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# Monitoring Falls in Cohort Studies of Community-Dwelling Older People: Effect of the Recall Interval

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**OBJECTIVES:** To determine whether the interval over which patients are asked to remember their falls affects fall reporting.

**DESIGN:** Systematic literature review.

**SETTING:** Community.

**PARTICIPANTS:** Individuals being monitored for falls in prospective studies that asked participants to recall falls over varying intervals.

**MEASUREMENTS:** Sensitivity and specificity of retrospective recall compared with a criterion-standard prospective assessment using some form of ongoing fall monitoring.

**RESULTS:** Six studies met the inclusion criteria. Recall of falls in the previous year was specific (specificity 91–95%) but less sensitive (sensitivity 80–89%) than the criterion standard of ongoing prospective collection of fall data using fall calendars or postcards. Patients with injurious falls were more likely to recall their falls. Lower Mini-Mental State Examination score was associated with poorer recall of falls in the one study addressing this issue.

**CONCLUSION:** Whenever accurate data on all falls are critical, such as with interventions to decrease the rate of falls, researchers should gather information on falls every week or every month from study participants. The optimal method of fall monitoring—postcard, calendar, diary, telephone, or some combination of these—remains unknown. *J Am Geriatr Soc* 53:2190–2194, 2005.

**Key words:** mental recall; falls; systematic review; bias; reproducibility of results

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Falls are a common problem in older adults, with about 30% to 60% of community-dwelling older adults falling every year.<sup>1</sup> Most falls do not result in injury, but 5% to 10% of falls result in serious injuries such as a head injury, serious laceration, or fracture.<sup>1</sup> Evidence from randomized trials suggests that multicomponent interventions to prevent falls are effective, reducing fall rates by approximately 12 falls per 100 patients per month.<sup>2</sup> Because falls in older adults are common, and their underlying causes are often treatable, a wide body of research attempts to identify risk factors that can be mitigated through effective fall-prevention programs.<sup>3</sup> Of the large number of studies that provide data on fall risk factors, prospective study designs are most likely to provide valid data,<sup>4</sup> but the literature contains a variety of prospective designs that monitor for falls at varying intervals and use different reporting schemes (e.g., postcards, diaries, and telephone calls).

Studies that gather data from patients at less-frequent intervals may misclassify the outcome—falls—particularly in an older population with a higher likelihood of memory impairment.<sup>5</sup> Some patient factors that have been linked with falls, including cognitive impairment or use of sedative-hypnotic medications,<sup>6</sup> may cause changes in recall, leading some individuals to be less likely to recall falling; other individuals may falsely recall a fall when none occurred. This could lead, respectively, to an underestimate or overestimate of fall risk. Studies without effective fall-monitoring strategies may therefore provide inaccurate information on the risk of falls.

A systematic review of prospective studies of community-dwelling older people was performed to determine whether the length of the recall interval or differing methods of data collection affect the accuracy of fall reporting. The studies that were found examined different recall intervals but not differing data collection methods, so the recall interval is focused on here.

## METHODS

A systematic review of the literature was undertaken for studies that documented the effect of differing data collection methods and frequencies on patient self-report of falls.

The following searchable question was asked: “In studies of falls in community-dwelling older people, to what extent does the data collection method, or the interval over which a patient is asked to recall a fall, affect reporting of falls during follow-up?” For a study to be included in the analysis, it had to include a comparison of at least two different data collection methods (e.g., postcards and telephone monitoring) or two different reporting intervals (e.g., weekly postcards to monitor falls vs asking patients about falls in the previous year), and the study could not be exclusively in an institutionalized population.

To perform the search, the MEDLINE database with the OVID search engine, covering the period 1966 to Week 3 of January 2005, was used. The search strategy included the keyword “recall,” along with subject headings “mental recall,” “bias,” “reproducibility of results,” and “data collection/mt” (mt = methods). The results of this search were then delimited to articles pertaining to falls (as captured by the keyword “falls” and the subject heading “accidental falls”). The search was delimited to include only articles on adult human subjects. The search was not limited by language. A copy of the search strategy is available on request.

The search resulted in 174 articles, which one of the authors (DAG) reviewed. Six articles met the inclusion criteria,<sup>7–12</sup> all of which addressed differing frequencies of data collection. There were no articles that explicitly compared different data collection methods. This author then reviewed the four English-language articles, and another author (TH) reviewed the two Japanese-language articles. The bibliographies of these six articles were searched, but no additional studies were found. Given the heterogeneity of recruitment sources, study designs, and study participants, a qualitative rather than quantitative synthesis of the data is presented.

In this review, “sensitivity” is defined as the number of individuals who recalled falling at least once during a given time interval divided by the number of individuals who actually fell at least once during that same time interval as measured using a criterion standard intensive prospective monitoring strategy. “Specificity” is defined as the number of individuals who recall not falling in a given time interval divided by the number of individuals who actually did not fall during that same time interval according to the criterion standard monitoring strategy.

