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Impact of chronic illness on functional outcomes and quality of life among injured older adults

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ABSTRACT

Introduction: Trauma care for injured older adults is complicated by pre-existing chronic illness. We examined the association between chronic illness and post-injury function, healthcare utilization and quality of life.

Methods: Trauma patients ≥65 years with an Injury Severity Score (ISS) ≥9 discharged from one of three level-1 trauma centers were interviewed 6-12 months post-discharge. Patients were asked about new functional limitations, injury-related emergency department (ED) visits or readmission, and health-related quality of life (HRQoL). Trauma registry data was used to determine presence of seven chronic illnesses. Adjusted regression models examined associations between increasing number of chronic illness (0, 1, ≥2) and outcomes.

Results: Of 1,379 patients, 46.5% had at least one chronic illness. In adjusted analysis, any chronic illness was associated with higher odds of new functional limitation (1 chronic illness, OR1.54, CI: 1.20-1.97; ≥2, OR1.69, CI: 1.16-2.48) and worse physical health-related QoL (1 chronic illness adj. mean diff= -4.0, CI: -5.6 to -2.5; ≥2 adj. mean diff.= -4.4, CI: -7.3 to -1.4, $p<0.01$). Mental health post-injury was consistent with population norms across all groups.

Conclusion: Presence of any chronic illness in older adults is associated with new functional limitations and worse physical HRQoL post-injury, but unchanged mental health. Focused interventions are needed to support long-term recovery.

Introduction

Older age is a risk factor for poor outcomes in trauma patients [1,2]. Among older patients, who represent the fastest growing age group in the United States and account for 20% of all hospital trauma admissions, [3] approximately 60-80% have at least one chronic condition, broadly defined as a medical condition lasting >1 year, requiring ongoing medical attention and/or limiting activities of daily living (ADLs) [4,5,6]. Pre-existing medical conditions are associated with worse morbidity and mortality after traumatic injury for older adults [7–9]. To address their specific needs, trauma societies have created best practice guidelines for the triage and early in-hospital management of older adults that specifically address pre-existing conditions, including resuscitation, anti-coagulation and assessment of acute medical conditions that may have contributed to injury [1,10].

However, recommendations for post-acute care of older adult trauma patients are limited, and most follow-up studies of post-injury functioning and health-related quality of life have been limited to short-term follow up or compared older adults to their younger counterparts [11,12,13]. These studies represent an important starting point for assessing the patient experience after discharge, however there is little data as to how chronic illness influences patient recovery trajectories after injury. Given the high prevalence of chronic illness and its association with poor outcomes after trauma, there is a need to better understand its as-

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sociation with patient outcomes over the longer term [9,14,15]. Patient-reported outcomes improve our understanding of traumatic injury by utilizing direct patient experience in lieu of proxy markers [16]. For geriatric patients, in whom quality of life is frequently more important than longevity, these outcomes are important to consider [17].

In this study, we aim to determine the association between chronic illness, disability and 6-12 months post-injury health care utilization and function in older adults. We had two hypotheses: (1) the presence of chronic illness would be associated with new functional limitations, increased healthcare utilization, and worse health-related quality of life; and (2) increasing number of chronic illnesses will result in more functional limitations, more healthcare utilization, and worse health-related quality of life.

Materials & methods

Date source

The Functional Outcomes and Recovery after Trauma Emergencies (FORTE) project is a multi-center study collecting long-term patient reported outcomes to understand barriers and facilitators to injury recovery from the patient perspective [18]. The registry tracks patients with an injury severity score (ISS)≥9 discharged from 1 of 3 Boston-area level I trauma centers since 2015. Eligible patients and their caregivers are contacted via phone between 6- and 12-months post injury to participate in a telephone survey to evaluate health related quality of life, trauma specific patient-reported outcomes and patient reported post-discharge contacts with healthcare. Interviews are conducted by a trained member of the research team (research fellow, research coordinator, research assistant, graduate student or medical student) using a structured telephone survey in English or Spanish. All interviewers receive training for 1-2 weeks and were supervised by a senior member of the team during the first month of phone calls [19]. After this period, some interviews were randomly recorded and verified monthly for quality purposes. All interviews conducted in Spanish were performed by a fluent or native Spanish-speaking interviewer. Patients are queried on participation in their personal medical decision making; for those who report decision making by a proxy/caregiver, this person completes an abbreviated interview. The abbreviated interview included questions about objective observations concerning the patient's education, insurance, occupation, residential status and functional engagement. Further details of the development and design of the FORTE project have been published previously [16].

