Emergency Department Visits Without Hospitalization Are Associated With Functional Decline in Older Persons

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Study objective: Among older persons, disability and functional decline are associated with increased mortality, institutionalization, and costs. The aim of the study was to determine whether illnesses and injuries leading to an emergency department (ED) visit but not hospitalization are associated with functional decline among community-living older persons.

Methods: From a cohort of 754 community-living older persons who have been followed with monthly interviews for up to 14 years, we matched 813 ED visits without hospitalization (ED only) to 813 observations without an ED visit or hospitalization (control). We compared the course of disability during the following 6 months between the 2 matched groups. To establish a frame of reference, we also compared the ED-only group with an unmatched group who were hospitalized after an ED visit (ED-hospitalized). Disability scores (range 0 [lowest] to 13 [highest]) were compared using generalized linear models adjusted for relevant covariates. Admission to a nursing home and mortality were evaluated as secondary outcomes.

Results: The ED-only and control groups were well matched. For both groups, the mean age was 84 years, and 69% were women. The baseline disability scores were 3.4 and 3.6 in the ED-only and control groups, respectively. During the 6-month follow-up period, the ED-only group had significantly higher disability scores than the control group, with an adjusted risk ratio of 1.14 (95% confidence interval [CI] 1.09 to 1.19). Compared with participants in the ED-only group, those who were hospitalized after an ED visit had disability scores that were significantly higher (risk ratio 1.17; 95% CI 1.12 to 1.22). Both nursing home admissions (hazard ratio 3.11; 95% CI 2.05 to 4.72) and mortality (hazard ratio 1.93; 95% CI 1.07 to 3.49) were higher in the ED-only group versus control group during the 6-month follow-up period.

Conclusion: Although not as debilitating as an acute hospitalization, illnesses and injuries leading to an ED visit without hospitalization were associated with a clinically meaningful decline in functional status during the following 6 months, suggesting that the period after an ED visit represents a vulnerable time for community-living older persons. [Ann Emerg Med. 2016;■:1-8.]

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INTRODUCTION

Background and Importance

Patients aged 65 years or older account for more than 15% of all emergency department (ED) visits each year in the United States,[1] and most of these patients are discharged home.[2] Among older persons, disability and functional decline are associated with increased mortality, institutionalization, and costs.[3-5] The estimated additional cost of medical and long-term care for newly disabled older persons in the United States is $26 billion per year.[6]

Previous work has shown that illnesses and injuries leading to hospitalization are associated with functional decline.[4,7-9] Prior studies have also suggested that older patients discharged from the ED may experience some functional decline, but these studies were limited by the absence of suitable comparison groups and by retrospective reports of preillness function.[10-16]

Goals of This Investigation

The objective of this study was to evaluate the burden of disability during a 6-month period in older persons who were discharged from the ED (ED only) by comparing them with a matched control group (control) and with a group that was admitted to the ED and hospitalized (ED-hospitalized). We hypothesized that older persons who visited the ED and were discharged would experience a

Editor's Capsule Summary

What is already known on this topic

Functional decline occurs in some older adults who are discharged home after an emergency department (ED) evaluation.

What question this study addressed

Do disability, nursing home use, and mortality differ for older patients evaluated in and discharged from an ED compared with that for matched control patients who did not make an ED visit?

What this study adds to our knowledge

Among community-dwelling adults aged 70 years and older, ED visits without hospitalization (n=813) were associated with greater disability, higher nursing home use, and increased morality during the following 6 months compared with periods without ED visits for otherwise similar individuals.

How this is relevant to clinical practice

Older adults who are evaluated in the ED but are not hospitalized are at risk for adverse health outcomes; interventions to improve ED and post-ED care for these patients may be warranted.

greater burden of disability during the following 6 months compared with those who did not visit the ED, but a lower burden of disability compared with those who were hospitalized. Admission to a nursing home and mortality were evaluated as secondary outcomes.

