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## Original Study

## Understanding Mortality of Femoral Fractures Following Low-Impact Trauma in Persons With and Without Care Need

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## A B S T R A C T

**Keywords:**

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 wild bootstrap

**Objectives:** Persons with osteoporotic fracture history are subject to an increased risk for subsequent fractures and mortality. The aim of this retrospective study was to investigate the impact of a previous osteoporotic low-impact (fragility) index fracture (eg, forearm, lower leg) on mortality of a subsequent femoral fracture.

**Design:** Retrospective cohort study.

**Participants/measurements:** Claims data of a German health insurance agency including >1.2 million insured persons aged 65 years or older and observed between 2004 and 2009.

**Methods:** A multistate model was developed handling index fractures and care need as time-dependent exposures, while age was chosen as the underlying time scale. Excess risks were expressed as differences in cause-specific hazards. Nelson-Aalen estimates were used for their nonparametric estimation. Time-simultaneous statistical inference was based on confidence bands provided by wild bootstrap resampling.

**Results:** Excess femoral fracture risk increased with progressive age and was highest in persons with care need. It was observed starting from an age of 79 years in women and 85 years in men onward. A prior index fracture increased mortality after a femoral fracture by increasing femoral fracture risk, while leaving the hazard of death after a subsequent femoral fracture unchanged.

**Conclusions:** The results indicated that increased mortality of a subsequent femoral fracture is not triggered by an intrinsically increased mortality hazard but an increased femoral fracture incidence.

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It is well established that osteoporosis in older individuals is associated with an increased fracture risk resulting from low-impact (fragility) trauma occurring either spontaneously or from a fall from not greater than standing height.<sup>1–4</sup> To reduce doubled health care

costs by 2025, fracture prevention is of outstanding importance.<sup>5,6</sup> Examples are fall prevention programs or diagnoses and therapies of osteoporosis intent.<sup>7</sup> Besides so-called index fractures, summarizing low-trauma fractures of the vertebra, wrist, spine, humerus, pelvis, and radius, femoral fractures in particular, make up a considerable part of the fractures in older European populations.<sup>6,7</sup> Several observational studies showed a twofold risk of femoral fractures after prior osteoporotic-related fractures<sup>8–12</sup>; thus, the latter can be seen as a simple and reliable indication for the occurrence of subsequent femoral fractures. Previous studies also established increased mortality after femoral fractures especially during the first 6 months after injury compared to age- and sex-matched controls.<sup>13–19</sup> However, these interpretations may be either compromised by a questionable choice of time scale (for

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instance, “time since fracture,” which is difficult to interpret for the control group without any fracture) or potential induction of time-dependent biases.<sup>20</sup> Because data and analyses combining both complex fracture histories and death are rarely available, the knowledge in which way a prior index fracture affects mortality after a subsequent fracture is limited. Thus, the objective of this study was to establish the relationship between incidence and mortality of femoral fractures in persons with and without a prior index fracture. A specific fracture death multistate model was applied and analyzed by advanced statistical time-to-event techniques. As a result, no matched control groups were required. A better understanding of the underlying processes and pathways may provide a unique opportunity for the design and selection of femoral fracture prevention strategies (eg, fall prevention or prescription of antiresorptive drugs).

### Study Population and Data Source

This retrospective cohort study exploited routine data collection of Germany’s largest non-profit health insurance agency “Allgemeine Ortskrankenkasse Bayern” (AOK Bavaria). The original database contained more than 1.2 million individuals (Figure 1) aged 65 years or older and permanently insured between January 1st, 2004 and June 30th, 2009. Compared to the sex and age frequencies obtained from the German census conducted in 2011,<sup>21</sup> the database has been comparable to the entire Bavarian population aged 65 years or older. Besides sex and age, information on status of care need, residence in a nursing home (NH), dates and diagnoses of both admission to and discharge from hospital, and dates of death were available. Analyses were restricted to individuals being at least 1 complete year fracture free (in 2004) in order to minimize dependencies on previous fractures. All data were held by the AOK Bavaria; thus, a linkage to other sources was

not required. The study was approved by the local ethics committee of Ulm University.

