitation due to small differences in coding practice.

CONCLUSION

The overall one-year mortality rate of patella fractures was 2.8% and this was increased to 6.2% in patients older than 65 years of age.

In elderly patients above 65 years of age, the relative risk of death was 0.9 indicating that patella fractures in elderly patients were not associated with an increased mortality rate.

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Table 1: Mortality rates following patella fractures

	Crude motality rates %, (N)			Relative risk (95%CI)		
	30 days	6 months	1 year	30 days	6 months	1 year
All patients, N=6096	0.7 (41)	1.8 (107)	2.8 (168)	2.4 (1.7-3.3)	1.2 (1.0-1.5)	1.0 (0.9-1.2)
Patients >65, N=1809	1.3(24)	3.9 (70)	6.2 (112)	1.9 (1.2-2.9)	1.0 (0.8-1.3)	0.9 (0.7-1.1)
Patients≤65, N=4287	0.4 (17)	0.9 (37)	1.3 (56)	3.9 (2.2-6.8)	1.9 (1.3-2.7)	1.6 (1.2-2.1)

N=number

95%CI: 95% confidence interval

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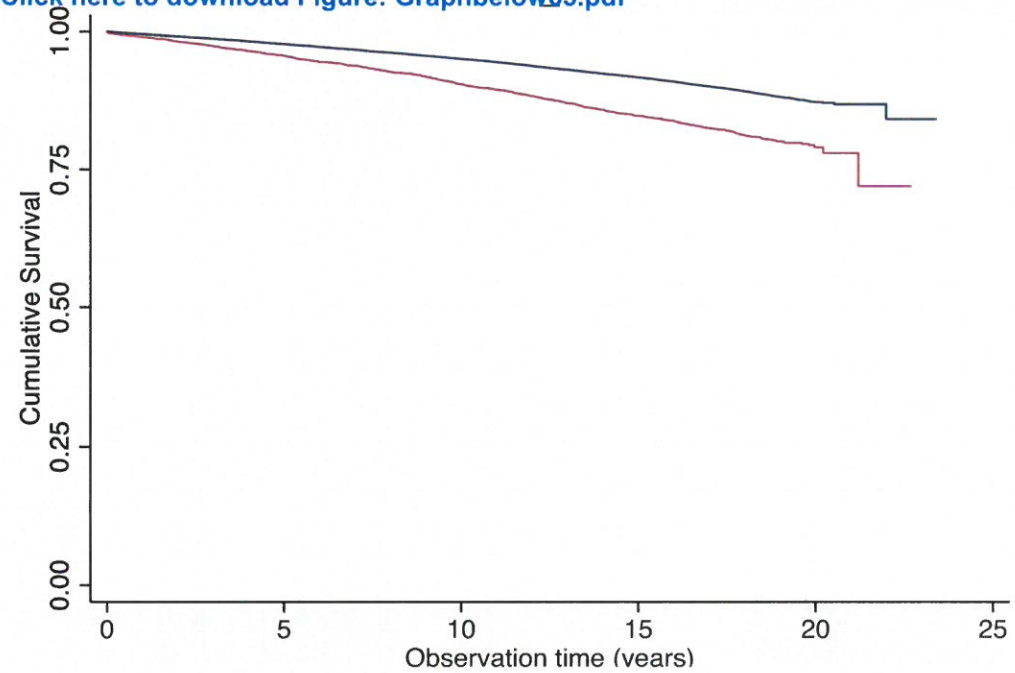