MATERIALS AND METHODS

Study Design and Setting

This study is part of the Yale Precipitating Events Project, an ongoing prospective, longitudinal study of 754 initially nondisabled, community-living persons aged 70 years or older. The Precipitating Events Project was designed to elucidate the epidemiology of disability, with the goal of informing the development of effective interventions to maintain and restore independent function. Methods of this longitudinal study have been described in detail elsewhere.[8,17,18] Briefly, the cohort was assembled between March 1998 and October 1999 from a computerized list of 3,157 age-eligible members of a large health plan in greater New Haven. Eligibility was determined during a screening telephone interview and was confirmed during an in-home assessment. Of the eligible members, 75.2% agreed to participate in the project, and persons who declined to participate did not significantly differ in age or sex from those who were enrolled. The Yale Human Investigation Committee approved the study protocol, and all participants provided informed consent.

Data Collection and Processing

From 1998 to 2012, participants completed comprehensive, home-based assessments at 18-month intervals and were interviewed monthly by telephone to reassess their functional status, ascertain intervening illnesses and injuries leading to ED visits and hospitalizations, and identify nursing home admissions and deaths. For participants with significant cognitive impairment, a proxy informant was interviewed, using a rigorous protocol with demonstrated reliability and validity, as described elsewhere.[19] During the comprehensive assessments, data were collected on demographic characteristics, chronic conditions, body mass index, cognitive impairment, depressive symptoms, and physical frailty.

Age was measured in years at the time of the index ED visit. Nine self-reported, physician-diagnosed chronic conditions were assessed: hypertension, myocardial infarction, congestive heart failure, stroke, diabetes, fractures, arthritis, chronic lung disease, and cancer (excluding minor skin cancers). Cognitive impairment was defined as a score less than 24 on the Folstein Mini-Mental State Examination.[20] Depressive symptoms were defined as a score greater than or equal to 20 on the Center for Epidemiological Studies–Depression scale.[21] Body mass index was assessed as self-reported weight in kilograms divided by height in meters squared.[22] Physical frailty was defined on the basis of slow gait speed, as previously described.[23]

Complete details about the assessment of disability are provided elsewhere.[17-19,24] Briefly, during the monthly interviews, participants were asked, "At the present time, do you need help from another person to [complete the task]?" for each of the 4 basic activities (bathing, dressing, walking across a room, and transferring from a chair), 5 instrumental activities (shopping, housework, meal preparation, receiving medications, and managing finances), and 3 mobility activities (walk one quarter mile [0.40 km], climb a flight of stairs, and lift and carry 10 pounds [4.5 kg]). For each of these 12 activities, disability was defined as the need for personal assistance or being unable to perform the activity. Participants were also asked about a fourth mobility activity, "Have you driven a car during the past month?" Participants who responded no were deemed to have stopped driving. To maintain consistency with the other activities, these participants were classified as being "disabled" in driving that month.[24] The number of disabilities overall and for each functional domain (basic, instrumental, and mobility) was summed.

The primary source of information on ED visits and hospitalizations was linked Medicare claims data, which were available for nearly all hospitalizations and for ED visits among fee-for-service participants.[25] Of the ED-only observations and ED-hospitalized observations, 605 (74.4%) and 619 (98.1%) were identified from the Medicare claims, respectively. For participants in managed Medicare, information on ED visits and some hospitalizations (ie, those without a Medicare claim) was obtained during the monthly interviews. Participants were asked whether they had visited an ED or stayed at least overnight in a hospital since the last interview. Among a subgroup of 191 participants, we found that the accuracy of self-reported ED visits, compared with Medicare claims data, was high (κ=0.80; 95% confidence interval [CI] 0.78 to 0.82). The raw agreement was 98.4%. The accuracy of self-reported hospitalization, based on an independent review of hospital records, was also high (κ=0.92; 95% CI 0.90 to 0.95). The raw agreement was 98.8%.[26]

Participants who reported visiting the ED were asked the primary reason for their visit. These self-reports were complemented by Medicare claims data when needed. The list of the visit reasons was independently reviewed by 2 physicians (J.M.N. and W.F.), and the reasons were grouped into distinct diagnostic categories with a revised version of a previously published protocol,[27] as shown in Table 1.

Participants or their proxies were also asked whether they had been admitted to a nursing home during the past month. The accuracy of these reports was high when compared with Medicare claims data, with a sensitivity of 96% and specificity of 100%.[8] Deaths were ascertained by review of the local obituaries or from a proxy during a subsequent telephone interview, with a completion rate of 100%.