### Long-Term Care Insurance and Level of Care Need

In Germany, it is compulsory to be health as well as long-term care insured. The latter was introduced in the German social insurance system in 1995. The corresponding insurance companies are freely selectable. To request for long-term care benefit, a person must need a minimum of assistance with basic activities of daily living (ADL) such as washing, eating, or dressing and of instrumental activities of daily living such as cleaning or shopping. Depending on the extent of care required, recipients are categorized into three levels after an assessment by a nurse or physician of the medical service of the German statutory health insurance system. The level of care 1 requires an average daily care need of at least 90 minutes of basic ADLs. Levels 2 and 3 require an average daily care need of at least 180 and 300 minutes containing more than 120 and 240 minutes of basic ADLs, respectively.<sup>22,23</sup> This classification showed good inter-rater reliability and can be utilized as a reliable measure for the degree of functional, physical, and psychological restrictions. In this study, two sub-populations were defined on the premise of long-term care insurance claims: persons with any level of care and persons without care need. NH residents belong to the former group of individuals.

### Fracture Groups

The identification of fractures followed the 10th Revision of the International Classification of Diseases (ICD-10) applied to hospital discharge diagnoses. The focus was on the investigation of femoral fractures (S72) subdivided into femoral fractures without any prior fracture (initial femoral fractures) and subsequent femoral fractures following a prior index fracture. The latter summarized low-impact osteoporotic-related (fragility) fracture types (cf. definition of fracture types in [3]): rib (S22.3, S22.4), cervical/lumbar spine (S12.0,

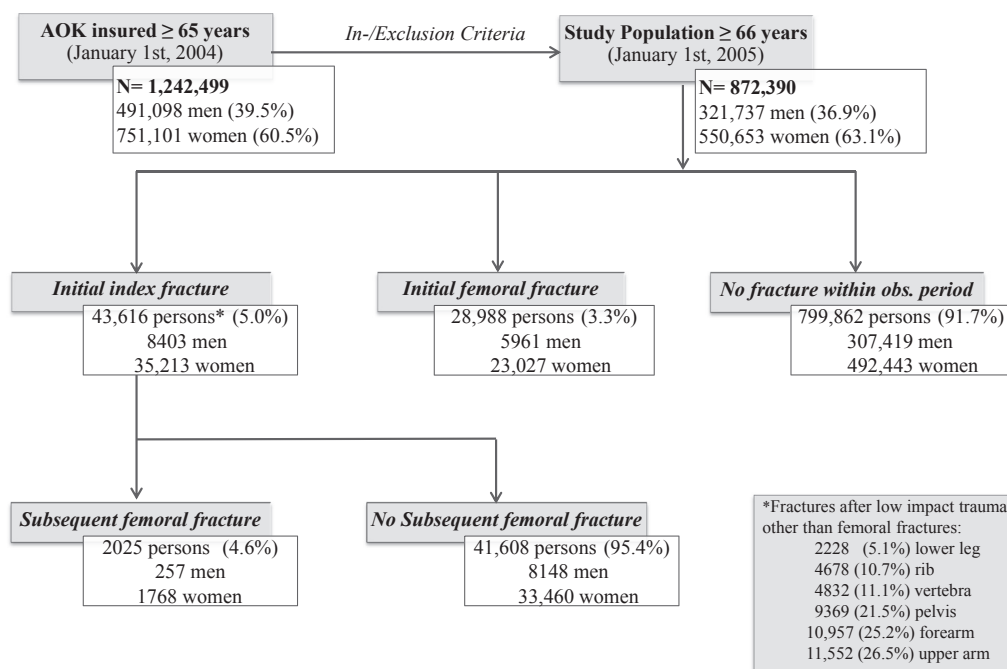


Fig. 1. Flow chart of study participants considering fractures occurred during the follow-up (without additional stratification for care need).

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