## RESULTS

Descriptions of study design are summarized in Table 1. One study included 325 individuals over 12 months, all of whom had fallen in the year before study enrollment; 304 individuals had full data for analysis.<sup>10</sup> The sample was 84% female; 37% were aged 60 to 69, 43% were aged 70 to 79, and 20% were aged 80 and older. Eight percent of the sample had Mini-Mental State Examination (MMSE) scores less than 24. Prospective follow-up occurred via weekly postcards; individuals who did not return postcards received a phone call. At the end of 12 months, study participants were contacted by phone and asked whether they had fallen in the most recent 3, 6, or 12 months. A fall was defined as falling “all the way to the floor or the ground, or falling and hitting an object like a chair or stair.” The in-

cidence of one or more falls over the 12-month study period was 59%.

The sensitivity and specificity of recall for at least one fall in the previous 12 months were 87% and 93%, respectively, using prospective follow-up via weekly postcards as the criterion standard. The sensitivity and specificity of recall for at least one fall over the most recent 6 months were 74% and 94%, respectively, whereas sensitivity and specificity of recall over the most recent 3 months were 68% and 94%, respectively. Lower MMSE scores predicted inability to recall a fall in the previous 12 months (sensitivity was 74% for MMSE <24, 82% for MMSE 24–26, and 91% for MMSE ≥27;  $P < .01$  for association between MMSE score and failure to recall a fall).

Study strengths included recruitment from a wide variety of locations with minimal loss to follow-up and MMSE scores available for all participants, allowing examination of the relationship between cognitive impairment and recall. Limitations included lack of detailed demographic information and inclusion of only those with a history of falls in the 12 months previous to study enrollment.

Another study compared two separate cohorts from similar populations.<sup>7</sup> Data on falls were available for both cohorts but were collected using different methods. In one group of 235 individuals (234 available for analysis), individuals kept a falls diary and were asked weekly whether they had fallen. In the other group, 193 individuals were asked quarterly whether they had fallen in the previous 3 months. Demographics of the study participants were not listed. The follow-up for the falls diary cohort was 12 months; for that study, a fall was defined as “an unintentional event where the older person came to be on the floor without the feet weight-bearing.”<sup>13</sup> The follow-up for the quarterly monitoring cohort was 18 months; the definition of a fall for that study was “unintended loss of control over one’s position such that the feet no longer were weight-bearing” (Sibylle Reinsch, PhD, personal communication). Kaplan-Meier estimates of falling at 12 months were 36% for the falls diary cohort and 21% for the quarterly monitoring cohort.

This study tested the hypothesis that the time to first fall should be the same in both groups, because the samples were drawn from similar populations. Using an exponential distribution, they found that the group surveyed quarterly about falls had 57% the rate of reported falls of the group that kept a falls diary and was surveyed weekly. This result was statistically significant. The authors also examined time to first fall by severity of fall and found that the more severe the fall, the more likely it was to be recalled quarterly when compared with the weekly reporting/falls diary approach as a criterion standard. This study was limited by comparing fall reporting intervals between (rather than within) samples, such that the observed differences could be due to factors that varied between the samples other than the fall-reporting interval.

A third study followed 120 older patients from a family practice for 12 months.<sup>9</sup> Patients’ mean age was 75 years; the sample was 80% female and 94% white, and 18% resided in retirement communities (none in skilled nursing beds). Of the 120 patients, 100 had full data available for analysis. The criterion standard was fall assessment using

Table 1. Details of Study Design

Study	Recruitment Site(s)	Inclusion Criteria	Criterion Standard	Proxy Measure
Cummings 1988 <sup>10</sup>	Senior citizens' centers, senior residences, churches, university-affiliated outpatient clinics	Aged 60 and older, history of at least one fall in the prior 12 months, ambulatory, English speaking <sup>†</sup>	Weekly postcard mailed in by patient; telephone calls if postcard not returned; home visit to obtain details of fall within 3 weeks of fall	Telephone interview asking patients whether they had fallen in the previous 12 months
Lachenbruch 1991 <sup>7</sup>	Sixteen senior centers	Not listed	Subjects asked weekly whether they had fallen; monthly diary on falls	Questionnaire in 3-month intervals (different cohort than criterion standard cohort)
Hale 1993 <sup>9</sup>	Five-physician private family practice	Aged 65 and older, ambulatory, mentally competent, not acutely ill	Weekly postcard to be returned by patient; telephone call if postcard not returned or if falls reported	Final postcard asking about falls in the previous 3, 6, or 12 months
Haga 1996 <sup>8</sup>	Registered residents of a rural village aged 65 and older*	No cognitive dysfunction	Four in-person interviews at 3-month intervals	Final interview asking about falls in previous year
Peel 2000 <sup>11</sup>	National seniors association	Not listed	Calendar to record fall events daily, to be returned monthly; telephone interview for any incident on calendar; telephone reminder for calendars not received within 2 weeks after end of month	Final questionnaire asking about falls in previous 12 months
Fujimoto 2000 <sup>12</sup>	Three community centers in a rural town in Japan	Willing to participate in "physical fitness measurement program," no self-report of cognitive impairment (unless family proxy available), data available for all measurements	Monthly postcard asking whether patient had fallen in previous month	Postcard asking about falls at 3- or 12-month intervals (two additional cohorts separate from criterion standard cohort)