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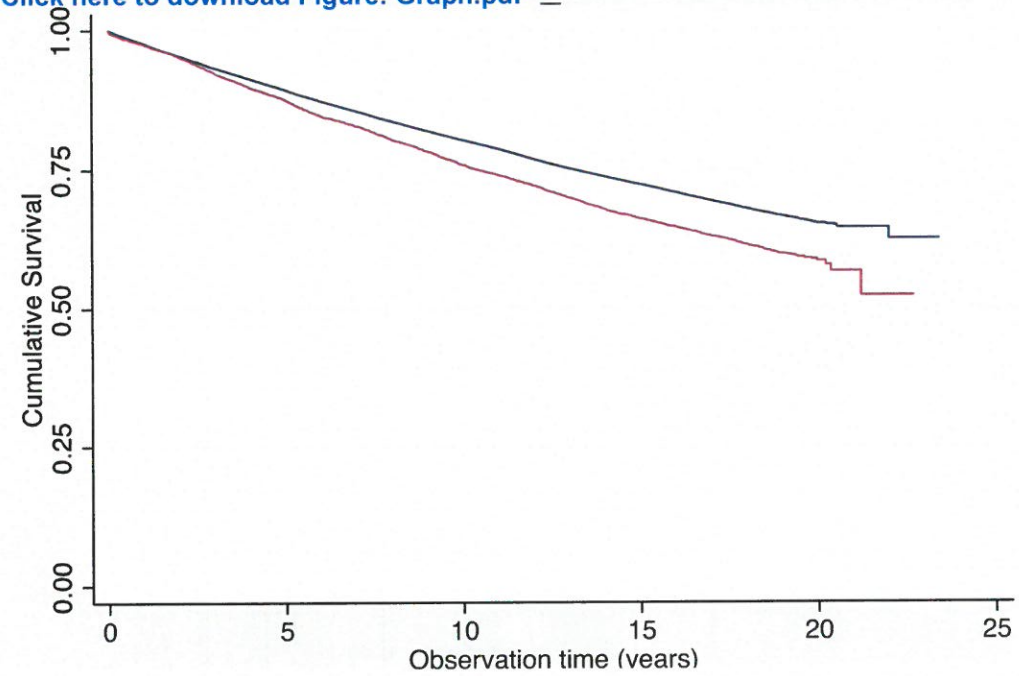

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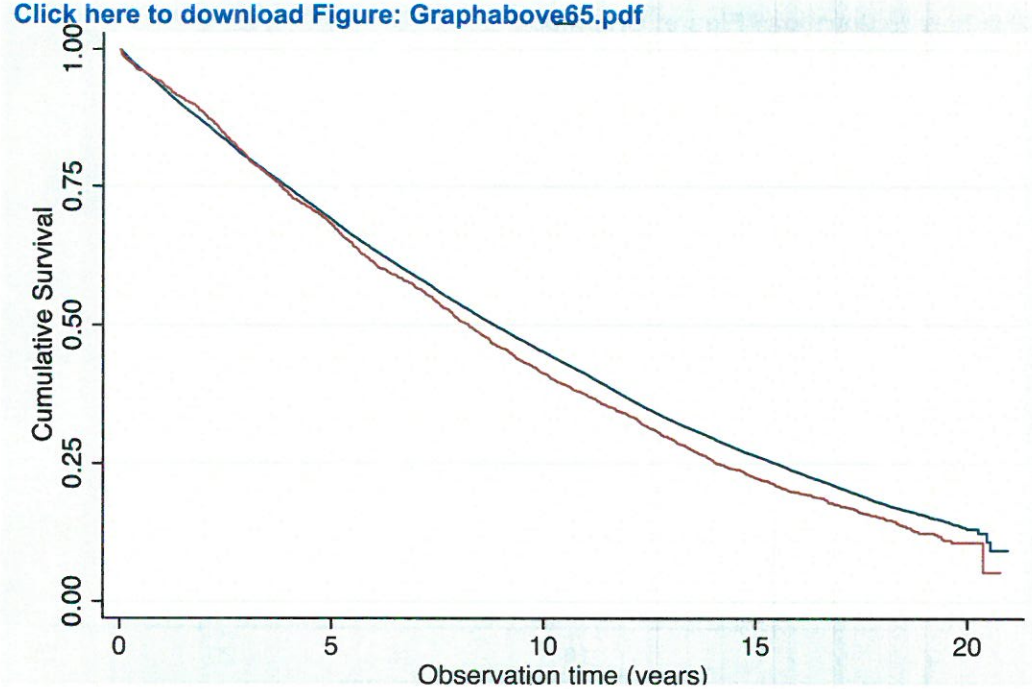
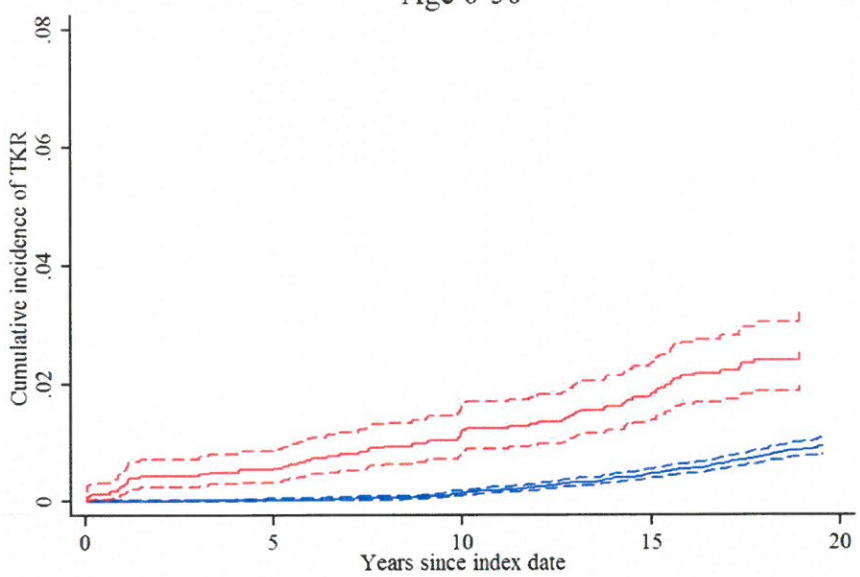


