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Individual housing-based socioeconomic status predicts risk of accidental falls among adults

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ABSTRACT

Purpose: Accidental falls are a major public health concern among people of all ages. Little is known about whether an individual-level housing-based socioeconomic status measure is associated with the risk of accidental falls.

Methods: Among 12,286 Mayo Clinic Biobank participants residing in Olmsted County, Minnesota, subjects who experienced accidental falls between the biobank enrollment and September 2014 were identified using ICD-9 codes evaluated at emergency departments. HOUSES (HOUsing-based Index of SocioEconomic Status), a socioeconomic status measure based on individual housing features, was also calculated. Cox regression models were utilized to assess the association of the HOUSES (in quartiles) with accidental fall risk.

Results: Seven hundred eleven (5.8%) participants had at least one emergency room visit due to an accidental fall during the study period. Subjects with higher HOUSES were less likely to experience falls in a dose-response manner (hazard ratio: 0.58; 95% confidence interval: 0.44–0.76 for comparing the highest to the lowest quartile). In addition, the HOUSES was positively associated with better health behaviors, social support, and functional status.

Conclusions: The HOUSES is inversely associated with accidental fall risk requiring emergency care in a dose-response manner. The HOUSES may capture falls-related risk factors through housing features and socioeconomic status-related psychosocial factors.

Introduction

Accidental falls are a leading cause of unintentional injury in older people. Every year accidental falls occur in nearly one-third of those over the age of 65 years, and in 50% of the adults over the age of 80 [1–4]. In the United States, more than 2.6 million elderly people suffer a fall annually that requires medical attention, resulting in over $19 billion in medical costs [1,5]. Although about 30%–50% of falls result in minor injuries, falls are the most common cause of traumatic brain injury, and 90% of all hip fractures are caused by a fall [4]. Some older adults who have experienced a fall may restrict their daily activities due to the fear of additional falls, which reduces physical activity and increases social isolation and depression [4]. This may lead to the loss of independence for these older adults and increase the risk of further falls.

Falls among adults are a result of a complex interplay of multiple risk factors that directly or indirectly affect health [4,6,7]. Biological characteristics (e.g., age and sex) interact with modifiable physical (e.g., comorbidity, decline of physical and cognitive capacities, intake of multiple medications, and excess alcohol use) and environmental (e.g., home hazards and hazardous features in public environment) factors to increase the risk and severity of fall-related injuries [7]. Socioeconomic (e.g., low education), housing (e.g., poor building design), and/or neighborhood characteristics (e.g., poor lighting in public places) have been reported to be associated with higher risk of falls among older adults [4,6,7]. However, the

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complexity underlying the risk of falls makes it difficult to develop a simple, yet practical, measure or tool predicting the risk of falls.

HOUSES (HOUsing-based SocioEconomic Status) is an individual-level socioeconomic status (SES) measure derived from linking an individual's address information with publicly available real property data from the Assessor's Office [8]. The validity and utility of the HOUSES in predicting various acute/chronic conditions have been established [8–17]. In addition, the HOUSES is also associated with several fall-related risk factors such as age [13] and housing/community features reflected through housing price (i.e., houses with poor conditions and/or located in poor neighborhoods tend to have lower housing prices and thus lower HOUSES). The HOUSES may also reflect an individual's physical status changes as individuals with declined functional status may move to smaller houses. However, little is known about whether the HOUSES is associated with the risk of accidental falls. We assessed the association between the HOUSES and the risk of accidental falls among adults in the community who participated in the Mayo Clinic Biobank (MCB) representing a relatively homogeneous older population.

Methods

Study subjects

The MCB originated in April 2009, and as of December 2013, over 35,000 Mayo Clinic adult patients were recruited into the MCB [18,19]. Participants provided broad consent that allowed the use of biological specimens, health-related questionnaire data, and electronic medical records (EMRs). A prior study showed that the association magnitude between the medical burden and health outcomes for the MCB participants was similar to the general patient population receiving primary care at Mayo Clinic [20]. For this analysis, we analyzed data on 12,286 MCB participants (7698 females [62.7%]) who resided in Olmsted County, MN at the time of the enrollment. We restricted the study to this geographic region as the main variable of interest, the HOUSES, is available only in Olmsted County. The MCB program was approved by the Mayo Clinic Institutional Review Board, and this study was reviewed and approved by the Mayo Clinic Biobank Access Committee.