Table 1. Reasons for ED visits.*

Diagnostic Categories	ED Only, No. (%)	ED-Hospitalized, No. (%)
Musculoskeletal	253 (31.4)	80 (12.7)
Cardiac	86 (10.7)	115 (18.3)
Gastrointestinal	75 (9.3)	74 (11.7)
Infectious	73 (9.1)	78 (12.4)
Difficulty ambulating	48 (6.0)	42 (6.7)
Pulmonary	31 (3.9)	56 (8.9)
Neurologic	30 (3.7)	49 (7.8)
Head and neck	28 (3.5)	3 (0.4)
Renal/genitourinary	20 (2.5)	14 (2.0)
Dermatologic	18 (2.2)	3 (0.5)
Toxic/environmental	6 (0.7)	0
Psychiatric	6 (0.7)	6 (1.0)
Other medical†	131 (16.3)	109 (17.3)

*The diagnostic categories are listed by decreasing frequency for the ED-only group. The ED-only group included 805 reasons for visits because 8 observations did not have a reason. The ED-hospitalized group included 630 reasons because 1 observation did not have a reason.

†Other medical problems included unclassifiable complaints such as feeling "weak," "tired," or generally unwell, with no other specifying features.

To test our hypotheses, we used a matched cohort design. This design reduces bias with little loss of precision and permits the use of generalized estimating equations, which accounts for the correlation of observations within each cluster of matched observations.[28-30] We compared the course of disability during 6 months among 3 groups: those who had an ED visit but were not hospitalized (ED only), a matched group who did not visit an ED (control), and an unmatched group who were hospitalized after an ED visit (ED-hospitalized). The pool of potential observations was not sufficiently large to permit concurrent matching for the ED-hospitalized group in addition to the control group.

Participants were included only if they had been living in the community immediately before their ED visit (or corresponding point for the control group). To make full use of our longitudinal data, participants were allowed to contribute more than one qualifying ED-only or ED-hospitalized event, but only the first event was included from a specific 18-month interval, which was the period between the comprehensive assessments. This combination of a participant and his or her event within an 18-month interval defined an "observation" and was our unit of analysis. Similarly, only one control observation per participant was permitted within a specific 18-month interval.

To assemble the control group, we used a SAS (version 9.4; SAS Institute, Inc., Cary, NC) macro[31] to sequentially match each ED-only observation with an unexposed, or control, observation on the following 4 features: sex, participant age (±4 years) at the ED visit, number of disabilities (±1) out of the 13 possible in the month before the ED visit, and number of months since the previous comprehensive assessment. The analytic sample included 813 observations (from 430 participants) in the ED-only group, 813 observations (from 442 participants) in the control group, and 631 observations (from 390 participants) in the ED-hospitalized group. One hundred twenty-one participants had observations in both the ED-only and control groups, 97 in both the ED-only and ED-hospitalized groups, and 139 in all 3 groups.

Outcome Measures

The primary outcome was the number of disabilities in the 13 basic, instrumental, and mobility activities during the 6 months after the ED visit, hospitalization, or corresponding time point for the control group. Hereafter, we refer to this time point as the index month. To determine whether our findings were consistent across these 3 functional domains, we also evaluated the number of disabilities in the 4 basic, 5 instrumental, and 4 mobility activities. Although there is some debate about whether these activities should be considered on an ordinal or interval scale,[32] we have chosen to analyze them on an interval scale as in a previous study.[8] We chose the 6-month period because it has previously been used to evaluate disability after hospitalization.[33] As secondary outcomes, we evaluated nursing home admissions and deaths during the 6-month period after the index month.

Primary Data Analysis

The reasons for the ED visits were tabulated. Demographic and clinical characteristics were summarized by means with SDs and frequencies with proportions for the ED-only group, the matched control group, and the unmatched ED-hospitalized group.

