Risk of Fractures Following Cataract Surgery in Medicare Beneficiaries

Victoria L. Tseng, MD, Fei Yu, PhD, Flora Lum, MD, Anne L. Coleman, MD, PhD

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Background

• Visual impairment associated with an increased risk of fractures
• **Cataracts are the most common cause**
• Untreated cataract causing up to 49% in femoral neck fractures related to decreased vision
Background

• Limited number of studies examined the influence of cataract surgery on fall incidence

• No other studies have examined the association of cataract surgery and fracture incidence
Objective

• To determine the association of cataract surgery with subsequent fracture risk in US Medicare beneficiaries with a diagnosis of cataract.
Methods
Methods

- 5% random sample of Medicare beneficiaries
- Obtained from the Centers for Medicare & Medicaid Services (CMS).
Exclusion criteria

- Age < 65 years
- Residence outside the 50 US states
- Lack of Medicare Part B coverage
- Possession of health maintenance organization coverage not processed by the CMS
- History of cataract surgery before the study period
Cataracts Patient

2002-2010
5% random sample

1-year look back

Cataract surgery group
Follow up 1 year after surgery

Cataract diagnosis group
Follow up annually
Outcomes

• Primary: the occurrence of hip fracture during the follow-up period

• Secondary: the occurrence of any fracture during the follow-up period
Fracture occurrence

- First surgical or nonsurgical fracture related Medicare service
- Single and multiple fractures were not distinguished
Baseline characteristic

- Demographics
  - Age, sex, self reported race/ethnicity, and US region of residence

- Categorized patients into 5-year age subgroups
Baseline characteristic

- Overall systemic health determined by the Charlson Comorbidity Index (CCI) score
- Score 0-6
- Classified 1-year mortality
  - 0 (12% mortality)
  - 1 or 2 (26% mortality)
  - 3 or 4 (52% mortality)
  - 5 or greater (85% mortality)
Diseases in the CCI

- Myocardial infarction
- Congestive heart failure
- Peripheral vascular disease
- Cerebrovascular disease
- Dementia
- Chronic pulmonary disease
- Rheumatologic disease
- Peptic ulcer disease
- Cirrhosis
- Hepatic failure
- Imunosuppression
- Diabetes mellitus with or without complications
- Hemiplegia or paraplegia
- Chronic renal disease
- Malignant neoplasms
- Multiple myeloma or leukemia
- Lymphomas
- Metastatic solid tumor
- AIDS
Baseline characteristic

• Systemic conditions that increase the risk of fractures
  – Osteoporosis
  – Hyperthyroidism
  – Hyperparathyroidism
  – Cushing syndrome
Baseline characteristic

• Other ocular co morbidities
  – Glaucoma
  – Age-related macular degeneration
  – Diabetes mellitus with ophthalmic manifestations
Baseline characteristic

• Severe cataracts
  – Anterior and posterior subcapsular cataracts, total/mature cataract, hypermature cataract, and combined forms of cataract

• Physically limiting conditions
  – Conditions secondary to cerebrovascular events, hemiplegia or paraplegia, myopathy, neuropathy, and peripheral vascular disease
Statistical analysis
Statistical Analysis

• Baseline characteristics
  – Descriptive statistics

• The association of cataract surgery with 1-year incidence of hip fractures and any fractures
  – Multivariable logistic regression models
Potential confounders

- Age
- Sex
- Race/ethnicity
- US region
- CCI score
- Osteoporosis
- Hyperthyroidism
- Hyperparathyroidism

- Glaucoma
- Age related macular degeneration
- DM with ophthalmic manifestations
- Severe cataract
- Have ≥ 1 physically limiting conditions
The propensity score

• Logistic regression model
• Calculated for each patient
• Including all variables in the fully adjusted logistic regression for fractures
• Divided patient into 10 subgroups

Age
Race
Sex
Region of US residence,
CCI score
Osteoporosis
Hyperthyroidism
Hyperparathyroidism
Age-related macular degeneration
DM with ophthalmic manifestations
Glaucoma
Physically limiting conditions
Severe cataract.
Results
2002-2010
5% random sample