\* All Japanese citizens register with the Japanese government, so the sample is population-based.

<sup>†</sup> Patients unable to answer interview questions because of dementia were excluded.

weekly postcards mailed in by study participants. A research associate called individuals who did not turn in a postcard. At the end of 12 months, individuals received a final postcard that asked them to recall how many times they had fallen in the previous 3, 6, and 12 months. A fall was defined as "inadvertently coming to rest on the floor or another lower surface but was not due to syncope, seizure, stroke, or an overwhelming displacing force." Fall incidence over the 12-month follow-up period was 37%.

The sensitivity and specificity of 12-month recall for at least one fall were 89% and 95%, respectively, compared with prospective monitoring with weekly postcards. The sensitivity of recall for at least one fall in the most recent 3 or 6 months was 31% and 44%, respectively. Of those who suffered an injurious fall, the sensitivity of 12-month recall

was 100%, compared with 78% for those who did not suffer an injurious fall. Lack of information on the relationship between cognitive function and ability to recall falls limits interpretation of this study.

A fourth study followed all residents aged 65 and older in a small rural village in Japan for 1 year.<sup>8</sup> Of the 1,399 residents of the village, 1,321 participated at baseline, of whom 1,206 (91%) completed all interviews. Only 799 individuals (66% of those with complete data) were included in the analysis; the remaining 407 were excluded because of cognitive impairment and the lack of an available proxy respondent. The analyzed sample was 66% female; 36% of the sample was aged 65 to 69, 46% were aged 70 to 79, and 18% were aged 80 and older. Ninety-eight percent of patients had no difficulty performing their regular activities at

home. During the study period, investigators conducted four in-person interviews at 3-month intervals and asked the participants (or a family proxy) whether they had fallen since the previous interview. At the fourth and final interview, the study team asked participants whether they had fallen during the previous 12 months. A fall was defined as "touching the ground or some lower level unintentionally with the hand, elbow, or buttock, including falling down from a ladder, stool or bicycle." Fall incidence over the 12-month follow-up period was 19%.

The agreement between the 12-month and 3-month recall methods was excellent (kappa statistic = 0.96). The sensitivity and specificity of the 12-month method compared with the 3-month method were 97% and 99%, respectively. Of those with no fall injuries, minor injuries, and major injuries, the sensitivity of the 12-month method compared with the 3-month method was 98%, 97%, and 94%, respectively.

Although this study suggests the feasibility of 12-month recall compared with 3-month recall, the data cannot address whether 3-month recall itself is comparable to more-intensive monitoring methods. In addition, the previous quarterly interviews may have helped participants to recall their fall status at 12 months, potentially overestimating the effectiveness of 12-month recall. The exclusion of individuals with cognitive impairment and the inclusion of individuals likely to be at low fall risk limit the generalizability of this study, because a vast majority of patients had no difficulty in performing their daily activities at home.

A fifth study was a prospective study of 252 individuals given a falls calendar to mark any falls occurring over 12 months.<sup>11</sup> The sample was 79% female; mean age was 69 (range 51–87). A total of 243 individuals had full data available for analysis. Study participants had to return their fall calendars monthly; if subjects did not return their calendars within 2 weeks of their due date, they received a telephone reminder call. At the end of the 12-month study period, participants were asked via questionnaire to recall whether they had fallen in the previous 12 months. A fall was defined as "occurring through loss of balance causing the person to hit the ground or other object at lower level." Fall incidence over the 12 months was 52%.

Using the falls calendar as the criterion standard, the sensitivity and specificity of the 12-month recall of falls were 80% and 91%, respectively. Individuals with injurious falls were statistically significantly more likely to recall their falls than those without injurious falls (sensitivity of 87% and 62%, respectively). The use of a specific sample (members of the National Seniors Association) and the study's lack of detailed demographic information regarding the participants' limit interpretation of the study's results.