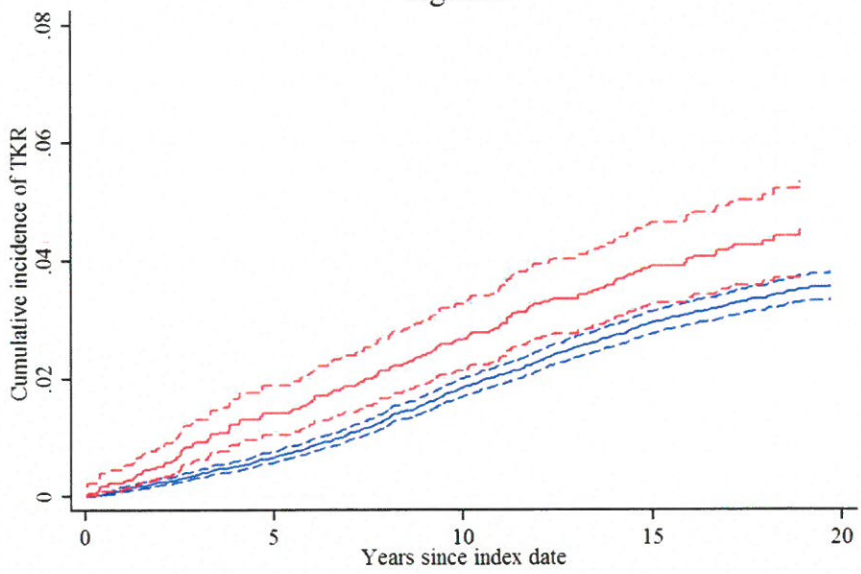
SUPPLEMENTAL FIGURES 1-8

Supplemental Figure 1: *Cumulative incidence of TKR age 0-50*



Legends: -- exposed group, -- non-exposed group

Supplemental Figure 2: *Cumulative incidence of TKR age 50+*



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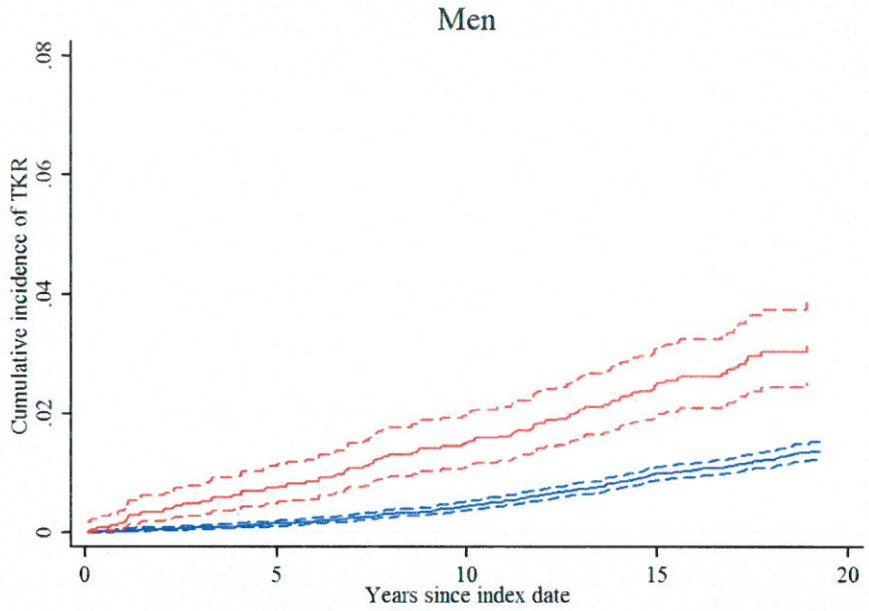
Supplemental Figure 3: *Cumulative incidence of TKR in men*