Cataracts Patient
N=1,113,640

1-year look back

Cataract surgery group
N=410,809

Follow up 1 year after surgery

Cataract diagnosis group
N=702,831

Follow up annually
Demographic data
### Table 1. Baseline Characteristics of Patients With Cataract in the 5% Medicare Sample, 2002-2009

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All Patients With Cataract (N = 1,113,640)</th>
<th>Cataract Surgery Group (n = 410,809)</th>
<th>Cataract Diagnosis Group (n = 702,831)</th>
<th>P Valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, y</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65-69</td>
<td>370,113 (33.2)</td>
<td>80,077 (19.5)</td>
<td>290,036 (41.3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>&gt;90</td>
<td>26,254 (2.4)</td>
<td>8,080 (2.0)</td>
<td>18,174 (2.6)</td>
<td></td>
</tr>
<tr>
<td>Mean (SD)b</td>
<td>74.0 (7.0)</td>
<td>75.7 (6.4)</td>
<td>73.0 (7.1)</td>
<td></td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Male</td>
<td>446,186 (40.1)</td>
<td>156,642 (38.1)</td>
<td>289,544 (41.2)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>667,454 (59.9)</td>
<td>254,167 (61.9)</td>
<td>413,287 (58.8)</td>
<td></td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>980,068 (88.1)</td>
<td>366,062 (89.1)</td>
<td>614,606 (87.5)</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>15,142 (1.4)</td>
<td>5,038 (1.2)</td>
<td>12,104 (1.7)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>17,887 (1.6)</td>
<td>6,959 (1.7)</td>
<td>10,928 (1.6)</td>
<td></td>
</tr>
<tr>
<td>Native American</td>
<td>3,745 (0.3)</td>
<td>1,425 (0.4)</td>
<td>2,320 (0.3)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>12,851 (1.2)</td>
<td>4,104 (1.0)</td>
<td>8,747 (1.2)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Unknown</td>
<td>1,237 (0.1)</td>
<td>416 (0.1)</td>
<td>821 (0.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Region of US residence</strong></td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>East</td>
<td>461,860 (41.5)</td>
<td>162,066 (39.5)</td>
<td>299,794 (42.7)</td>
<td></td>
</tr>
<tr>
<td>West</td>
<td>181,651 (16.3)</td>
<td>66,351 (16.2)</td>
<td>115,300 (16.4)</td>
<td></td>
</tr>
<tr>
<td>Midwest</td>
<td>282,544 (25.4)</td>
<td>107,246 (26.1)</td>
<td>175,298 (24.9)</td>
<td></td>
</tr>
<tr>
<td>South</td>
<td>187,585 (16.8)</td>
<td>75,146 (18.3)</td>
<td>112,439 (16.0)</td>
<td></td>
</tr>
</tbody>
</table>

65-69 years old (n=370,113; 33.2%)
Mean age in surgery group = 75.7
Mean age in diagnosis group = 73

Female (n=667,454; 59.9%)
Baseline comorbidities
Table 1. Baseline Characteristics of Patients With Cataract in the 5% Medicare Sample, 2002-2009

