Case-Control Study of Exposure to Medication and the Risk of Injurious Falls Requiring Hospitalization among Nursing Home Residents

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The association between injurious falls requiring hospitalization and selected classes of medications was examined in a case-control study of nursing home residents. Information for this study was obtained exclusively from four computerized administrative databases. Over the period from April 1987 to March 1992, a total of 1,560 first injurious falls occurred to 14,744 residents of Manitoba, Canada, nursing homes who were eligible for inclusion in the study. An injurious fall was defined as an injury consequent to a fall that resulted in admission to the hospital for treatment. Medication use was ascertained from prescription information contained in computerized dispensing records from community pharmacies. Three series of single controls were pair-matched to each case, implementing increasing stringent matching on age, sex, level of dependency, duration of residence, and the presence of up to five chronic disorders. Estimates of relative odds obtained from the most stringently matched case-control series identified two medication classes in which a prescription dispensed in the previous 30 days was associated with an elevated risk of injurious fall: antipsychotic agents (odds ratio = 1.31, 95 percent confidence interval 1.06–1.61) and anxiolytics/sedatives/hypnotics (odds ratio = 1.35, 95 percent confidence interval 1.09–1.68). An unexpected protective effect was associated with the use of inotropic agents (odds ratio = 0.69, 95 percent confidence interval 0.54–0.89). These results support the hypothesis that psychotropic medications are an independent risk factor for injurious falls in nursing home settings. \textit{Am J Epidemiol} 1997;145:738-45.

accidental falls; nursing homes

The multifactorial etiology of falls in the elderly has been well documented. Considerable attention has been focused on the role of medications in contributing to this risk (1–16), in part because medication exposure may represent an important modifiable factor in fall prevention strategies. Mechanisms suspected of elevating the risk of falling among the elderly that are associated with medication use include age-related declines in liver metabolic capacity and reduced renal function, which may contribute to extending the duration of drug action (12), psychomotor impairment produced by sedative action of psychotropic medications, medication effects that increase the prevalence of orthostatic hypotension (3, 13), medication effects that induce ambulation, as in the case of diuretics, and the occurrence of multiple effects associated with the high prevalence of polydrug treatment regimes in the elderly (17).

There continue to be inconsistencies in the literature estimating the risk of falling associated with specific classes of medications. These inconsistencies can be attributed to a number of factors. The accumulated research is unsystematic, describing a range of different elderly populations, fall outcomes, and time periods and frequently relying on sampling strategies that may not recruit representative or sufficiently large samples. There are substantial challenges in reliably measuring medication exposure (18). Finally, there are important potential threats of inferential error in a body of research largely dependent on observational designs and natural experiments.

Confounding by indication is a primary threat to valid inference in research examining the relation between medication use and the risk of falling (19). The objective of this study was to estimate the magnitude of association between medication use and the risk of an injurious fall in a study design that focused on maximizing external validity and controlling for the

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Abbreviations: CD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification; CI, confidence interval; MHSIP, Manitoba Health Services Insurance Plan; OR, odds ratio.

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potential confounding of underlying medical conditions.

**MATERIALS AND METHODS**

**Study design and study setting**

This study reports a matched-pair case-control analysis of the association of medication use and injurious falls in a complete population of nursing home residents in the province of Manitoba, Canada, over the 5-year period from April 1987 to March 1992. A complementary paper has described trends in medication use in this population (C. A. Mustard et al., submitted for publication). Over this period, prescribing practices in the nursing home system in the province of Manitoba were influenced by the dissemination of explicit guidelines, and physician prescribing patterns were systematically monitored. In addition, a province-wide nursing home drug formulary restricted the use of medications that were judged to have poor efficacy or that were contraindicated in elderly populations (20).

**Population and study period**

During the study period, a total of 17,839 persons were resident in the 120 nursing homes in the province. Excluded from the population eligible for inclusion in this study were 2,840 persons who resided in nursing homes for which prescription medications were not dispensed by community pharmacies. An additional 255 persons resident in a nursing home for less than 15 days during the study period were also excluded. After these exclusions, 14,744 persons remained eligible for inclusion in the study.

