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Original Study

Long-Term Effectiveness of a Multifactorial Fall and Fracture Prevention Program in Bavarian Nursing Homes: An Analysis Based on Health Insurance Claims Data

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A B S T R A C T

Objective: Femoral fractures are frequently consequences of falls in nursing homes and are associated with considerable costs and unfavorable outcomes such as immobility and mortality. The purpose of this study was to examine the long-term effectiveness of a multifactorial fall and fracture prevention program in nursing homes in terms of reducing femoral fractures.
Design: Retrospective cohort study.
Setting: Nursing homes.
Participants: Health insurance claims data for 2005-2013 including 85,148 insurants of a sickness fund (Allgemeine Ortskrankenkasse Bayern), aged 65 years or older and living in 802 nursing homes in Bavaria, Germany.
Intervention: The fall prevention program was implemented stepwise in 4 time-lagged waves in almost 1,000 nursing homes in Bavaria, Germany, and was financially supported by a Bavarian statutory health insurance for the initial period of 3 years after implementation. The components of Bavarian Fall and Fracture Prevention Program were related to the staff (education), to the residents (progressive strength and balance training, medication, hip protectors), and suggested environmental adaptations as well as fall documentation and feedback on fall statistics.
Measurements: Data were used to create an unbalanced panel data set with observations per resident and quarterly period. We designed each wave to have 9 quarters (2.25 years) before implementation and 15 quarters (3.75 years) as follow-up period, respectively. Time trend–adjusted logistic generalized estimating equations were used to examine the impact of implementation of the fall prevention program on the likelihood of femoral fractures, controlling for resident and nursing home characteristics. The analysis took into account that the fall prevention program was implemented in 4 time-lagged waves.
Results: The implementation of the fall prevention program was not associated with a significant reduction in femoral fractures. Only a transient reduction of femoral fractures in the first wave was observed. Patient characteristics were positively associated with the likelihood of femoral fractures ($P < .001$); women compared to men [odds ratio (OR) = 0.877], age category 2 (OR = 1.486) and 3 (OR = 1.973) compared to category 1, care level 1 compared to 2 (OR = 0.897) and 3 (OR = 0.426), and a prior fracture (OR = 2.230) significantly increased the likelihood of a femoral fracture.
Conclusions: There was no evidence for the long-term effectiveness of the fall prevention program in nursing homes. The restriction of the transient reduction to the first implementation wave may be explainable by a higher motivation of nursing homes starting first with the fall prevention program. Efforts should be directed to further identify factors that determine the long-term effectiveness of fall prevention programs in nursing homes.

Physical inactivity is toxic for nursing home residents. Falls and concerns about fall-related injuries are one of the main causes for restricting adequate physical activity in nursing homes. Enabling *safe* mobility therefore remains a major challenge worldwide. Femoral fractures are the most common type of injurious falls. Fractures are

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not only associated with considerable costs, but they frequently lead to negative health outcomes such as pain, reduced quality of life, immobility and increased mortality.[1–3] Therefore, fall and fracture prevention should be an important topic in nursing homes. Efforts have been directed to develop and evaluate efficacious and effective fall and fracture prevention programs (FPP).

Common endpoints in the literature to evaluate the effectiveness of FPP are falls or fall-related injuries like fractures. Regarding falls, the Cochrane review and a recent meta-analysis summarized the evidence that multifactorial multidisciplinary and multilevel interventions can reduce the number of falls and recurrent fallers in long-term care.[4,5] However, nursing home studies focusing on exercise only or less intensive interventions had no effect, and one study from New Zealand was even harmful.[6] Regarding fractures, there are comparatively fewer studies and with less conclusive results, mainly because of a lack of power.[4,7]

Motivated by the results of a cluster-randomized trial,[8] which found a reduction in the number of falls due to a multifaceted intervention in nursing homes in Germany, a large statutory health insurance decided to finance a roll-out of the program in several hundred nursing homes in the federal state of Baden-Wuerttemberg, Germany, from 2003 onward. Yet, the analysis showed no change in the femoral fracture rate during the implementation.[9] It was hypothesized that this could be due to shortcomings during the implementation process such as a lack of motivation, conflicts of interests with other activities, or staff fluctuation. As a consequence, a modified implementation was planned in the federal state of Bavaria, Germany. Several components were changed. Examples were the signing of a 3-year contract between the health insurance and the nursing homes, the modification of the training, the provision of education materials and a more interactive educational process.[8,10] This so-called Bavarian Fall and Fracture Prevention Program (BF2P2) was implemented in almost 1,000 nursing homes in Bavaria, Germany, through 4 successive annual implementation waves of approximately 200 to 250 nursing homes each. The funding health insurance did not accept a random order of nursing homes for the implementation waves. Therefore, a selection on the institutional level could not be ruled out. The first implementation wave was analyzed and a reduction of femoral fracture rate by 18% during the first year of BF2P2 was found compared to the waiting group of nursing homes not yet participating in the program.[8] Yet, it remained unclear whether BF2P2 may reduce femoral fractures in the long run. Furthermore, as a result of the possible selection on the institutional level, there might be systematic differences between the implementation waves.