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All Patients (N = 1,113,640)</th>
<th>Cataract Surgery Group (n = 410,809)</th>
<th>Cataract Diagnosis Group (n = 702,831)</th>
<th>P Valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charlson comorbidity index score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td>732,759 (65.8)</td>
<td>258,024 (62.8)</td>
<td>474,735 (67.6)</td>
<td></td>
</tr>
<tr>
<td>3-4</td>
<td>293,779 (26.4)</td>
<td>118,330 (28.8)</td>
<td>175,449 (25.0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≥5</td>
<td>87,102 (7.8)</td>
<td>34,455 (8.4)</td>
<td>52,647 (7.5)</td>
<td></td>
</tr>
<tr>
<td>Systemic comorbidities associated with fracture risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>134,335 (12.1)</td>
<td>54,156 (13.2)</td>
<td>80,179 (11.4)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Hyperthyroidism</td>
<td>16,667 (1.5)</td>
<td>6,259 (1.5)</td>
<td>10,408 (1.5)</td>
<td>.07</td>
</tr>
<tr>
<td>Hyperparathyroidism</td>
<td>6,085 (0.6)</td>
<td>2,400 (0.6)</td>
<td>3,685 (0.5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Cushing syndrome</td>
<td>460 (0.0)</td>
<td>188 (0.1)</td>
<td>272 (0.0)</td>
<td>.08</td>
</tr>
<tr>
<td>Physically limiting conditionsc</td>
<td>153,604 (13.8)</td>
<td>60,073 (14.6)</td>
<td>93,531 (13.3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Ocular comorbidities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMD</td>
<td>182,417 (16.4)</td>
<td>87,674 (21.3)</td>
<td>94,743 (13.5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>DM with ophthalmic manifestations</td>
<td>62,004 (5.6)</td>
<td>26,688 (6.5)</td>
<td>35,316 (5.0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>212,382 (19.1)</td>
<td>92,742 (22.6)</td>
<td>119,640 (17.0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Severe cataractd</td>
<td>233,118 (20.9)</td>
<td>168,180 (40.9)</td>
<td>64,938 (9.2)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
Fracture incidence
Table 2. One-Year **Crude Incidence** of Fractures Among Patients With Cataract in the 5% Medicare Sample, 2002-2009 (N = 1,113,640)

<table>
<thead>
<tr>
<th>Type of Fracture</th>
<th>No.</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any fracture</td>
<td>59,791</td>
<td>5.37 (5.33-5.41)</td>
</tr>
<tr>
<td>Head and neck</td>
<td>3,214</td>
<td>0.29 (0.28-0.30)</td>
</tr>
<tr>
<td>Rib</td>
<td>6,448</td>
<td>0.58 (0.56-0.59)</td>
</tr>
<tr>
<td>Vertebral</td>
<td>8,516</td>
<td>0.76 (0.75-0.78)</td>
</tr>
<tr>
<td>Upper limb</td>
<td>18,136</td>
<td>1.63 (1.61-1.65)</td>
</tr>
<tr>
<td>Lower limb</td>
<td>27,344</td>
<td>2.46 (2.43-2.48)</td>
</tr>
<tr>
<td>Pelvis</td>
<td>3,377</td>
<td>0.30 (0.29-0.31)</td>
</tr>
<tr>
<td><strong>Hip</strong></td>
<td>13,976</td>
<td>1.25 (1.23-1.28)</td>
</tr>
<tr>
<td>Other/unspecified</td>
<td>1,947</td>
<td>0.17 (0.17-0.18)</td>
</tr>
<tr>
<td></td>
<td>Cataract surgery group</td>
<td>Cataract diagnosis group</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td><strong>1 Year Prior to Surgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any cataract Hip fracture</td>
<td>4261/410,809 1.04 (1.01-1.07)</td>
<td>5321/410,809 1.30 (1.26-1.33)</td>
</tr>
<tr>
<td>Any fracture</td>
<td>20,722/410,809 5.04 (4.98-5.11)</td>
<td>23,333/410,809 5.68 (5.61-5.75)</td>
</tr>
<tr>
<td><strong>1 Year After Surgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any cataract Hip fracture</td>
<td>8627/168,180 5.13 (5.02-5.24)</td>
<td>982/64,938 1.51 (1.42-1.61)</td>
</tr>
<tr>
<td>Any fracture</td>
<td>9582/168,180 5.70 (5.59-5.81)</td>
<td>3698/64,938 5.69 (5.52-5.88)</td>
</tr>
</tbody>
</table>

\[P^a\]

\[^a^\] Data on fractures prior to 2002 were not available for patients who had cataract surgery in 2002.

\[^b^\] One year after diagnosis.