Study cohort

This cohort included adult patients ≥65 years who sustained moderate to severe injury (ISS≥9) and patient or caregiver completed follow-up between 6- and 12-months post-injury during the enrollment period spanning 2015 – 2019.

Study variables

Demographics

Interview data is linked with institutional trauma registry data to capture patient demographic and injury-related clinical characteristics, including, including age, sex, race, injury mechanism, ISS, location of injury (head, extremity), chronic illnesses, intensive care unit (ICU) length of stay, hospital length of stay (LOS) and discharge disposition.

Exposure

The exposure of interest was the presence of chronic illness. From the trauma registry, 16 illnesses were abstracted at all three trauma centers (see **Supplement,** Table 1). Of these illness, seven were identified as common chronic illness, as defined by the Centers for Disease Control and Prevention based on their morbidity, mortality and cost of care: dementia, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), chronic renal failure (CRF), diabetes mellitus (DM), functional dependence prior to injury and disseminated cancer [20-22].

Outcome measures

Outcomes included new functional limitation, healthcare utilization and health-related quality of life, as reported by the patient.

New functional limitation

Functional outcomes were ascertained from the revised Trauma Quality of Life (TQoL) functional engagement domain [23]. The Trauma Quality of Life survey is a trauma-specific questionnaire with questions regarding emotional well-being, functional engagement, recovery/resilience and physical well-being post-injury. The functional engagement domain of TQoL assesses new need for assistance with daily activities: walking up stairs, walking on flat surfaces, dressing, showering, eating, going to the bathroom and cooking. Participants are asked if they agree or disagree with individual statements, such as *"I need help with ____."* To assess patient's baseline functional status, an additional question asks if any limitations were present before injury.

Post-discharge healthcare utilization

Post-discharge healthcare utilization was defined as patient report of an injury-related visit to an emergency department or readmission. All post-discharge healthcare contacts in the FORTE project are based on patient report [16].

Health-related quality of life

General health related quality of life is measured using the Short-Form Health Survey (SF-12) [24]. The SF-12 is a 12-item validated questionnaire on patient-reported health status outcomes, assesses eight health profile domains (physical functioning, role-physical, bodily pain, general health perceptions, vitality, social functioning, role-emotional, mental health) and provides a norm-based scoring system, with a population mean of 50 and a standard deviation (SD) of 10, in which 0 represents the lowest level of health and 100 the highest. The eight health domains assessed are summarized as composite scores of physical (PCS) and mental (MCS) health. Patients for whom a caregiver completed interview were excluded from HRQoL analysis, as caregivers are not asked to complete the SF-12.

Statistical analysis

As in our prior analysis, outcomes do not differ significantly between 6- and 12-month time points, [16] data from patients who completed an interview between 6 and 12 months post-injury were combined for analysis. Descriptive statistics were calculated to compare patients with no chronic illnesses to patients with ≥1 chronic illness. Continuous variables were summarized using means and SDs and compared using parametric tests (t-test). Categorical variables were described using count and percentage and compared using X^2 tests. Multivariable logistic regressions were used to determine associations between the number of chronic illnesses (none, 1, ≥2) and long-term outcome measures: new functional limitations, post-discharge healthcare and health-related quality of life. The models adjusted for demographics [age (continuous), sex, education level (high school or lower vs. greater than high school)], type and severity of injury [ISS (continuous),

Table 1
Participant Clinical and Demographic Characteristics.