**Sources of data**

Information for this study was obtained exclusively from four computerized administrative databases maintained by Manitoba Health Services Insurance Plan (MHSIP, formerly the Manitoba Health Services Commission). These databases contain common personal identifiers that permit records to be combined to create composite histories of health care utilization.

**Personal Care Home abstracts.** The Personal Care Home file contains a record of demographic and health status information for each nursing home resident, including date of admission to the facility, age, sex, assessment of the required level of nursing care, date of discharge, and up to three diagnoses coded according to the *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* and recorded on admission to the nursing home.

**Personal Care Home drug prescription file.** Since April 1985, a computerized registry has recorded prescription type and dose, prescription quantity, cost, and date on an resident-specific basis for nursing home residents. Records in this file are generated from the transaction of claims for reimbursement from dispensing community pharmacies. Residents of nursing homes in the province receive all required medications without deductible charges or copayment fees.

**Hospital separation abstracts.** Separation abstracts are completed for each hospital admission and contain information on patient age, sex, and unique personal identifiers; admission and separation dates; and up to 16 fields for recording ICD-9-CM diagnostic codes.

**Physician claim files.** All physician claims for reimbursement of medical care in Manitoba are submitted to the single payer agency, MHSIP. All but a minority of services are provided by physicians who bill MHSIP on a fee-for-service basis, submitting a claim for each care encounter. As a requirement for reimbursement, all service claims must be accompanied by a single diagnosis of the patient condition that was most responsible for the encounter. This diagnostic information is recorded in the ICD-9-CM classification system to the level of the third digit.

**Measures**

**Case definition of an injurious fall.** In this study, an injurious fall was defined as an injury suffered as the result of a fall that resulted in admission to the hospital for treatment. All hospital separations with an admission date between April 1, 1987 and March 31, 1992 were retrieved for eligible nursing home residents and reviewed for the presence of codes identifying an accidental fall as the external cause of injury (ICD-9-CM codes E880-E889) or for an injury in the ICD-9-CM code range E800-E924. Of all admissions recording an eligible external cause of injury code, 2.8 percent did not have an accompanying injury diagnosis and were excluded. A total of 1,896 hospital admissions with an accidental fall noted as the external cause of injury were identified in the 5-year observation period after the exclusion of hospital admissions occurring prior to an individual's admission to a nursing home or hospital admissions for the treatment of an injury associated with a fall occurring in a nursing home within 45 days after a previous hospital discharge (10). Of these admissions for treatment of an injurious fall, 88.5 percent were associated with the treatment of a fracture, and the remaining 11.5 percent were associated with the treatment of a soft tissue injury only, without mention of fracture.

The case definition for this study was restricted to the first injurious fall occurring to a resident who had multiple injurious falls in the observation period. Of
the 1,896 hospital admissions associated with the treatment of an injurious fall, 336 (17.7 percent) were determined to be subsequent to a previous first admission for treatment of an injurious fall and were excluded, resulting in 1,560 cases eligible for analysis. Injuries not requiring hospitalization, including fractures ascertained in physician claim files \((n = 1,168)\), were excluded because the cause, type, and date of injury could not be reliably verified from these records.

Dependency status. All institutions licensed to provide nursing care in the provincial system are reimbursed by a per diem rate that reflects residents’ need for nursing care. Four levels of nursing care are established, reflecting the resident’s degree of dependency on nursing staff time for activities of daily living and basic nursing care to maintain functioning. The highest dependency level, level 4, generally indicates nonambulatory status. The assessment of dependency level is performed by multidisciplinary assessment panels, and standard criteria are applied across the system. Level of care requirements for each resident are assessed annually. Accordingly, for cases and matched controls, dependency status information was obtained within 1 year prior to the date the case fell.