\[^c^\] \(X^2\) test compares crude incidence of fractures 1 year after surgery between cataract surgery and cataract diagnosis groups.
Fracture risk
The absolute risk differences:
- Hip fractures = 0.20% and any fractures = 0.24%

The NNT:
- Hip fractures = 507 and any fractures = 422

### Table 4. Fracture Risk Among Patients With Cataract in the 5% Medicare Sample, 2002-2009

<table>
<thead>
<tr>
<th>Adjustment Factors</th>
<th>Hip Fractures After Cataract Surgery</th>
<th>Any Fractures After Cataract Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)a</td>
<td>OR (95% CI)a</td>
</tr>
<tr>
<td>Unadjusted</td>
<td>1.05 (1.02-1.09)</td>
<td>1.10 (1.08-1.12)</td>
</tr>
<tr>
<td>+Age</td>
<td>0.84 (0.81-0.87)</td>
<td>0.98 (0.97-1.00)</td>
</tr>
<tr>
<td>+Race, sex, residence b</td>
<td>0.83 (0.80-0.86)</td>
<td>0.97 (0.95-0.98)</td>
</tr>
<tr>
<td>+Comorbidities b,c</td>
<td>0.84 (0.81-0.87)</td>
<td>0.96 (0.94-0.97)</td>
</tr>
<tr>
<td>+Physically limiting conditions and severe cataract b,d</td>
<td>0.84 (0.81-0.87)</td>
<td>0.95 (0.93-0.97)</td>
</tr>
</tbody>
</table>

Among patients with any cataract (N = 1,113,640)

| Adjustment Factors                                      | OR (95% CI)a                         | P Value   | OR (95% CI)a                         | P Value   |
| Unadjusted                                              | 0.85 (0.79-0.92)                     | <.001     | 1.00 (0.96-1.04)                     | .96       |
| Fully adjusted                                          | 0.77 (0.72-0.84)                     | <.001     | 0.92 (0.89-0.96)                     | <.001     |

Abbreviation: OR, odds ratio.

a Cataract patients without cataract surgery were used as a reference.
b Each additional adjustment also includes all the adjustment factors previously listed.
c Includes Charlson Comorbidity Index score and systemic and ocular comorbidities listed in Table 1, except for Cushing syndrome, physically limiting conditions, and severe cataract.
d Includes anterior and posterior subcapsular cataracts, total/mature cataract, hypermature cataract, and combined forms of cataract.
Risk of Fractures by Propensity Score Decile
### Table 5. One-Year Incidence of Fractures Stratified by Propensity Score of Cataract Surgery Among Patients With Cataract in the 5% Medicare Sample, 2002-2009 (N = 1 113 640)