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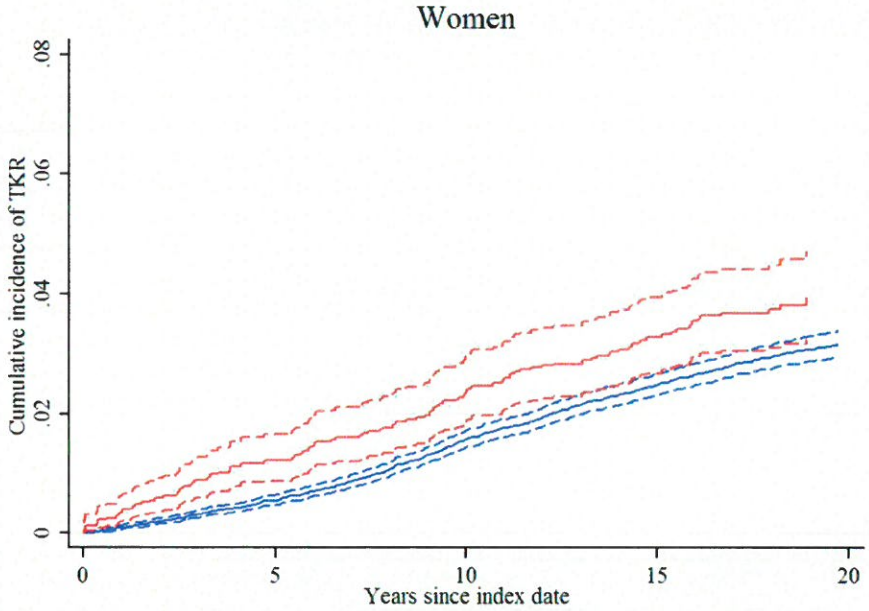
Supplemental Figure 4: *Cumulative incidence of TKR in women*



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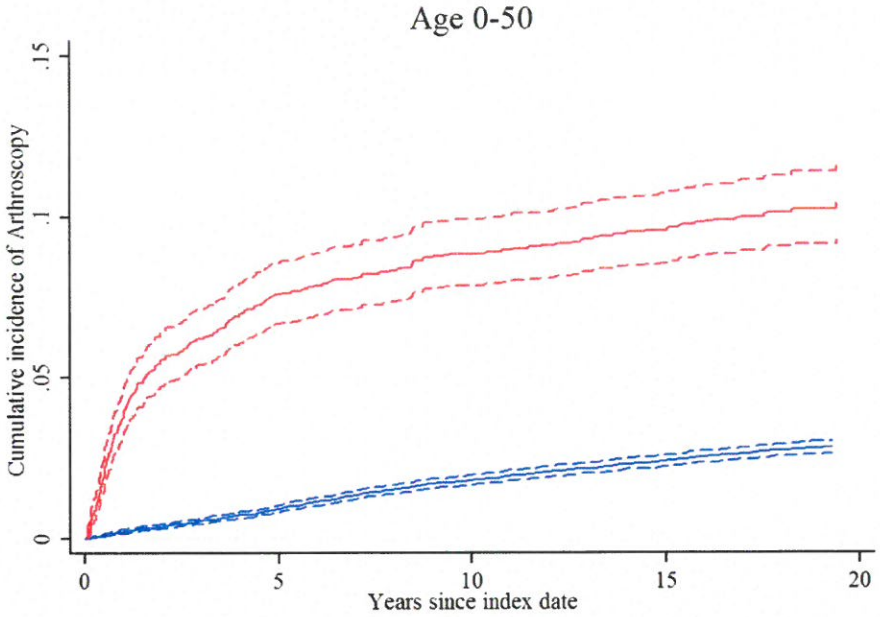
Supplemental Figure 5: *Cumulative incidence of knee arthroscopy age 0-50*