Prevalence of chronic disorders. For each case and matched control, the presence or absence of 12 chronic disorders was identified from diagnostic information reported on annual nursing home abstracts or on hospital separation abstracts. These chronic conditions, investigated as risk factors for falls in previous studies of the elderly (1–2, 7–9, 21–23), were Parkinson’s disease (ICD-9-CM code 332), osteoarthritis (ICD-9-CM codes 715–716), dementia or cognitive impairment (ICD-9-CM codes 290 and 331), depression or psychosis (ICD-9-CM codes 295–299 and 311), neurotic disorder (ICD-9-CM codes 300–309), osteoporosis (ICD-9-CM code 733), cerebrovascular disease (ICD-9-CM codes 430–438), hypertension (ICD-9-CM codes 401–405), cardiovascular disease (ICD-9-CM codes 410–414 and 420–429), diabetes (ICD-9-CM code 250), cancer (ICD-9-CM codes 140–239), and gait or balance disturbance (ICD-9-CM codes 333–334, 342, 359, 365–366, 369, 458, 721, and 781). In multivariate analysis of the complete cohort, six of these disorders were found to be associated with the risk of injurious falls: Parkinson’s disease, dementia or cognitive impairment, depression or psychosis, osteoporosis, cerebrovascular disease, and cardiovascular disease. Five of these conditions were retained as case-control matching characteristics, with disease status obtained from diagnostic information reported on hospital separation and nursing home abstracts in the 12-month period prior to April of each year. As a low-prevalence condition, Parkinson’s disease was not used for matching.

Measurement of exposure to medication. Comprehensive prescription records for each resident were obtained from the Personal Care Home drug prescription file and grouped into medication classes on the basis of the American Hospital Formulary Service system (24). A set of 12 categories of medications, examined in previous studies of the risk of falls in the elderly, were selected for investigation (1, 3–7) (appendix table 1). Drug use was measured for each case and control in the 12-month period prior to the date the case fell. Each subject’s prescription history for each medication category was determined in four time periods prior to the index date: 0–30, 31–90, 91–180, and 181–365 days.

Matching of cases and controls. Controls were drawn from the population of 14,744 nursing home residents. Three series of single-matched case-control pairs were assembled. In the first series, a single control was matched to each case on sex, year of residence, and age (within 5 years). In the second series, matching variables from the first series were supplemented by measures of the level of dependency and the duration of residence in the nursing home. In the final series, controls and cases were matched on all of the above characteristics with the addition of the presence of up to five chronic disorders: dementia/cognitive impairment, depression or psychosis, osteoporosis, cerebrovascular disease, and cardiovascular disease. Common residence in the same nursing home was not a matching characteristic.

A number of objectives influenced the decision to use a matched-pair design (25). In this population with multiple disorders (C. A. Mustard et al., submitted for publication), attempts to control for the effects of underlying disorder on the risk of falls through analytic methods may not be as effective as an approach based on a matched-pair design. In addition, matching facilitated the selection of controls with maximum time comparability with cases (26) and was an efficient approach given the access to a complete population in the secondary administrative data.

An individual resident hospitalized for treatment of an injurious fall was eligible to be a control from the beginning of the study observation period or from the date of admission to the nursing home until the date of the hospital admission for treatment of the fall. A resident who experienced an injurious fall was excluded from eligibility as a control from the date of the fall through to the end of the observation period.

Matching of controls to cases was performed in two stages. In the first stage, controls who were identical to cases on all matching characteristics were identified.
In the second stage, probabilistic linkage methods were used to resolve the matches for cases who did not identically match a control in the first phase. When more than one control was available to be selected as a case match, a random-number method was used to select a single control.

For cases who experienced an injurious fall within 180 days of admission to the nursing home, eligible controls were required to agree on month of admission. Of the 196 cases in this group, 45 controls (22.9 percent) in the third series were matched by deterministic methods. Among the 1,290 cases who experienced an injurious fall more than 180 days after admission to the nursing home, a control was eligible for selection if admission to the nursing home had occurred within 365 days of the case admission date. Under this more relaxed agreement criteria, 991 controls (76.8 percent) were selected by deterministic methods.