<table>
<thead>
<tr>
<th>Propensity Score Decile Subgroup</th>
<th>Cataract Surgery Group</th>
<th>Cataract Diagnosis Group</th>
<th>OR (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (n = 114 815)</td>
<td>50/13 023 (0.38, 0.29-0.51)</td>
<td>329/101 792 (0.32, 0.29-0.36)</td>
<td>1.19 (0.88-1.60)</td>
<td>0.26</td>
</tr>
<tr>
<td>2 (n = 107 921)</td>
<td>90/15 354 (0.59, 0.47-0.72)</td>
<td>502/92 567 (0.54, 0.45-0.63)</td>
<td>1.08 (0.86-1.35)</td>
<td>0.50</td>
</tr>
<tr>
<td>3 (n = 117 691)</td>
<td>201/22 484 (0.89, 0.78-1.03)</td>
<td>888/95 207 (0.93, 0.87-1.00)</td>
<td>0.96 (0.82-1.12)</td>
<td>0.59</td>
</tr>
<tr>
<td>4 (n = 105 332)</td>
<td>308/27 358 (1.13, 1.00-1.26)</td>
<td>926/77 974 (1.19, 1.11-1.27)</td>
<td>0.95 (0.83-1.08)</td>
<td>0.41</td>
</tr>
<tr>
<td>5 (n = 111 068)</td>
<td>449/34 330 (1.31, 1.16-1.43)</td>
<td>1106/76 738 (1.44, 1.35-1.53)</td>
<td>0.91 (0.81-1.01)</td>
<td>0.08</td>
</tr>
<tr>
<td>6 (n = 111 359)</td>
<td>539/39 669 (1.36, 1.25-1.48)</td>
<td>1173/71 690 (1.64, 1.54-1.73)</td>
<td>0.83 (0.75-0.92)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>7 (n = 109 416)</td>
<td>700/43 485 (1.61, 1.49-1.73)</td>
<td>1428/65 931 (2.17, 2.06-2.28)</td>
<td>0.74 (0.68-0.81)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>8 (n = 113 313)</td>
<td>749/52 738 (1.42, 1.32-1.52)</td>
<td>1207/60 575 (1.99, 1.88-2.11)</td>
<td>0.71 (0.65-0.78)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>9 (n = 111 397)</td>
<td>819/72 990 (1.12, 1.05-1.20)</td>
<td>586/38 407 (1.53, 1.41-1.65)</td>
<td>0.73 (0.66-0.82)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>10 (n = 111 328)</td>
<td>1416/89 378 (1.58, 1.50-1.67)</td>
<td>510/21 950 (2.32, 2.13-2.53)</td>
<td>0.68 (0.61-0.75)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviation: OR, odds ratio.

---

For fractures after cataract surgery, Cataract patients with OMI had significantly lower incidence compared to cataract patients without OMI. OR 0.68, 95%CI 0.61-0.75
Risk of fractures by age
<table>
<thead>
<tr>
<th>By Age</th>
<th>Cataract Surgery Group</th>
<th>Cataract Diagnosis Group</th>
<th>Adjusted OR (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No./Total No. of Patients</td>
<td>Incidence, % (95% CI)</td>
<td>No./Total No. of Patients</td>
<td>Incidence, % (95% CI)</td>
</tr>
<tr>
<td>Hip fracture 65-69 y (n = 370,113)</td>
<td>438/80,077</td>
<td>0.55 (0.50-0.60)</td>
<td>1124/290,036</td>
<td>0.39 (0.37-0.41)</td>
</tr>
<tr>
<td>70-74 y (n = 265,993)</td>
<td>782/103,758</td>
<td>0.75 (0.70-0.81)</td>
<td>1110/162,235</td>
<td>0.68 (0.64-0.73)</td>
</tr>
<tr>
<td>75-79 y (n = 226,880)</td>
<td>1291/110,278</td>
<td>1.17 (1.11-1.24)</td>
<td>1666/116,602</td>
<td>1.43 (1.36-1.50)</td>
</tr>
<tr>
<td>80-84 y (n = 152,583)</td>
<td>1465/76,818</td>
<td>1.91 (1.81-2.01)</td>
<td>2022/75,765</td>
<td>2.67 (2.56-2.79)</td>
</tr>
<tr>
<td>85-89 y (n = 71,817)</td>
<td>996/31,798</td>
<td>3.14 (2.95-3.34)</td>
<td>1651/40,019</td>
<td>4.13 (3.93-4.32)</td>
</tr>
<tr>
<td>≥90 y (n = 26,254)</td>
<td>347/8080</td>
<td>4.29 (3.86-4.76)</td>
<td>1082/18,174</td>
<td>5.95 (5.61-6.31)</td>
</tr>
<tr>
<td>Any fracture 65-69 y (n = 370,113)</td>
<td>3424/80,077</td>
<td>4.28 (4.14-4.42)</td>
<td>10,385/290,036</td>
<td>3.58 (3.51-3.65)</td>
</tr>
<tr>
<td>70-74 y (n = 265,993)</td>
<td>4897/103,758</td>
<td>4.72 (4.59-4.85)</td>
<td>6736/162,235</td>
<td>4.15 (4.06-4.25)</td>
</tr>
<tr>
<td>75-79 y (n = 226,880)</td>
<td>6036/110,278</td>
<td>5.48 (5.34-5.61)</td>
<td>6782/116,602</td>
<td>5.82 (5.68-5.95)</td>
</tr>
<tr>
<td>80-84 y (n = 152,583)</td>
<td>5351/76,818</td>
<td>6.97 (6.79-7.15)</td>
<td>6052/75,765</td>
<td>7.99 (7.80-8.18)</td>
</tr>
<tr>
<td>85-89 y (n = 71,817)</td>
<td>2746/31,798</td>
<td>8.64 (8.33-8.95)</td>
<td>4202/40,019</td>
<td>10.50 (10.20-10.80)</td>
</tr>
<tr>
<td>≥90 y (n = 26,254)</td>
<td>877/8080</td>
<td>10.85 (10.18-11.55)</td>
<td>2291/18,174</td>
<td>12.61 (12.13-13.10)</td>
</tr>
</tbody>
</table>
Risk of fractures by CCI score
Table 6. Incidence and Risk of Fractures by Age and Charlson Comorbidity Index Score Among Patients With Cataract in the 5% Medicare Sample, 2002-2009\textsuperscript{a,b}