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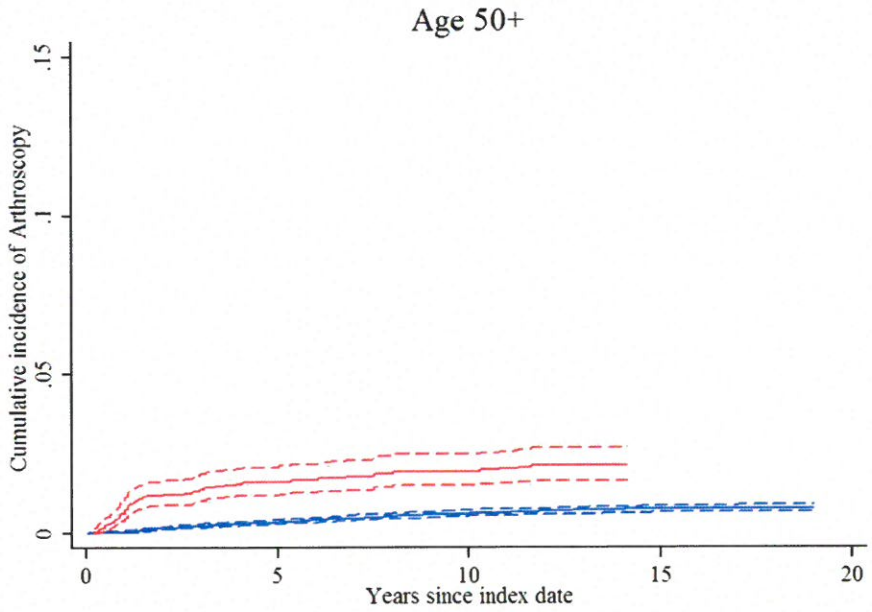
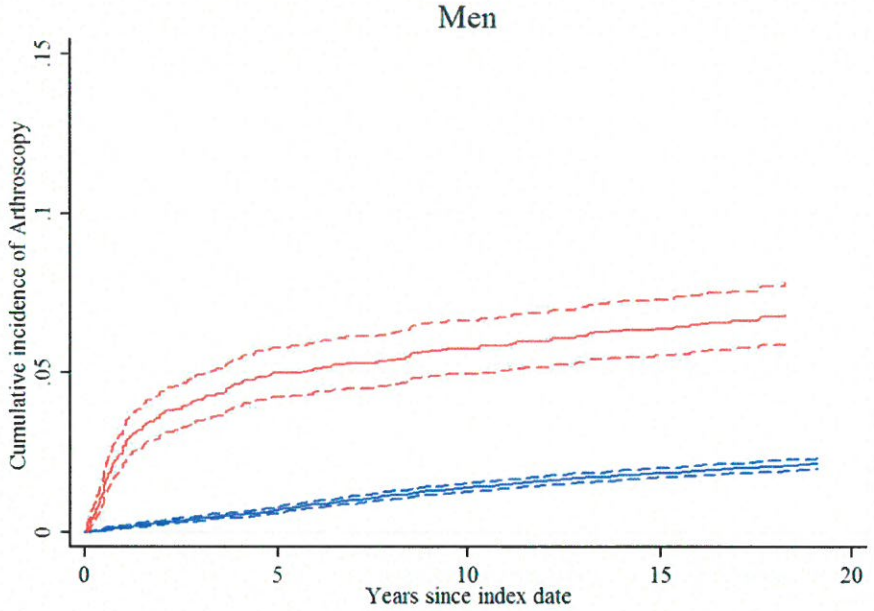
Supplemental Figure 6: *Cumulative incidence of knee arthroscopy age 50+*



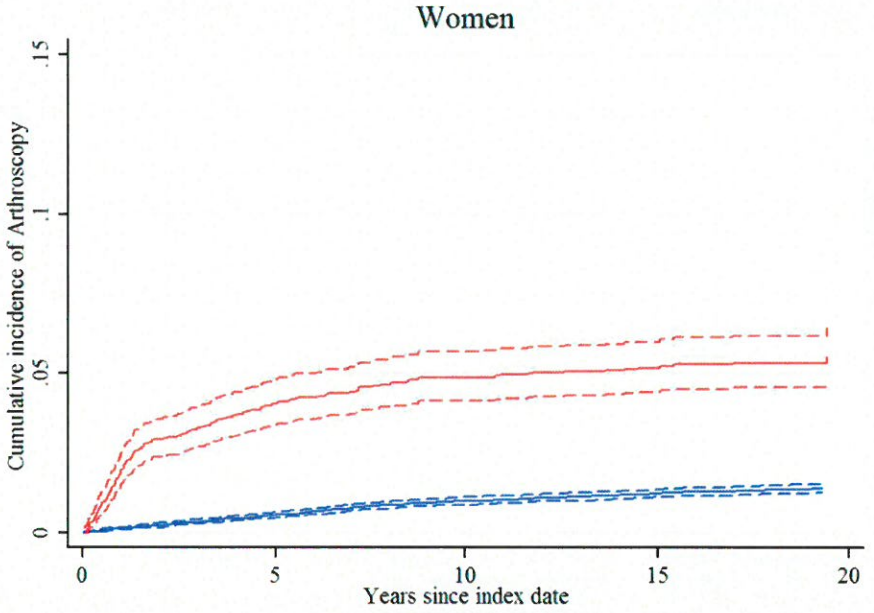
Legends: -- exposed group, -- non-exposed group

Supplemental Figure 7: *Cumulative incidence of knee arthroscopy in men*



Legends: -- exposed group, -- non-exposed group

Supplemental Figure 8: *Cumulative incidence of knee arthroscopy in women*



Legends: -- exposed group, -- non-exposed group