	No Chronic Illness	≥1 Chronic Illness	P-value
Sample Size	N=737	N=642	
Age, mean (SD)	76.8 (SD: 8.5)	80.3 (SD: 8.3)	<0.01
Sex, Male	41.7% (n=307)	43.1% (n=277)	0.58
Race			<0.01
White	90.9% (n=651)	86.1% (n=538)	
Black	3.1% (n=22)	6.2% (n=39)	
Other	6.0% (n=43)	7.7% (n=48)	
Missing	(n=21)	(n=17)	
Education level			<0.001
High school or lower	35.1% (n=258)	47.2% (n=303)	
More than high school	64.5% (n=475)	49.7% (n=319)	
Missing	0.5% (n=4)	3.1% (n=20)	
Injury Mechanism			<0.01
Falls	82.2% (n=605)	93.5% (n=600)	
Road Traffic Injury	15.6% (n=115)	5.0% (n=32)	
Penetrating	0.4% (n=3)	0% (n=0)	
Blunt Assault	0.4% (n=3)	0.5% (n=3)	
Other	1.4% (n=10)	1.1% (n=7)	
Missing	(n=1)	0% (n=0)	
Injury Severity Score (ISS)			0.60
Moderate (9-14)	72.6% (n=535)	74.3% (n=477)	
Severe (15-24)	19.5% (n=144)	17.4% (n=112)	
Critical (≥25)	7.9% (n=58)	8.3% (n=53)	
Head Injury (AIS≥2)	32.8% (n=242)	36.0% (n=231)	0.22
Extremities Injury (AIS≥2)	65.4% (n=482)	68.5% (n=268)	0.04
ICU Admission	31.9% (n=235)	35.7% (n=229)	0.14
Ventilator use	6.5% (n=48)	5.9% (n=38)	0.65
Length of stay, mean (SD)	5.9 (7.5)	6.3 (5.2)	0.32
Discharge Disposition			<0.01
Home	18.1% (n=133)	10.9% (n=70)	
Home with services	19.2% (n=141)	16.3% (n=104)	
Rehab	37.5% (n=275)	37.7% (n=241)	
Nursing Home	22.3% (n=164)	33.0% (n=211)	
Other	2.9% (n=21)	2.2% (n=14)	
Missing	(n=3)	(n=2)	
Chronic Illness*			
COPD		5.8% (n=80)	
DM		19.1% (n=263)	
Dementia		9.3% (n=129)	
CHF		6.6% (n=91)	
Functional depend.		10.7% (n=147)	
CRF		2.8% (n=39)	
Diss. cancer		0.7% (n=9)	

*COPD: chronic obstructive pulmonary disease; DM: diabetes mellitus; CHF: congestive heart failure, CRF: chronic renal failure

injury mechanism (fall, road traffic injury, penetrating, blunt assault, other), head injury (abbreviated injury scale (AIS)≥2), extremities injury (AIS≥2)] and in-hospital course (intensive care admission, ventilator use) (Table 2), and results are reported as the adjusted odds ratio (OR) with 95% confidence intervals (CI). Mean SF-12 physical and mental composite scores as well as individual domains scores were reported and compared to the U.S. population mean score of 50. The linearity assumption of regression models was checked for quantitative independent variables using scatter plots. The assumption of multivariate normality was checked using Q-Q plots of residuals in linear regression models. Finally, a sensitivity analysis was performed to compare patients who participated in telephone surveys to those screened eligible but who did not complete telephone surveys to assess for the risk of selection bias; this analysis included demographic and clinical data abstracted from the institutional trauma register (see supplement) [25]. All statistical analyses were carried out using Stata SE v14.2 (StataCorp LLC, College Station, Texas).

Data management

Interviews with missing data on the predictor or outcome variables were excluded, consistent with a complete case analysis approach [19,26]. Interviews with missing data on the model covariates (n= 25 [1.8%]) were kept and excluded from regression analyses. Interview data is collected and managed in REDCap hosted at Partners Healthcare. Ethical approval for this study was obtained from the institutional review board of each of the participating hospitals.

Results & discussion

Patient characteristics

Among 3375 eligible patients enrolled in the FORTE project, 1,379 patients were ≥65 years and completed the telephone survey; 1,040 were patients and 339 were caregivers (Fig. 1). Approximately half of patients (47%) had at least one of the seven chronic illnesses (Table 1). Of the chronic illnesses, diabetes was most prevalent (19.1%). When comparing those with ≥1 chronic illnesses to those with no chronic illnesses, patients in both groups were primarily white, and less than half of all patients were male (43.1% for ≥1 chronic illness, 41.7% no chronic illness, p=0.58). Primary mechanism of injury for all older adults was fall, and the majority had a moderate ISS. Patients with ≥1 chronic illness were older than those without (≥1 chronic illness mean age: 80.3 (SD:8.3), no chronic illness mean age: 76.8 (SD: 8.5), p<0.01) and more likely to be non-White (Black/other ≥1 chronic illness 13.9%

Table 2
Association of chronic illness with functional limitations, healthcare utilization and quality of life.