After the completion of the matching of cases and controls, two additional exclusion criteria were applied. A total of seven case-control pairs were excluded from the analysis because the control had been resident in the nursing home for less than 15 days prior to the date the case fell. A further 67 case-control pairs were excluded because the control had been discharged from the hospital 45 days or less prior to the date the case fell.

**Analysis.** Estimates of the relative odds of an injurious fall were obtained from multivariate logistic regression models (27–29) that simultaneously included terms for case and control concordance on all 12 medication exposure measures. Medication exposure was classified hierarchically as a prescription in a 30-day period prior to the date the case fell or any prescription in the period 31–365 days prior to the fall date. The two exposure variables were fit simultaneously in regression models. To test for evidence of confounding by underlying disorder (19), three regression models were performed, implementing the three series of matched case-control.

Based on the assumption of a 10 percent exposure prevalence among controls, a significance level of 0.05, and a power of 0.80, the study was estimated to require a sample size of 1,200 matched pairs to detect an exposure odds ratio of 1.5 (30). All analyses were performed using SAS software (31). Critical values for significance tests were two-sided.

**RESULTS**

The concordance of cases and controls on matching characteristics is reported in table 1. In this table, we describe the agreement of cases and controls in the third matching series, which was based on the most extensive set of characteristics (age, year of residence, sex, duration of residence from admission to index event, level of dependency, and the presence of up to five chronic disorders). Controls agreed closely with cases on all characteristics with the exception of the set of chronic disorders. On this characteristic, cases generally had a higher prevalence of disorder.

Relative to the population of all nursing home residents, those who experienced an injurious fall were older, more likely to be female, and less likely to be maximally dependent on nursing care (table 1). Cases had a higher prevalence of dementia, depression, osteoporosis, and cardiovascular disease than did the population from which they were drawn.

During the 5 years of observation, the rate of injurious falls resulting in a hospital admission in the complete population of nursing home residents was 55.5 per 1,000 person-years. No time trend was detected (C. A. Mustard et al., submitted for publication). Fully 25.3 percent of first injurious falls requiring hospitalization occurred within 365 days of admission to the nursing home. The majority of injuries involved hip fracture (65.7 percent), followed by fracture of the skull, neck, trunk, or limbs (22.1 percent). Soft tissue injuries without mention of a fracture were associated with 11.4 percent of admissions.

Odds ratios of an injurious fall associated with medication use in the 30-day period prior to the index event are reported in table 2. This table also reports the prescribing prevalence in each medication class for cases in the 30-day period prior to the injurious fall. Results are reported for the three matching series, from the least stringent matching criteria (series 1) to the most stringent criteria, which includes the matching on underlying disorder (series 3). Four classes of medications had a significant association with the risk of an injurious fall in at least one case-control series when analyzed in a multivariate logistic model: inotropic agents, antipsychotic agents, anxiolytics/sedatives/hypnotics, and narcotic/opioid analgesics. The magnitude of the increased risk of an injurious fall associated with antipsychotic agents, anxiolytics/sedatives/hypnotics, and narcotic/opioid analgesics was generally similar, ranging from relative odds of 1.59 for anxiolytics/sedatives/hypnotics in series 1 (95 percent confidence interval 1.27–1.98) to 1.18 for narcotic/opioid analgesics in series 3 (95 percent CI 0.96–1.45). The class of inotropic agents, which was dominated by prescriptions for digoxin indicated for cardiac arrhythmias, demonstrated a consistent protective effect.

In all four classes of agents associated with the risk of falling, the confidence interval obtained from the risk estimate in series 1 enclosed the risk estimates obtained from the subsequent two match series. There
was no consistent risk estimate trend toward the null as matching criteria became more stringent, suggesting that confounding by indication is not a substantial threat to inference concerning medication use and the risk of injurious falls in this setting.

When analyses were stratified by dependency level, we observed no stable patterns that departed from the overall results reported in table 2.

