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Persistent Pain among Older Adults Discharged Home from the Emergency Department Following Motor Vehicle Collision: A Prospective Cohort Study

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Abstract

Study Objectives—Motor vehicle collisions (MVCs) are the second most common form of trauma among older adults. We sought to describe the incidence, risk factors, and consequences of persistent pain among older adults evaluated in the emergency department (ED) after an MVC.

Methods—We conducted a prospective longitudinal study of patients aged 65 years or older who presented to one of eight EDs after MVC between June 2011 and June 2014 and were discharged home after evaluation. ED evaluation was done via in-person interview; follow-up data were obtained via mail-in survey or phone call. Pain severity (0-10 scale) overall and for 15 parts of the body (locations) were assessed at each follow-up time point. Principal component analysis was used to assess the dimensionality of the locations of pain data. Participants reporting pain severity ≥4 attributed to the MVC at six months were defined as having persistent pain.

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Results—Of the 161 participants, 72% reported moderate to severe pain at the time of the ED evaluation. At six months, 26% of participants reported moderate to severe MVC-related pain. ED characteristics associated with persistent pain included acute pain severity, pain located in the head, neck, and jaw or low back and legs, poor self-rated health, less formal education, pre-MVC depressive symptoms, and patient's expected time to physical recovery more than 30 days. Compared to those without persistent pain, individuals with persistent pain were substantially more likely at 6 month follow-up to have also experienced a decline in their capacity for physical function (73% vs. 36%; difference = 37%, 95% CI 19%-52%), a new difficulty with activities of daily living (42% vs. 17%; difference = 26%, 95% CI 10%-43%), a one point or more reduction overall self-rated health on a 5-point scale (54% vs. 30%; difference = 24%, 95% CI 6%-41%), and a change in their living situation in order to obtain additional help (23% vs. 8%; difference = 15%, 95% CI 2%-31%).

Conclusion—Among older adults discharged home from the ED after evaluation following an MVC, persistent pain is common and frequently associated with functional decline and disability.

Keywords

Geriatrics; Motor Vehicle Collision; Pain

Introduction

Motor vehicle collisions (MVCs) are the second most common form of traumatic injury among individuals aged 65 years and older and result in an estimated 250,000 U.S. emergency department (ED) visits by older adults each year.[1] The majority (>75%) of older adults seen in the ED after an MVC do not require hospitalization and are discharged home after evaluation.[1] The initial care of these discharged patients is the responsibility of emergency physicians.

Persistent back and neck pain are known to be common and disabling health outcomes among younger adults experiencing MVC, with an estimated cost of $29 billion in the U.S. alone.[2-4] Increased age has been identified as a risk factor for persistent MVC-related pain,[5,6] but neither risk factors for, nor the consequences of persistent MVC-related pain have been described among older adults. Older adults are an important subgroup of individuals experiencing MVC because safe and effective pharmacologic management of acute pain in older adults is challenging,[7,8] and once pain becomes persistent in older adults it has profound negative consequences for function and quality of life.[9-12] Further, due to the anticipated increase in the number of independent older adults, the number of older drivers experiencing an MVC is projected to double over the next two decades.[13]

In this paper, we present results from a study of pain and functional outcomes among older adults receiving emergency care after an MVC. We estimate rates of persistent pain during the year following MVC, examine associations between patient characteristics obtained at the time of the ED evaluation and persistent pain, and examine associations between persistent pain attributable to the MVC and other adverse outcomes.

Methods

Study Design and Setting

The Older Adult CRASH study is a prospective longitudinal study of patients aged 65 years and older evaluated in an ED within 24 hours after an MVC. Study participants received an initial research interview at the time of the ED visit. Follow up assessments were completed by phone or mail at 6 weeks, 6 months, and 1 year. Patients were enrolled from 8 ED's in 4 no fault insurance states (Florida, Massachusetts, Michigan, and New York). No-fault insurance states were chosen to minimize the number of participants for whom on-going legal activity might promote symptom persistence.[14] The study was approved by institutional review boards at each site, and each participant provided written informed consent. Each of the eight study sites screened ED electronic tracking boards for potentially eligible patients for a minimum of 50 hours per week. For most sites this covers a period of time between 9 a.m. and 7 p.m. Monday-Friday, with some sites also covering weekends. During screening, enrollment is consecutive. Additional details for the methods of this study have been published in a manuscript describing methods for a related study examining pain outcomes among younger adults (aged 18-65 years).[15]