Because each outcome represents a count, we fit Poisson generalized estimating equation models to evaluate associations between the 2 primary comparison groups (ED only and control) and disability scores during the 6 months of follow-up. The generalized estimating equation Poisson models were adjusted for the 4 matching criteria, race, education, living situation (alone versus with others), number of chronic conditions, body mass index, cognitive impairment (Mini-Mental State Examination score <24), depressive symptoms (Center for Epidemiological Studies–Depression scale score ≥ 20), physical frailty, and calendar year. In accordance with previous recommendations,[34] the model adjusts for matching variables to address residual confounding and censoring. A compound symmetry covariance structure accounted for correlations among multiple intervals from the same participant and matching between the ED-only and control groups. These models yielded adjusted relative risks, which denote the increase in disability burden during the 6-month follow-up period for the ED-only group relative to the control group. These analyses were repeated for comparisons between the ED-only and unmatched ED-hospitalized groups. All models were checked for fit with the quasi-information criterion.

For the secondary outcomes, we plotted the percentage of observations with a nursing home stay and the percentage of reported deaths in the 6 months after the index month. We then used multivariable Cox regression models to assess the independent associations between exposure to ED only (versus matched control) and ED-hospitalized (versus ED only) and time to nursing home admissions and death, respectively, while adjusting for the previously described set of covariates. The correlation among multiple intervals from the same participant for the nursing home outcome was accounted for as a cluster, whereas matching between the ED-only and control groups was accounted for using a conditional model.

All analyses were performed with SAS (version 9.4), and $P<.05$ (2-tailed) was used to indicate statistical significance.

RESULTS

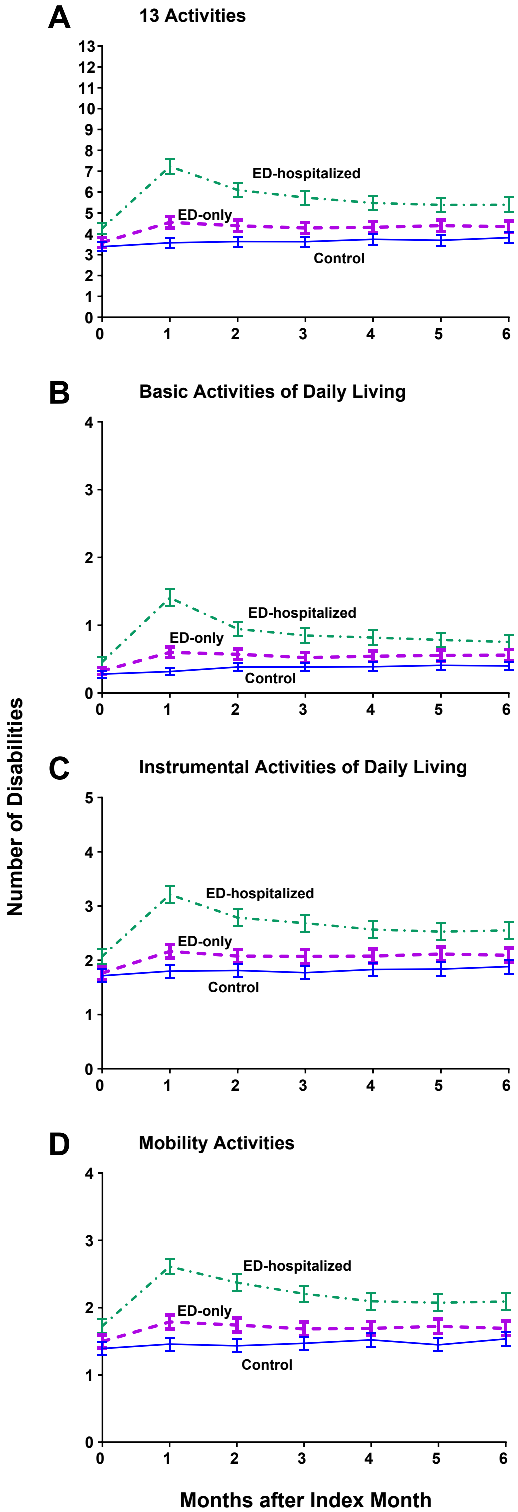
Table 1 provides the reason for ED visits for the ED-only and the ED-hospitalized groups. The most common reasons for an ED visit in both groups were musculoskeletal complaints, cardiac complaints, and "other" medical problems, such as feeling weak, tired, or unwell.