To substantiate evidence for a potential causal role of medication use in the etiology of injurious falls, we conducted additional analyses that tested for an association between hospitalization for injurious falls and medication use in the period 31-365 days prior to the hospital admission. These analyses excluded cases who received a prescription in the 30 days prior to hospitalization. No association with injurious falls was found for prior prescribed medication use in the classes of inotropic agents, anxiolytics/sedatives/hypnotics, and narcotic/opioid analgesics, nor in any of the medication classes that were not associated with the risk of injurious falls in the 1- to 30-day exposure period. However, exposure to medication in the class of antipsychotic agents 31-365 days prior to hospitalization was associated with injurious falls (case-control series 1 odds ratio (OR) = 1.63, \( p < 0.001 \); series 2 OR = 1.49, \( p < 0.01 \); series 3 OR = 1.36, \( p < 0.001 \)) (data not shown).

**DISCUSSION**

The results of this study can be compared with findings from eight other investigations of the association of specific medication classes with the risk of falls in nursing home settings (table 3). Across this group of studies, there are important differences in sample size (and therefore study power), case definition of fall, exclusion criteria, measurement of medication exposure, and control for the potential confounding of underlying medical conditions that limit the validity of comparisons. In this study, the odds ratio for an injurious fall associated with an antidepressant prescription in the previous 30 days was 0.92.
TABLE 2. Odds ratios of injurious fall associated with medication use in the previous 30 days, by medication class, Manitoba nursing home residents, Manitoba, Canada, 1987–1992

<table>
<thead>
<tr>
<th>Medication class</th>
<th>Medication prevalence (% of cases)</th>
<th>Series 1—Controls matched on age and sex (n = 1,488 matched pairs)</th>
<th>Series 2—Controls matched on age, sex, dependency level, and duration of residence (n = 1,488 matched pairs)</th>
<th>Series 3—Controls matched on age, sex, dependency level, and duration of residence, and underlying disorder (n = 1,488 matched pairs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inotropic agents</td>
<td>8.2</td>
<td>0.76* 0.60–0.97</td>
<td>0.73** 0.57–0.94</td>
<td>0.69** 0.54–0.89</td>
</tr>
<tr>
<td>Calcium channel blocking agents</td>
<td>3.6</td>
<td>1.00 0.85–1.52</td>
<td>1.01 0.67–1.52</td>
<td>1.02 0.68–1.51</td>
</tr>
<tr>
<td>Beta blocking agents</td>
<td>2.6</td>
<td>1.03 0.64–1.67</td>
<td>0.97 0.62–1.52</td>
<td>1.04 0.64–1.63</td>
</tr>
<tr>
<td>Antihypertensive agents</td>
<td>5.6</td>
<td>1.01 0.73–1.38</td>
<td>1.05 0.76–1.45</td>
<td>0.91 0.68–1.26</td>
</tr>
<tr>
<td>Vasodilating agents</td>
<td>6.3</td>
<td>1.08 0.79–1.48</td>
<td>1.02 0.75–1.38</td>
<td>0.86 0.64–1.17</td>
</tr>
<tr>
<td>Other cardiovascular agents</td>
<td>0.7</td>
<td>0.89 0.57–2.04</td>
<td>1.12 0.47–2.67</td>
<td>0.64 0.29–1.40</td>
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<tr>
<td>Nonsteroidal antiinflammatory agents</td>
<td>17.5</td>
<td>1.17 0.97–1.41</td>
<td>0.95 0.79–1.15</td>
<td>1.11 0.92–1.33</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>13.3</td>
<td>1.18 0.95–1.46</td>
<td>0.83 0.76–1.14</td>
<td>0.92 0.75–1.12</td>
</tr>
<tr>
<td>Antipsychotic agents</td>
<td>15.6</td>
<td>1.32** 1.08–1.62</td>
<td>1.51*** 1.23–1.85</td>
<td>1.31** 1.06–1.61</td>
</tr>
<tr>
<td>Anxiolytics/sedatives/hypnotics</td>
<td>14.5</td>
<td>1.59*** 1.27–1.98</td>
<td>1.28* 1.03–1.58</td>
<td>1.35** 1.09–1.68</td>
</tr>
<tr>
<td>Diuretics</td>
<td>20.2</td>
<td>0.97 0.82–1.16</td>
<td>1.05 0.89–1.29</td>
<td>0.97 0.82–1.15</td>
</tr>
<tr>
<td>Narcotic/opiod analgesic</td>
<td>16.7</td>
<td>1.34** 1.08–1.64</td>
<td>1.39** 1.13–1.70</td>
<td>1.18 0.96–1.45</td>
</tr>
</tbody>
</table>

* p < 0.05; ** p < 0.01; *** p < 0.001.
† OR, odds ratio; CI, confidence interval.