Inclusion Criteria

Patients aged 65 years or older who presented to the ED within 24 hours after an MVC were screened for enrollment. Patients were excluded if they had fractures, major lacerations, intracranial injuries, spinal injuries, or were admitted to the hospital directly from the ED for any reason. We restricted the sample to patients who are discharged home from the ED in order to focus on a group of patients whose initial care is provided primarily, and often exclusively, by emergency physicians. In contrast, patients with more serious injuries were excluded because long-term pain and functional outcomes in these patients are generally determined by the specific injuries experienced, comorbidities, the length of hospitalization required, and the outcome of surgical interventions, if performed. Patients were also excluded if they had moderate or severe cognitive impairment based on a six item screener score ≤3;[16] were prisoners; or were receiving hospice, end of life, or comfort care. Recruitment took place between June 2011 and June 2014.

Measures

The ED interview obtained information about the patient's pre-MVC health, characteristics of the MVC,[17] and pain symptoms. Pain severity was measured using the 0 to 10 numeric rating scale with 0 indicating “no pain” and 10 indicating “pain as severe as it could possibly be.” Pain severity was assessed overall and in 15 different parts of the body. Pain scores were categorized as mild (1-3), moderate (4-6), or severe (7-10).[18,19] Distress was assessed using the Peritraumatic Distress Inventory, a 13-item measure which assesses distress in the early aftermath of trauma.[20] The Peritraumatic Distress Inventory was dichotomized at 23.[21] Pain catastrophizing, which refers to a cognitive and emotional response to pain characterized by magnification of pain, rumination on pain, and feelings of helplessness in response to pain, was assessed using the 13-item Pain Catastrophizing Scale.[22] Pain catastrophizing (range 0-52) was dichotomized at 15, a value previously found to be best associated with high follow-up pain ratings among individuals experiencing MVC.[10]

Depressive symptoms were considered present if the patient answered yes during the ED interview to either of two question about 1) feeling down, depressed, or hopeless or 2) being bothered by having little interest in doing things.[23] Anticipated time in days to physical recovery was estimated by the participant as part of the ED interview and dichotomized at >30 days or ≤30 days. Distress, pain catastrophizing, and anticipated time to physical recovery were also examined as continuous variables.

Follow-up interviews 6 weeks, 6 months, and 1 year after the initial ED visit assessed average MVC-related pain during the previous week. At each follow-up time point, pain was considered MVC-related if the patient answered yes to the question, "Is this pain related to your motor vehicle collision?" Our primary outcome, MVC-related persistent pain, was defined as moderate or severe pain (pain score of 4 or more on a 0-10 scale) on average during the past week which the patient attributed to the MVC at the 6 month interview. Brief Pain Inventory questions at baseline and each follow up were used to assess pain interference with general activity, walking ability, sleep, and enjoyment of life using a 0 (no interference) to 10 (maximum interference) scale.[24] For each domain, pain interference was defined as present if the patient reported a score ≥4. There is no establish cutoff for pain interference; this cutoff was chosen because pain interference scores are scaled the same as and correlate with the pain numeric rating scale,[25] and a pain numeric rating scale score of ≥4 is an established cutoff used to define moderate to severe pain.[18,19,26] MVC-related pain interference was defined as present if 1) the pain interference score was ≥4 and 2) the participant attributed their overall pain to the MVC.[27,28] Self-reports of physical function was assessed at each time point using a validated measure of higher-level function based on patient-reported ability to walk, climb stairs, and lift or carry groceries.[29] Disability was defined as having some difficulty, a lot of difficulty, or requiring assistance with the following six activities of daily living (ADLs): bathing, dressing, transitioning out of a bed or chair, rising from a chair, using the bathroom, and eating.[30] New disability was defined as any increase (i.e. 1 point or more) in the composite 0-18 score based on responses for each of these ADLs. Both the percentage of patients with at least a 1 point increase and the percentage with at least a 2 point increase are reported. We defined driving anxiety as present if patients reported feeling quite a bit more or much more nervous about driving as compared to before the accident. The percentage of patients with driving anxiety at 6 months is reported only from among patients who were still driving at 6 months.