<table>
<thead>
<tr>
<th></th>
<th>Cataract Surgery Group</th>
<th></th>
<th>Cataract Diagnosis Group</th>
<th></th>
<th>Adjusted OR</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No./Total No. of Patients</td>
<td>Incidence, % (95% CI)</td>
<td>No./Total No. of Patients</td>
<td>Incidence, % (95% CI)</td>
<td>Adjusted OR (95% CI)</td>
<td></td>
</tr>
<tr>
<td>Hip fracture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 (n = 732 759)</td>
<td>2344/258 024</td>
<td>0.91 (0.87-0.95)</td>
<td>3075/474 735</td>
<td>0.65 (0.63-0.67)</td>
<td></td>
<td>.86</td>
</tr>
<tr>
<td>3-4 (n = 293 779)</td>
<td>1965/118 330</td>
<td>1.66 (1.59-1.74)</td>
<td>3569/175 449</td>
<td>2.03 (1.97-2.10)</td>
<td>0.72 (0.68-0.77)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≥5 (n = 87 102)</td>
<td>1012/34 455</td>
<td>2.94 (2.76-3.12)</td>
<td>2011/52 647</td>
<td>3.82 (3.66-3.98)</td>
<td>0.74 (0.68-0.81)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Any fracture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 (n = 732 759)</td>
<td>11 706/258 024</td>
<td>4.54 (4.46-4.62)</td>
<td>17 895/474 735</td>
<td>3.77 (3.72-3.82)</td>
<td>1.03 (1.00-1.06)</td>
<td>.04</td>
</tr>
<tr>
<td>3-4 (n = 293 779)</td>
<td>7979/118 330</td>
<td>6.74 (6.60-6.89)</td>
<td>12 586/175 449</td>
<td>7.17 (7.05-7.30)</td>
<td>0.86 (0.83-0.89)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≥5 (n = 87 102)</td>
<td>3648/34 455</td>
<td>10.59 (10.26-10.91)</td>
<td>5967/52 647</td>
<td>11.33 (11.06-11.61)</td>
<td>0.90 (0.86-0.94)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
Comment
Comment

- Cataract surgery group had a higher crude risk of hip fracture due to unequal age distributions and confounding.
- Cataract surgery was associated with a 16% decrease in the adjusted odds of hip fracture 1 year after the procedure.
Comment

Lower odds of hip surgery in
• Severe cataracts
• Patients with higher propensity score
• Sicker (CCI ≥ 3)
Limitation

• Observational and retrospective
• Unmeasured confounders → use propensity scores to adjust for selection bias and confounder
• Misclassification of existing codes → occur in the same in both groups due to large sample size
Limitation

• Inability to identify patients who self-paid for cataract surgery in the control group → likely to have *ICD-9-CM code for pseudophakia* → excluded from the study
Limitation