	0 Chronic Illness (n=737)	1 Chronic Illness (n=489)	≥2 Chronic Illnesses (n=153)	1 chronic illness. Adjusted Odds Ratio (95% Confidence Interval); p-value	≥2 chronic illnesses. Adjusted Odds Ratio (95% Confidence Interval); p-value
New functional limitation for an ADL	289 (39.2%)	254 (51.9%)	88 (57.5%)	1.54 (1.20, 1.97); <0.01	1.69 (1.16, 2.48); 0.01
Injury-related ED visit or readmission	99 (13.4%)	71 (14.5%)	24 (15.7%)	1.16 (0.83, 1.64); 0.39	1.32 (0.79, 2.20); 0.29
				Adjusted Mean Difference (95% Confidence Interval); p-value	Adjusted Mean Difference (95% Confidence Interval); p-value
SF-12 Physical Composite Score	41.9 (SD: 11.1)	37.9 (SD: 11.0)	37.4 (SD: 10.0)	-4.0 (-5.6, -2.5); <0.01	-4.4 (-7.3, -1.4); <0.01
SF-12 Mental Composite Score	53.3 (SD: 10.2)	54.1 (SD: 10.1)	51.6 (SD: 11.1)	0.78 (-0.7, 2.2); 0.29	-1.9 (-4.6, 0.9); 0.18

Reference group: No chronic illness
Adjusted for age, sex, education level, ISS, injury cause, head injury, extremity injury, ICU use, ventilator use

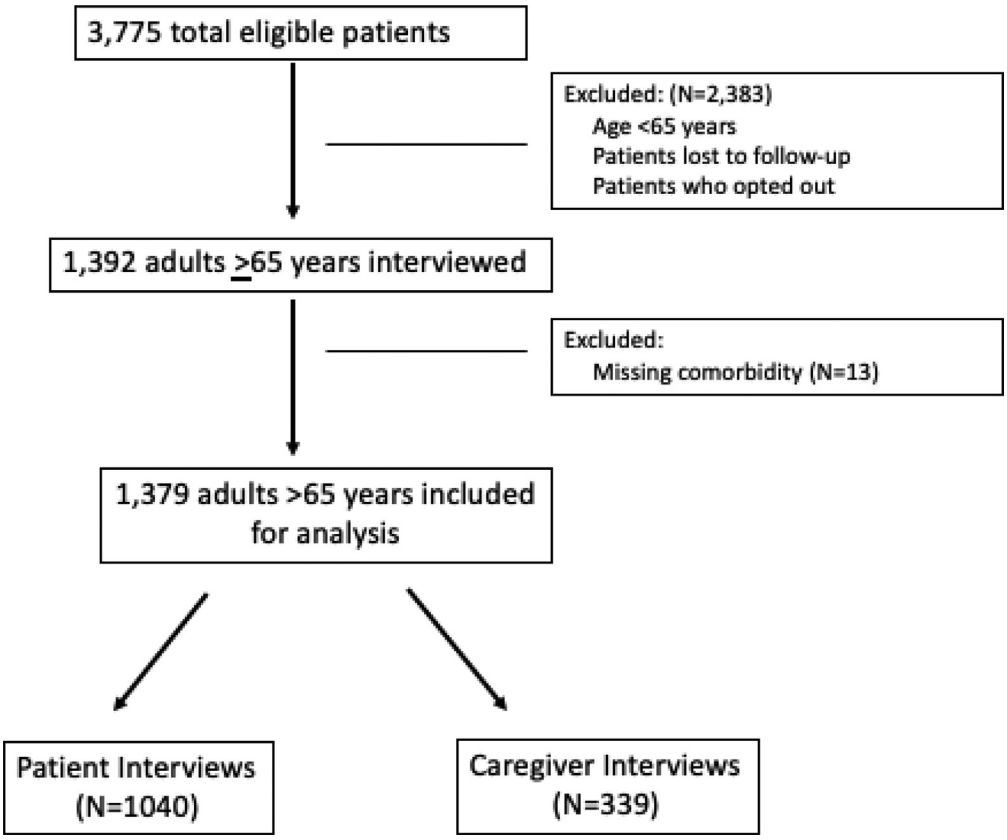

Fig. 1. Study Flow Diagram. Total eligible: 3,375. Total followed: 1,392. Total included: 1,379 (1,040 patient and 339 caregiver interviews).

vs. 9.1% no chronic illness, p<0.01). Patients with ≥1 chronic illness were more likely to be discharged to a non-home location (70.7% vs. 59.8%, p<0.01). In a comparison of respondents (n=1392) versus non-respondents (n=1983), non-respondents were more likely to be male (42.3% vs 38.6%, p: 0.032), and younger (78 years vs 80 years, p: <0.001) (**Supplement Table 2**).