Statistical Analysis

Frequencies of outcomes and difference in the frequencies of outcomes among patient subgroups are reported as percentages with 95% confidence intervals. We report pain symptoms at each of the three follow-up time points but focus on 6 month outcomes throughout the manuscript because this is widely considered a standard time point for defining persistent pain.[31] The percentage of participants with persistent pain is reported for subgroups based on patient and collision characteristics. We also report predicted probabilities of persistent pain after adjustment for patient age and sex and site of enrollment. The purpose of this adjustment is to examine whether observed associations are independent of these potential confounders.

Principal component analysis was used to reduce the dimensionality of the data characterizing pain locations for 15 different locations for acute pain reported at the time of the ED interview and for pain locations at 6 months. The number of components to retain was determined by applying Kaiser-Guttman criterion and by visual exploration of a scree plot.[32] An orthogonal rotation was applied to the principal components to produce interpretable uncorrelated dimensions (factors) of acute pain to be utilized in subsequent analyses. In interpreting the rotated factor pattern, an item was determined to contribute to a given component if the absolute value of the factor loading was 0.30 or greater for that component. Associations of the principal components with pain scores, physical function, and pain interference subscales at 6 months were performed using a general linear model. The strength of associations between each principal component and the outcome of interest are reported using the coefficient of determination (R^2). Statistical analyses were conducted using STATA 13.1 (StataCorp LP, College Station, TX).

Results

Of 946 patients screened, 439 were eligible and 199 consented to participate (Figure 1). Of eligible patients who declined participation, the most common reasons were that the study would take too much time (N=65) or the patient was too stressed or overwhelmed (N=46). Seventeen eligible patients stated they did not want to participate because they were in too much pain. Of the 199 eligible, 4 did not complete the interview and 34 were admitted to the hospital directly from the ED; these 38 patients were excluded from this analysis.

Of the 161 participants, 80% were white and 40% had a college degree (Table 1). The median age was 70 (IQR 67 to 75). At the time of ED evaluation, most participants (85%) reported their health as excellent, very good, or good prior to the MVC. Most participants (72%) reported moderate to severe pain in the ED, and half reported severe damage to their motor vehicle.

In the ED, the most common sites of pain in order of decreasing frequency were chest, neck, upper back, lower back, and head (Table 2). Principal component analysis of ED pain symptoms at these 15 locations identified 5 principal components with eigenvalues greater than 1 (Table 2). These 5 components accounted for 68% of the variance in the pain location data and incorporated the following anatomically related body areas: Component 1 included head, neck, and jaw (17% of variance); Component 2 included low back, hips, and legs (16% of variance); Component 3 included left shoulder, left arm, and left hip (14% of variance); Component 4 included right shoulder and right arm (12% of variance); and Component 5 included chest and upper back (9% of variance). Left hip was included in both Components 2 and 3.

Follow-up assessments were completed in 93% of participants (N=150) at 6 weeks, 89% (N=143) at 6 months, and 83% (N=134) at one year. Most follow-up assessments (58%) were obtained by phone interview; the remainder were sent by mail. Pain, pain interference in life activities, and pain treatment at each follow-up time point during the year after the MVC are shown in Table 3. At 6 months, 26% (37/143) had moderate to severe pain which they attributed to the MVC, and at least one in four participants had moderate to severe pain interference with general activities, walking, sleep, and enjoyment of life and overall pain symptoms that they attributed to the MVC. More than half (54%, 77/143) of participants continued to take an analgesics (i.e. an opioid, acetaminophen, or an NSAID) at six months, and 18% (26/143) were taking an opioid on a daily basis. Ten percent (14/143) of participants who reported daily opioid use 6 months after the MVC reported not taking an opioid in the past month at the time of the initial ED interview, suggesting that this 10% of the sample had become chronic opioid users. The frequencies of moderate to severe MVC-related pain and pain interference at one year were similar to the frequencies at 6 months.

Associations between pain and collision characteristics assessed in the ED and MVC-related persistent pain are shown in Table 4. An increase in absolute risk of 20% or more was observed for the following patient with the following ED characteristics: severe pain in the ED; expected recovery >30 days; self-rated health fair or poor; and depressive symptoms. These associations remained after adjusting for age, sex, and enrollment site (Table 4).