A sixth study prospectively followed 350 older rural individuals in Japan who participated in a physical fitness measurement program.<sup>12</sup> They divided the sample into three groups (116, 116, and 118 participants, of whom 101, 104, and 114 had data for analysis, respectively). The investigators matched these groups so that the distribution of age, sex, history of falls in the previous year, hospitalization during the previous year, and ability to walk 1 kilometer was similar across groups. The analyzed sample was 58% female, mean age was 71, 20% fell in the year before study inception, and 8% had difficulty walking 1 kilometer. Each

of the three groups was asked by mail about falls at a different interval (every month for the first group, every 3 months for the second group, and at 12 months for the third group). Nonrespondents were contacted by telephone. A fall was defined as "touching the ground or floor unintentionally with a body part other than the soles of the feet." Fall incidence over the 1-year follow-up period was 19%.

The proportion of men who reported falling at least once in the 12-month study period was 21% for the 1-month group, 16% for the 3-month group, and 6% for the 12-month group ( $P = .09$  using chi-square test with Yates correction). The fall report rates of the female sample were 26%, 18%, and 21%, respectively. If the true underlying fall rates for the three groups were the same, as assumed in the study, there was a trend that men were less likely to report falls when asked about falls over longer intervals. This study was limited because participants were relatively healthy and cognitively intact, because they enrolled themselves in the physical fitness measurement program.

## DISCUSSION

This literature review suggests several findings with respect to falls. First, recall of any fall in the previous year is relatively specific (91–95%) but somewhat less sensitive (80–89%) than intensive prospective data collection involving postcards or diaries in the three studies for which data were available.<sup>9–11</sup> The results for sensitivity may be an overestimate of the true value, because as one study suggested,<sup>5</sup> the data were generated from individuals who were undergoing intensive surveillance for falls.

Second, data were mixed regarding individuals' ability to recall falls over various time intervals once the recall interval extends beyond 1 month. Individuals had more difficulty remembering a fall in the previous 3 or 6 months than in the previous 12 months in two studies,<sup>9,10</sup> 3-month recall appeared equivalent to 12-month recall in a third study,<sup>8</sup> and there was a trend toward higher rates of recall over shorter (1-month vs 3-month, 3-month vs 12-month) intervals in men in a fourth study.<sup>12</sup> These conflicting data reflect differences in study design. The two studies that found lower recall of falls over 3 or 6 months than over 12 months based their data only on recall questions at the end of the 1-year study period, looking backward 3, 6, or 12 months.<sup>9,10</sup> In these cases, study enrollment 12 months prior marked the beginning of an intensive monitoring period that would stand out distinctly in participants' minds, because they had to return weekly postcards, whereas there was nothing distinctive to mark the arrival of the half-way (or three-quarters way) time point in these studies that would help individuals to remember whether a fall occurred after these time points.<sup>10</sup> In contrast, the studies that found better or similar recall over shorter intervals did not engage their participants in as intensive a monitoring scheme,<sup>8,12</sup> and they examined recall intervals monthly or quarterly throughout the study period, not just at the end of the study, mitigating bias that the well-defined marker of study enrollment might have generated in the other studies.

Third, individuals with poorer cognitive function were less likely to recall falling in the previous 12 months in the one study that assessed this relationship.<sup>10</sup> Studies relying on 12-month recall to ascertain falls may therefore

underestimate the true relationship between poor cognition and falls.

This review has several important limitations. First, there were only a small number of studies available for review, and these had marked heterogeneity of study populations, criterion standard assessment strategies, and fall definitions. Second, the first study was also limited by including only individuals who recalled a history of falls in the 12 months before study inception, which at baseline may have enriched the sample with individuals who recalled falls that did not occur, while excluding people who fell but did not recall falling.<sup>10</sup>

This review is also limited by what it could not cover. First, because no studies performing a head-to-head comparison of different assessment strategies (e.g., telephone, postcard, or diary) for a given monitoring interval were found, no conclusion could be reached about the optimal fall-monitoring method. Researchers who study falls would benefit from work addressing this issue. Second, several important topics, including the validity of proxy reports of falls and fall-related injuries, the best way to ascertain multiple falls over time, and the validity of self-reported fall injury versus medical record review, were not covered.

What are the important messages for researchers seeking the best method for prospectively monitoring falls? The available data are too limited to reach firm conclusions, but a few tentative conclusions seem warranted. First, the sensitivity of 12-month fall recall is not high enough to recommend it as a substitute for weekly or monthly monitoring, particularly in populations in which false negatives (people who fell but do not recall falling) are a concern. Second, the specificity of 12-month recall compared with intensive prospective monitoring was quite high. This implies that there will be few false positives (individuals who recall falling in the previous 12 months but did not actually fall) when investigators use a history of falls in the previous 12 months to select a cohort of older people at high risk for falling for enrollment in a study. Third, 12-month recall deteriorates with poorer cognitive function, leading to potential biases in studies that enroll individuals with poor cognition and rely on 12-month recall. Advancing the methodological quality of fall research will require more information on the advantages and disadvantages of different reporting intervals and reporting methods.

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