Association of increasing number of chronic illnesses with functional limitations, healthcare utilization and quality of life

Frequency of patient-reported outcomes increased with increasing number of illnesses. Only 39.2% of patients with no chronic illnesses reported a new functional limitation, compared with 51.9% of those with 1 chronic illness and 57.5% of those with >2 chronic illnesses (Table 2). The frequency of patients reporting injury-related ED visits or readmission increased by a smaller magnitude, only 1% with increasing number of chronic illnesses. In adjusted analysis chronic illnesses (1, ≥2) was associated with higher odds of new functional limitation (1 chronic illness OR1.54, CI 1.20-1.97, p<0.01; ≥2 chronic illnesses OR1.69, CI 1.16-2.48, p<0.01, ref[0]). There was no statistically significant difference in injury-related ED visits or readmissions in those with increasing number of chronic illness (1 chronic illness OR 1.16, CI 0.83-

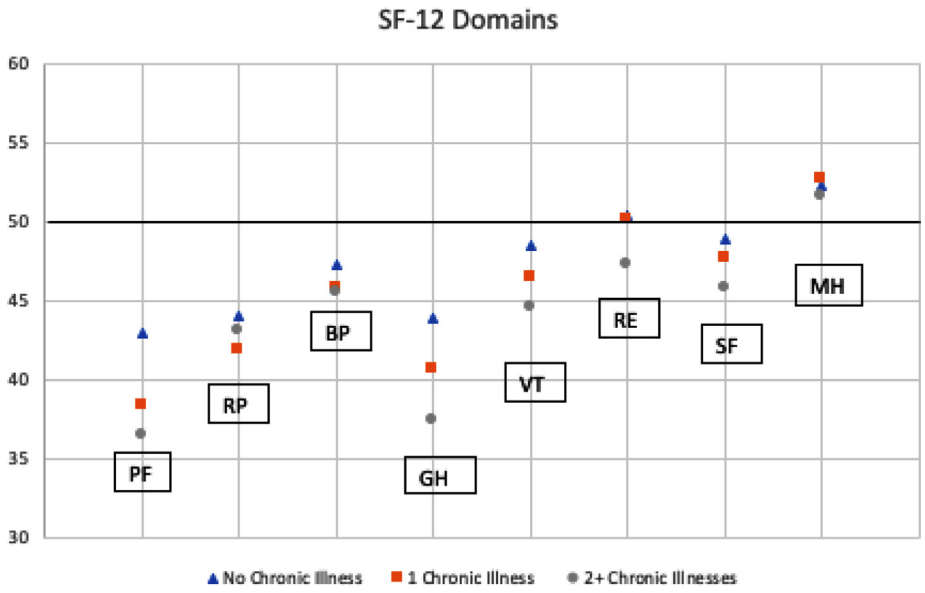

Fig. 2. Individual SF-12 Sub-Domains and Chronic Illness Burden. Y-axis scale shows individual SF-12 sub domains in relation to the population norm of 50. PF: physical functioning; RP: role, physical; BP: bodily pain; GH: general health perception; VT: vitality; RE: role, emotional SF: social functioning; MH: mental health.

1.64, p=0.39, ≥2 chronic illnesses OR 1.32, CI 0.79-2.20, p=0.29), ref[0]).

Compared to population norms, patients with 1 and ≥2 chronic illnesses had lower scores in all physical health domains compared to those without (Fig. 2). Scores for the physical domains (physical functioning, role physical, bodily pain, and global health) were below average for all groups but lowest for those with ≥2 chronic illnesses. Scores in two of the four mental health domains (role emotional and mental health) were consistent with population norms regardless of presence of comorbidity. In adjusted analysis, patients with an increasing number of chronic illnesses (1, ≥2) reported worse physical health-related quality of life compared to those with 0 (1 chronic illness adj. mean diff= -4.0, CI: -5.6 to -2.5; 2+ chronic illness adj. mean diff.= -4.4, CI: -7.3 to -1.4). There was no difference in mental health-related quality of life among the groups (1 chronic illness adj. mean diff= 0.78, CI: -0.7 to 2.2; ≥2 chronic illness adj. mean diff.= -1.9, CI: -4.6 to 0.9) (Table 2).