(95 percent CI 0.75–1.12) (table 2, series 3). Three of the six studies that examined this class of medications reported odds ratios significantly greater than 1.0, ranging from 1.8 to 2.9 (table 3). In the class of anxiolytics/sedatives/hypnotics, three of eight studies reported significant odds ratios, ranging from 1.4 to 2.6, consistent with the estimate of 1.35 (95 percent CI 1.09–1.68) reported in this study. Finally, in the class of antipsychotic agents, significant odds ratios ranging from 1.8 to 4.4 were reported from three of six studies. The risk estimate in this study was 1.31 (95 percent CI 1.06–1.61). When the eight studies are reviewed, there does not appear to be a pattern of risk estimates adjusted toward the null in those studies that controlled for health status. This is consistent with the finding of limited evidence of confounding by indication observed across the three case-control series described in this study. To our knowledge, the potential protective effect associated with inotropic agents observed in this study has not been reported previously.

The low-magnitude risk estimates observed in this study population raise concerns that many previous studies in nursing home settings may have been underpowered. Given the high prescribing prevalence in nursing home settings, researchers should be attentive to designing studies that minimize the risk of type II errors for risk estimates in the range of 1.3–1.7.

This study has made exclusive use of secondary data derived from routine administrative sources. As demonstrated by a number of important studies that have relied upon similar data sources (3–4, 10), these secondary sources of data have a number of strengths. First, by permitting the enumeration of injurious falls over an extended period of observation within an entire nursing home system, the study minimizes the threats to external validity of observational studies restricted to a single institution or a limited period of time. Second, by permitting access to a complete population, comprehensive administrative data sources provide opportunities to select controls that are either representative of a sample population or closely comparable with cases (32). In this study, we have emphasized the objective of maximizing the comparability of cases and controls. Controls were drawn from the sample population matched to cases on known potential confounding characteristics, and the method of measuring injurious falls and medication exposure was equivalent in cases and controls (33).

Conversely, there are potential limitations of these secondary data, primarily associated with the validity of measurement in three domains: the measurement of medication exposure, the ascertainment of injurious falls, and the measurement of chronic conditions. First, measurement of medication exposure in this study was based on the proxy indicator of a dispensed prescription. While this approach has been used by other studies (3–4, 10), these data do not measure the actual administration of medication. Given the frequent use of "provide as needed" instructions in the administration of psychoactive medications, there is the potential for misclassification of drug exposure in this study. We would argue that the effect of this misclassification would be to bias odds ratio estimates toward the null and therefore suggest that the findings reported in this study represent conservative estimates of the magnitude of risk associated with the use of these agents.
The estimated incidence rate of injurious falls resulting in a fracture admitted to hospital for treatment in this study was 55.5/1,000 person-years. As previously noted, an additional 1,168 fracture injuries occurring in the complete cohort (34.2/1,000 person-years) that were ascertained exclusively in physician claim files were excluded from the case definition. These injuries, for which cases were not admitted to the hospital for treatment, were excluded because the cause, nature, and date of injury could not be reliably established from physician service records. Given the methods of this study, the group of controls may include some of these excluded fracture injuries, with the potential result of a misclassification bias that would dilute the estimated odds ratios.

Estimates of the prevalence of chronic disorders among Canadians resident in long-term care facilities are available from the 1994 National Population Health Survey (34). This survey has estimated the prevalence of Alzheimer’s disease and dementia (30 of 100 residents), stroke (26 of 100 residents), and heart disease (22 of 100 residents). Comparable estimates in this study derived from secondary administrative data were: Alzheimer’s disease and dementia (29.5 of 100 residents), stroke (30.3 of 100 residents), and cardiovascular disease (49.1 of 100 residents).