Ascertainment for falls-related injuries

For ascertaining subjects with accidental falls, we searched the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes for fall-related injuries treated at emergency department (ED) listed as the primary reason for the visit (ICD-9-CM codes: E880–E888) from their EMR data between the time of enrollment and September 2014. To explore a potential false-positive rate by using ICD-9-CM codes, we randomly selected 10 subjects having the codes for falls and reviewed their EMR (by PYT). The occurrence of a fall was confirmed clinically through medical record review (PYT) for these 10 subjects. While medical care for fall-related injuries can be provided outside the ED, we adopted the current surveillance of fall-related injuries in the literature which is primarily based on the E-codes.[7,21] In this study, we mainly focused on falls serious enough to warrant a concern about major injury or fracture, mostly resulting in ED visits.

HOUSES

Based on address information provided by the MCB participants at enrollment, the HOUSES was formulated. A detailed description of the methodology for developing and validating the HOUSES was previously reported in Juhn et al [8]. Briefly, each individual's address information was linked to the public real property data to collect seven housing-related characteristics (assessed housing value, square footage of the unit, number of bedrooms, and number of bathrooms, ownership of the unit, residential status [whether a unit is in a residential zone], and lot size of the unit in acres). In addition, six neighborhood characteristics were collected from census-tract level data, including percent of people speaking English as a second language, percent of foreign-born people, percent of households headed by a female, percent of households that are nonfamily households, percent of people with less than a high school education, and percent of families with income below the poverty level [8,14]. The first factor in the principal component factor analysis, accounting for the largest proportion of total variance, included four housing-related characteristics (assessed housing value, square footage of the unit, number of bedrooms, and number of bathrooms). Each of these four characteristics was transformed into a z-score and then summed to create the HOUSES for each subject. Higher HOUSES indicates higher SES.

Socio-demographic and clinical characteristics

Socio-demographic characteristics

Demographic characteristics (age at enrollment [<30 years, 30–64, and 65 or older] and sex) were collected from EMR. Two socioeconomic/racial characteristics (race [White vs. non-White] and education level [high school or less, some college, and 4-year degree or higher]) were collected from questionnaire data completed by the participants at the MCB enrollment.

Clinical and health-related characteristics

Body mass index (BMI, kg/m^2) were collected from EMR and were grouped into four categories (underweight [<18.5], normal [18.5–24.9], overweight [25–29.9], and obese [≥ 30]). For each subject, Minnesota (MN) tiers, a medical risk stratification used in the clinical practice, was also calculated at the month of the MCB enrollment [20]. Each subject was categorized into five groups: tier 0 (no chronic conditions), tier 1 (1-3), tier 2 (4-6), tier 3 (7-9), and tier 4 (10+). In this study, we used MN tiers as a measure for the total disease burden. Perceived general health was obtained by a single question from the questionnaire, "In general, would you say your health is excellent, very good, good, fair or poor?", and grouped into two categories (poor/fair vs. good/very good/excellent) [22]. Binge drinking status (as defined as having six or more alcoholic drinks on one occasion) and smoking status (never, former, and current smoker) were collected from the self-administered questionnaire completed at the enrollment. In addition, the level of moderate physical activity (number of days per week, doing nonexhaustive exercise [e.g., fast walking, easy swimming, and easy bicycling] for more than 15 minutes) was collected from the questionnaire. Furthermore, any difficulties of self-care tasks (e.g., preparing meals, dressing, and climbing stairs) were obtained from a questionnaire administered at the time of clinic visits for usual medical care. If multiple records before the MCB enrollment exist in the EMR, the records closest to the enrollment date were used as a measure for functional status.

Social support

The participants also completed a series of questions related to social support [18]. In this study, three questions were utilized: two related to degree of isolation ("How much of the time is there someone available to you whom you can count on to listen to you when you need to talk?" and "How much of the time can you count on anyone to provide you with emotional support?") and one question for tangible support ("How much of the time is there someone available to help with daily chores?"). Each question was