- Dropped out due to died or switched to insurance outside of Medicare
Advantage

- Largest comprehensive study
- Diverse patient population
Conclusion

• Cataract surgery may be associated with lower odds of subsequent fracture in patients aged 65 years and older in the US Medicare population

• Further prospective study?
• Cost effectiveness?
Critical appraisal
# Screening Questions

<table>
<thead>
<tr>
<th></th>
<th>Did the study address a clearly focused issue?</th>
<th>Yes</th>
<th>Can't tell</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>HINT:</td>
<td>A question can be focused in terms of:</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- the population studied</td>
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<td></td>
<td>- the risk factors studied</td>
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<td>- the outcomes considered</td>
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<td></td>
<td>- is it clear whether the study tried to</td>
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<tr>
<td></td>
<td>detect a beneficial or harmful effect?</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Did the authors use an appropriate method to answer their question?</th>
<th>Yes</th>
<th>Can't tell</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>HINT:</td>
<td>Consider</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- Is a cohort study a good way of answering the question under the circumstances?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Did it address the study question?</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
### Detailed Questions

3. Was the cohort recruited in an acceptable way?

**HINT:** We are looking for selection bias which might compromise the generalisability of the findings:

- Was the cohort representative of a defined population?
- Was there something special about the cohort?
- Was everybody included who should have been included?
4. Was the exposure accurately measured to minimize bias?

HINT: We are looking for measurement or classification bias:

- Did they use subjective or objective measurements?
- Do the measures truly reflect what you want them to (have they been validated)?
- Were all the subjects classified into exposure groups using the same procedure?
5. Was the outcome accurately measured to minimize bias?

**HINT:** We are looking for measurement or classification bias:

- Did they use subjective or objective measurements?
- Do the measures truly reflect what you want them to (have they been validated)?
- Has a reliable system been established for detecting all the cases (for measuring disease occurrence)?
- Were the measurement methods similar in the different groups?
- Were the subjects and/or the outcome assessor blinded to exposure (does this matter)?
6. A. Have the authors identified all important confounding factors? List the ones you think might be important, that the authors missed.

B. Have they taken account of the confounding factors in the design and/or analysis?

HINT:
- Look for restriction in design, and techniques eg modelling, stratified-, regression-, or sensitivity analysis to correct, control or adjust for confounding factors
7. A. Was the follow up of subjects complete enough?

B. Was the follow up of subjects long enough?

HINT:
- The good or bad effects should have had long enough to reveal themselves
- The persons that are lost to follow-up may have different outcomes than those available for assessment
- In an open or dynamic cohort, was there anything special about the outcome of the people leaving, or the exposure of the people entering the cohort?
B/ What are the results?

8. What are the results of this study?

HINT:
- What are the bottom line results?
- Have they reported the rate or the proportion between the exposed/unexposed, the ratio/the rate difference?
- How strong is the association between exposure and outcome (RR)?
- What is the absolute risk reduction (ARR)?

9. How precise are the results?

How precise is the estimate of the risk?

HINT:
- Size of the confidence intervals

10. Do you believe the results?

HINT:
- Big effect is hard to ignore!
- Can it be due to bias, chance or confounding?
- Are the design and methods of this study sufficiently flawed to make the results unreliable?
- Consider Bradford Hills criteria (eg time sequence, dose-response gradient, biological plausibility, consistency).

<table>
<thead>
<tr>
<th>Yes</th>
<th>Can't tell</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
11. Can the results be applied to the local population?

**HINT:** Consider whether

- The subjects covered in the study could be sufficiently different from your population to cause concern.
- Your local setting is likely to differ much from that of the study.
- Can you quantify the local benefits and harms?

<table>
<thead>
<tr>
<th>Yes</th>
<th>Can’t tell</th>
<th>No</th>
</tr>
</thead>
</table>

12. Do the results of this study fit with other available evidence?

<table>
<thead>
<tr>
<th>Yes</th>
<th>Can’t tell</th>
<th>No</th>
</tr>
</thead>
</table>