Discussion

In this study we found that chronic illness in older adult trauma patients is associated with new functional limitations and worse physical health-related quality of life at 6-12 months post-injury, but no difference in post-discharge healthcare utilization or mental health-related quality of life. Additionally, increasing number of chronic illness had an associated stepwise increase in the odds of adverse outcome. These findings suggest that the mere presence of pre-injury burden of disease may have long-term effects on post-injury functioning and physical health-related quality of life.

This study builds upon previous research showing an association between chronic illness, injury and poor outcomes in older adults. Presence of comorbidity has been shown to be predictive of discharge to a non-home location and long-term functional impairments after trauma persist across a range of ages and injury mechanism; in a study of traumatic brain injury survivors >55 years old, the presence of fewer comorbid conditions was associated with increased likelihood of independence in mobility and self-care [27–30,15]. Multiple studies of older adults ≥65 years have demonstrated that the majority of patients lose at least one ADL in the year following trauma [31,32]. Unfortunately, older adults who experience traumatic injury are under-represented in analyses of long-term outcomes after injury; in a systematic review by *Brown et al.* only 13 articles were identified with serial assessments of functional status and HRQoL and there was significant heterogeneity in population demographics and metrics used to evaluate HRQoL; previous studies using patient reported outcomes or quality of life measurement have been small, single-center or single diagnosis [11,33,34,35]. To our knowledge, this is the largest study to examine the association between chronic illness, functional impairment and quality of life reported directly by the patient up to a year post-injury.

The “hidden burden” of adverse mental health has become an area of increasing interest for trauma survivors, particularly for young adults and those who are involved in firearm injuries; in contrast, patient-centered outcomes for older adults have primarily focused on function and independence, often overlooking the social and emotional impact of injury [36–38,39]. Unique to our cohort was the finding that mental health appears to be preserved across all groups, even in the presence of chronic illness, with scores consistent with population norms. This is notable, as it differs from previous studies of patients with chronic illness that have shown an association of physical impairments with adverse mental health outcomes [40,41,42]. However, studies examining components of successful aging have postulated that individual perception of well-being may be partially independent from functional decline [43]. Further investigation of post-injury quality of life should focus on exploring the characteristics promoting or inhibiting mental health in older adults, such as resilience, social support or environmental factors. Additional FORTE studies are currently exploring these social determinants of recovery [44].

There are a few limitations to consider and this study must be interpreted in the context of the study design. First, as with all prospective cohort studies, there is a risk of selection bias due to loss to follow-up and decline to participate, and there are a variety of reasons that patients may not have responded that we are unable to differentiate in this study. Our sensitivity analysis showed statistically significant differences in the demographics of our cohort, including younger age and slightly higher proportion of men, but no differences in clinical variables, including injury severity, ICU admission, or length of stay. Second, this study is conducted at three level-one trauma centers within a large city in the Northeast United States, and results may not be generalizable to

other centers. Third, data about patients is collected via trauma registries and its accuracy is subject to the limits of the data abstraction processes [45]. From the available medical conditions we selected seven that have been previously been identified as chronic illnesses and could be assumed to be present or absent at time of injury, but we are limited to presence or absence of disease and cannot account for disease severity. Finally, as this data is collected post-injury, we are unable to compare our findings to pre-injury quality of life and cannot quantify any difference in quality of life pre-injury by presence of comorbidities.

Conclusion

Our findings indicate that chronic illness is associated with diminished functional status and physical health-related quality of life for older adults 6-12 months post-injury, but self-report of mental health consistent with population norms. Chronically ill older adults who suffer traumatic injury represent a population for whom focused interventions should be investigated to support long-term recovery of function, independence and mental health.

Ethical Requirements: No conflicts of interest to disclose. Informed consent was obtained from all participants in this study. This study was approved by the Partners Healthcare IRB.

Declaration of Competing Interest

The authors of this paper have no conflicts of interest to disclose.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.injury.2021.03.052.

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