Table 2 provides the characteristics of the 3 groups. As expected, the ED-only and control groups were well matched on age, sex, number of disabilities, and number of months since the previous comprehensive assessment. The mean age in both groups was 84 years, and 68.9% were

Table 2. Characteristics of the analytic sample.*

Characteristics	Control, N=813	ED Only, N=813	ED-Hospitalized, N=631
Age, mean (SD), y	83.6 (5.6)	83.6 (5.7)	84.4 (5.6)
Female sex, No. (%)	560 (68.9)	560 (68.9)	399 (63.2)
Nonwhite, No. (%)	97 (11.9)	85 (10.5)	76 (12.0)
Did not complete high school, No. (%)	278 (34.2)	249 (30.6)	229 (36.3)
Lives alone, No. (%)	326 (40.1)	372 (45.8)	292 (46.3)
Months since previous comprehensive assessment, mean (SD)	7.7 (5.3)	7.7 (5.3)	7.4 (5.1)
No. of disabilities, mean (SD)	3.6 (3.4)	3.4 (3.3)	4.3 (3.5)
No. of chronic conditions, mean (SD)†	2.3 (1.3)	2.1 (1.2)	2.4 (1.3)
Cognitive impairment, No. (%)‡	132 (16.2)	159 (19.6)	152 (24.1)
Depressive symptoms, No. (%)§	164 (20.2)	149 (18.3)	128 (20.3)
Body mass index, mean (SD)‖	26.5 (5.1)	26.3 (5.7)	26.2 (5.1)
Frailty, No. (%)¶	429 (52.8)	415 (51.1)	404 (64.0)

*The analytic sample included 813 observations (from 442 participants) in the control group, 813 (from 430 participants) in the ED-only group, and 631 (from 390 participants) in the ED-hospitalized group.
†Includes hypertension, myocardial infarction, congestive heart failure, stroke, diabetes, fractures, arthritis, chronic lung disease, and cancer (excluding minor skin cancers).
‡Defined as score less than 24 on the Folstein Mini-Mental State Examination.
§Defined as score greater than or equal to 20 on the Center for Epidemiological Studies–Depression Scale.
‖Body mass index: weight (kg)/height (m^2).
¶Defined on the basis of slow gait speed, as described in the methods.



	Number At Risk						
Control	813	813	808	804	791	783	776
ED-only	813	806	796	789	778	774	763
ED-hosp	631	606	586	571	558	548	540

Figure 1. Course of disability by study group. Month 0 represents the interview immediately preceding the ED visit and corresponding time for the matched control (as described in the methods). The bars denote 95% CIs.

women. The baseline disability scores were 3.4 and 3.6 in the ED-only and control groups, respectively.

Figure 1*A* shows the disability scores in all 13 activities during the 6-month follow-up period. Throughout the follow-up period, the ED-only group had disability scores that were higher than those of the control group but lower than those of the ED-hospitalized group. In the longitudinal model, the ED-only group had significantly higher overall disability scores than the control group, with an adjusted risk ratio of 1.14 (95% CI 1.09 to 1.19). Compared with participants in the ED-only group, those who were hospitalized after an ED visit had disability scores that were significantly higher, with an adjusted risk ratio of 1.17 (95% CI 1.12 to 1.22). Comparable results were observed for each of the 3 functional domains (basic, instrumental, and mobility activities), as shown in Figure 1*B* to *D* and Table 3.

Figure 2*A* provides descriptive results on the percentage of participants living in a nursing home during the 6-month follow-up period according to study group. Nursing home use was highest in the ED-hospital group, intermediate in the ED-only group, and lowest in the control group. In the multivariable analysis, nursing home stays were more likely in the ED-only group than the control group (hazard ratio 3.11; 95% CI 2.05 to 4.72) and in the ED-hospitalized group than the ED-only group (hazard ratio 3.57; 95% CI 2.83 to 4.50). Figure 2*B* provides descriptive results on the percentage of participants dying during the 6-month follow-up period according to study group. On average, mortality was highest in the ED-hospitalized group, intermediate in the ED-only group, and lowest in the control group. In the multivariable analysis, the likelihood of dying was greater in the ED-only group compared with the control group (hazard ratio 1.93; 95% CI 1.07 to 3.49) and in the ED-hospitalized group compared with the ED-only group (hazard ratio 3.11; 95% CI 2.05 to 4.72).