As in the meantime BF2P2 had been disseminated to all intended Bavarian nursing homes since 2010, this allows for comprehensive analyses. The purpose of the present study was (1) to examine the long-term effectiveness of BF2P2 in nursing homes in terms of reducing femoral fractures and (2) to investigate differences in the effectiveness between the implementation waves, in particular, between pioneering nursing homes of the first wave and nursing homes of later waves.

Methods

The Bavarian Fall Prevention Program

BF2P2 is a further development of previous multifactorial FPP.[9,11] It was implemented stepwise in almost 1,000 nursing homes in Bavaria and was financially supported by a Bavarian statutory health insurance [Allgemeine Ortskrankenkasse Bayern (AOK)] for the initial period of 3 years after implementation.[1,8,10] The components of BF2P2 were related to the staff (education), to the residents (progressive strength and balance training, medication, hip protectors), and suggested environmental adaptations as well as fall documentation and feedback on fall statistics. The intervention was restricted to nursing homes with more than 35 residents and it was planned to reach more than 80% of all nursing homes in Bavaria. Although it was financially supported by a single insurance company, BF2P2 was targeted at all residents of the participating nursing homes, independent from their insurance. The details of BF2P2 have been reported elsewhere.[8]

The stepwise implementation of BF2P2 proceeded in 4 time-lagged waves, starting on April 1, 2007 (wave 1), April 1, 2008 (wave 2), April 1, 2009 (wave 3), and April 1, 2010 (wave 4), respectively. Participation in one of the 4 waves was voluntarily decided by the nursing home's management. By signing a contract the nursing homes committed themselves to conduct BF2P2 for the initial 3 years of financial support and were recommended to continue afterward.

Data Source

The AOK is the fourth largest statutory health insurance company in Germany and covers nearly 50% of residents living in nursing homes in Bavaria. The AOK supported BF2P2 by participating in the implementation process and provided health insurance claims data of all insured nursing home residents aged 65 years or older for the period beginning January 1, 2004, through December 31, 2013. The year 2004 was only used as a washout period to identify prior fractures; the years 2005 through 2013 were used for analysis. Data included information on residents' sex, date of birth, date of admission to the nursing home, information on the care level (for more details, see below), and if applicable, femoral fractures, date of discharge from the nursing home, and date of death. Moreover, information on nursing homes' number of beds and ownership was available.

Data Preparation

Based on all AOK-insured residents, we excluded residents aged less than 65 years, who did not live in a participating nursing home, who moved between nursing homes, or who had lived outside the nursing home for more than 31 days in a row. Furthermore, we excluded nursing homes that had fewer than five observations in any quarterly period or that stopped participation in BF2P2.

Health insurance claims data were rearranged in order to create an unbalanced panel data set with observations per resident and quarterly period as long as the resident lived in the nursing home. After that, we trimmed the data set. In order to ensure comparability of all 4 waves, we allowed each wave to have the same number of quarterly periods before and after implementation of BF2P2, that is, 9 quarters before and 15 quarters (3.75 years) after starting BF2P2, respectively.

Dependent Variable

The binary variable *femoral fracture* was used as outcome variable. It was created based on data on inpatient hospital stays due to a fracture of the femur (discharge diagnosis coded as S72 in the 10th revision of the International Classification of Diseases, German Modification[12]) in the corresponding quarterly period. In order to distinguish between a prior fracture and a new fracture, we defined a compulsory period of 30 days free of hospital stay. Data on femoral fractures treated in outpatient settings could not be accessed and, therefore, were not included in the analyses. However, they should be extremely rare.

Independent Variables

As a consequence of trimming the data, we defined the count variable *time* (which can take on any values between 1 and 24) to measure time as quarterly periods relatively to the start of BF2P2. Therefore, BF2P2 starts at *time* = 10 for every wave. In order to