In addition to the potential for misclassification on exposure status, the results reported in this study may also be conservatively biased by the decision to include residents with a range of ambulatory deficits in this study. Although we did not detect important differences in risk estimates when analyses were stratified by dependency level, additional research is warranted on the joint relation of medication use and functional impairments on the risk of falling (2, 35). Injurious falls represent a minority of all falls in elderly populations. While some research has examined the concordance of risk factors for injurious and noninjurious falls (1, 2), it remains uncertain if the results observed in this study can be generalized to all falls in this setting. Nevertheless, on the basis of the prevalence of prescribing of two classes of psychoactive agents, anxiolytic/sedative/hypnotic agents, and antipsychotic agents in the cohort from which the case-control series was drawn for this study, we estimate the pooled attributable risk of injurious falls associated with these pharmaceutical agents to be in the range of 20 percent. This is a significant potentially preventable component of injuries from falls in this setting associated with medications primarily indicated for the management of behavior rather than for medical conditions. Nonpharmaceutical approaches to behavioral management in nursing home settings may

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Analysis</th>
<th>No.</th>
<th>OR</th>
<th>95% CI</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ray et al. (10)</td>
<td>B</td>
<td>B</td>
<td>1.40</td>
<td>1.34</td>
<td>1.05</td>
<td>0.95</td>
</tr>
<tr>
<td>Sobel and Maccart (6)</td>
<td>B</td>
<td>B</td>
<td>1.60</td>
<td>1.60</td>
<td>1.05</td>
<td>0.95</td>
</tr>
<tr>
<td>Ray et al. (3)</td>
<td>B</td>
<td>B</td>
<td>2.60</td>
<td>2.60</td>
<td>1.05</td>
<td>0.95</td>
</tr>
<tr>
<td>Gareau et al. (1)</td>
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<td>A</td>
<td>2.50</td>
<td>2.50</td>
<td>1.05</td>
<td>0.95</td>
</tr>
<tr>
<td>Myers et al. (12)</td>
<td>A</td>
<td>A</td>
<td>1.48</td>
<td>1.48</td>
<td>1.05</td>
<td>0.95</td>
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<tr>
<td>Runniner and Upitz (16)</td>
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<td>A</td>
<td>1.20</td>
<td>1.20</td>
<td>1.05</td>
<td>0.95</td>
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<tr>
<td>Yip and Cumming (14)</td>
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<td>A</td>
<td>1.00</td>
<td>1.00</td>
<td>1.05</td>
<td>0.95</td>
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<tr>
<td>Thapa et al. (9)</td>
<td>A</td>
<td>A</td>
<td>1.08</td>
<td>1.08</td>
<td>1.05</td>
<td>0.95</td>
</tr>
</tbody>
</table>

* All reported p-values are for two-tailed tests (critical value = 0.05) unless noted. Entries for p-values or 95% confidence intervals (CI) are blank when statistics were not reported.
contribute to a reduction in the incidence of injurious falls.

ACKNOWLEDGMENTS

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REFERENCES


APPENDIX TABLE 1. AHFS* category codes for medication classes

<table>
<thead>
<tr>
<th>Medication Class</th>
<th>AHFS* Category codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inotropic agents</td>
<td>240404</td>
</tr>
<tr>
<td>Calcium channel blocking agents</td>
<td>240408</td>
</tr>
<tr>
<td>Beta blocking agents</td>
<td>240412</td>
</tr>
<tr>
<td>Antihypertensive agents</td>
<td>240800</td>
</tr>
<tr>
<td>Vasodilating agents</td>
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<td>Other cardiovascular agents</td>
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<td>Narcotic opioid</td>
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<td>Nonsteroidal antiinflammatory agents</td>
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<td>Antidepressants</td>
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<td>Antipsychotic agents</td>
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<td>Anticonvulsants</td>
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<td>Diuretics</td>
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* AHFS, American Hospital Formulary Service.