LIMITATIONS

Our study has important limitations. First, because it was observational, the associations identified cannot be interpreted as causal. However, the frequency of our assessments increases the likelihood that the intervening illnesses and injuries leading to an ED visit were temporally related to the worsening course of disability, an important criterion for causality. Second, to make full use of our longitudinal data, we analyzed observations, rather than participants. Rigorous methods were used to match the ED-only and control group intervals and to reduce bias and colinearity among observations. The multiple entries for a single participant could be construed as posing a violation

Table 3. Adjusted risk ratio of disability burden during the 6-month follow-up period for pairwise comparisons.*

	ED Only vs Control		ED-Hospitalized vs ED Only	
Disability Burden	**RR**	**95% CI**	**RR**	**95% CI**
Composite 13 items	1.14	1.09–1.19	1.17	1.12–1.22
4 ADL†	1.37	1.22–1.55	1.37	1.25–1.50
5 IAD‡	1.11	1.05–1.17	1.14	1.09–1.20
4 Mobility§	1.10	1.05–1.16	1.12	1.08–1.17

RR, Relative risk; *ADL*, activities of daily living; *IAD*, instrumental activities of daily living.
*Values denote the relative increase in disability burden during the 6-month follow-up period for the 2 comparison groups. For each of these 13 activities, disability was defined as the need for personal assistance or unable to do. The number of disabilities overall and for each group of activities (basic, instrumental, and mobility) was summed.
†ADLs included bathing, dressing, walking across a room, and transferring from a chair.
‡IADLs included shopping, housework, meal preparation, receiving medications, and managing finances.
§Mobility activities included walking 0.40 km, climbing 1 flight of stairs, lifting and carrying 4.5 kg, and driving a car in the past month.

of the independence assumption, but rigorous statistical methods were used to account for within-participant correlations. Finally, our cohort was limited to members of a single health plan in a small urban area and may not be generalizable to other areas. The demographics of our cohort, however, were similar to those of the United States as a whole, with the exception of race, and the generalizability of our results is enhanced by the high participation rate, which was greater than 75%.

DISCUSSION

In this matched cohort study of community-living older persons, we found that participants who presented to the ED and were discharged had a worse functional course and higher nursing home use and mortality during a 6-month period than participants who did not present to the ED, but they had better outcomes than those who presented to the ED and were hospitalized. These results were observed for all 3 functional domains and persisted despite adjustment for multiple potential confounders. Collectively, our findings provide strong evidence that illnesses and injuries leading to an ED visit without hospitalization have serious adverse consequences among community-living older persons.

Much of the previous work on functional outcomes after an acute illness or injury has focused on the course of disability after hospitalization, but less is known about the functional consequences of an illness or injury leading to an ED visit without hospitalization. Our findings are consistent with those of previous studies showing that older persons who present to an ED with traumatic injuries experience a short-term decline in function of 7% to 42%.[10-12,14] Instead of focusing on a single presenting problem, our study included ED visits for a large number of reasons, the most common being musculoskeletal, which represented almost one third of the ED-only visits. Although beyond the scope of the current study, determining whether the course of disability after an ED visit differs according to the presenting problem should be the focus of future research.

Our findings are also consistent with previous studies that found that 20% to 25% of older ED patients

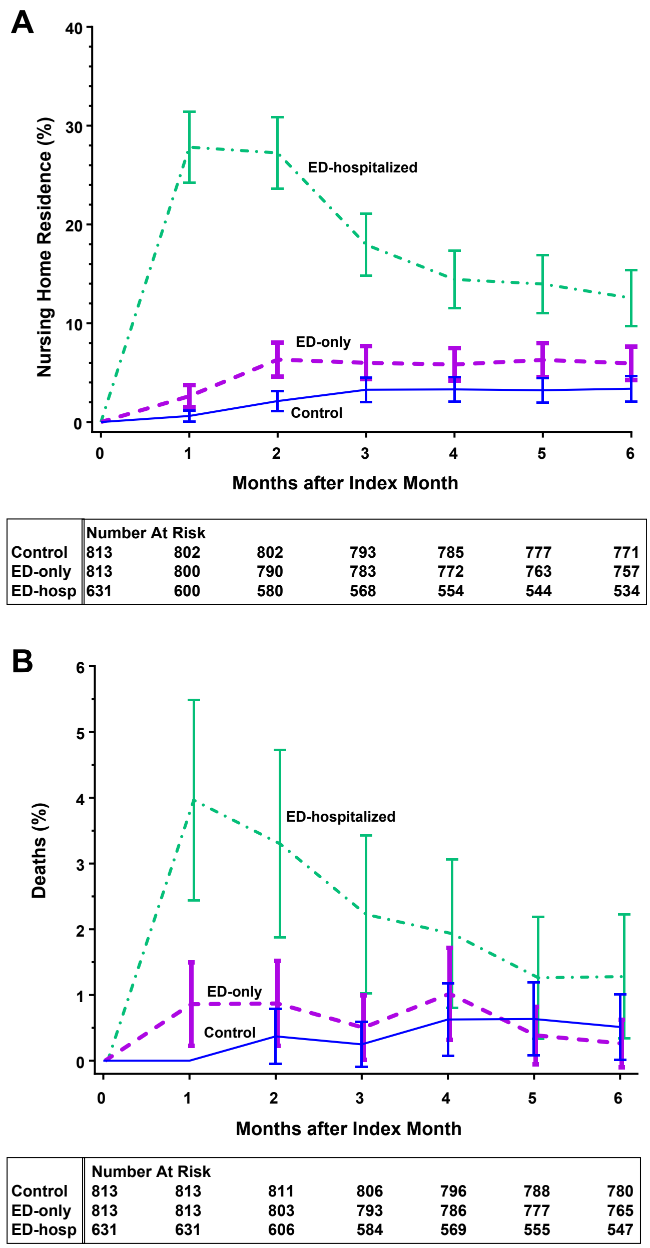


Figure 2. Secondary outcomes by study group. Point estimates represent unadjusted values, whereas the bars denote 95% CIs. The number at risk refers to observations, not participants, as described in the text.

experience some functional decline in the 6 months after an ED visit.[13,15] These studies, however, were limited by the absence of suitable comparison groups and by retrospective reports of preillness function. In contrast, our study included a matched comparison group of older persons with no ED visit and included prospective reports of preillness function. To our knowledge, the current study is the first to evaluate the course of disability after an ED visit in a general cohort of community-living older persons in the United States.

In contrast to previous work, the current study included nursing home use and mortality as additional outcomes. The higher rates of nursing home stays and mortality among participants with an ED visit but not hospitalization strengthen our primary finding of increased disability in the ED-only group and support the clinical significance of the observed functional decline.

Additional strengths of the current study include its prospective longitudinal design, high participation rate, and minimal attrition for reasons other than death; the rigorous ascertainment of ED visits and hospital admissions through claims data supplemented by self-reported information with demonstrated validity; the monthly assessments of disability with 13 basic, instrumental, and mobility activities for more than 14 years; and adjustment for a comprehensive set of potential confounders, which were updated every 18 months. Although residual confounding is always a possibility in an observational study, participants in the ED-only and control groups were well matched on the most important prognostic characteristics, including pre-ED function.

Previous work has shown that disability results from a combination of preexisting vulnerability (such as frailty and cognitive impairment) and subsequent precipitating events, including hospitalization.[4,7] The results of the current study indicate that illnesses and injuries leading to an ED visit without hospitalization have serious adverse consequences, including worsening disability and increased nursing home use and death. These results provide strong evidence that an ED visit often acts as a precipitating event of disability, and they suggest that the period after an ED visit represents a vulnerable time for community-living older persons. Our findings should spur ongoing efforts[35,36-38] to provide functional assessments and appropriate interventions for older patients who present to the ED, and they support the need for further research to evaluate new models of care for this population.

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Author contributions: TMG conceived and designed the study and supervised its conduct. JMN, WF, LH, LL-S, and HGA conducted data processing and analysis. JMN drafted the article, and all authors contributed substantially to its revision. JMN takes responsibility for the paper as a whole.

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