The relationships between components of pain locations reported in the ED and pain severity, physical function, and pain interference at 6 months are shown in Figure 2. The presence of pain in the distributions of the head/neck/jaw, low back/hips/legs, and left shoulder/arm/hip at the time of the ED evaluation were more strongly associated with these outcomes than was pain in other body locations. Pain in the chest and upper back were both frequently reported in the ED (Table 2), but the principal component composed of pain in these areas accounted for little of the variance in pain severity, physical function, or pain interference at 6 months. Consistent with this, at 6 months, moderate to severe chest pain was only reported by 6% (9/143) of patients, making it one of the least frequently reported pain locations (Supplementary Table 1). In contrast, upper back pain was still reported by 17% (24/143) of patients at 6 months, suggesting some divergence of the recovery process for chest and upper back pain. The most common sites of pain at 6 months were low back (25%, 36/143), upper back (17%, 24/143), and neck (17%, 24/143).

Outcomes for participants 6 months after the motor vehicle collision (MVC), for the entire sample and for those with and without MVC-related persistent pain are shown in Table 5. Compared to study participants without MVC-related persistent pain at 6 months, those with persistent pain were more likely to have experienced a decline in physical function, a new impairment in ADLs, and a decrease in their self-rated overall health. Twenty three percent (33/143) of older adults with persistent moderate to severe pain at six months had experienced a change in living situation in order to obtain additional help vs. only 8% (11/143) of those without persistent pain. Among drivers, one third of those with persistent pain also reported feeling quite a bit or much more nervous about driving. The percentage of participants with an ED visit during the 6 months after the MVC was twice as high among those with persistent pain as the percentage among those without persistent pain (30% vs. 15%), and the percentage of participants with an ED visits that participants said was due to the MVC was also higher among those with persistent pain than those without persistent pain (11% vs. 3%). Several of the observed differences between individuals with and without persistent MVC-related pain at 6 months were also present at one year: individuals with persistent pain at 1 year were twice as likely to have a new disability or a change in living situation over the course of the year and almost as twice as likely to have visited an ED (38% vs. 21%; Supplementary Table 2).

Limitations

We excluded patients with life threatening injuries. Severely injured patients constitute less than 2 in 10 older adults experiencing an MVC, and outcomes for these patients are determined largely by comorbidities and the number and severity of injuries.[33,34] Our results cannot serve as estimates of the prevalence of persistent pain for all older adults experiencing MVC, because only about one-third of older adults experiencing an MVC receive emergency care.[35] In analysis of Department of Motor Vehicles data from North Carolina, females, minorities, and those experiencing more severe collisions or more severe injuries were more likely to be transported to an ED. Although we do not know, it seems likely that persistent pain is less common among older adults who experience an MVC but do not seek emergency care. Although we enrolled patients in no-fault insurance states, legal involvement might have influenced reporting of pain symptoms, either consciously or subconsciously, in some participants.

As is often the case with principal component analysis, our analysis did not result in complete separation of pain locations. Specifically, left hip pain is part of Component 2 (low back, hips, and legs) and Component 3 (left arm, left shoulder, and left hip) in the analysis of ED data and low back pain is part of two components in the analysis of 6 month data. The identification of a component which includes both left upper extremity pain and left hip pain in the ED data analysis may be due to the inclusion of participants who were drivers exposed to a driver's side impact resulting in pain in both the left upper extremity and left hip. The inclusion of left hip pain in the 3rd component of the ED data analysis also likely explains the relatively high amount of variance in pain interference with walking explained by this component. In comparing patients with isolated left and right upper extremity pain, we think it is unlikely that one is different from the other or that either has as strong an influence on walking ability as pain in the neck, low back, hips, or legs.

Discussion

We characterized pain and the burden of pain among older adults discharged from the ED following evaluation after an MVC. In this multi-center sample, 26% of participants continued to have moderate to severe MVC-related pain at 6 months. A similar proportion experienced moderate to severe pain interference with general activity, walking, sleep, and enjoyment of life. Further, at 6 months more than one third of participants continued to use analgesics on a daily basis to treat their pain and approximately 10% were new daily users of opioids. (The prevalence of opioid use prior to the MVC of 8% in our sample is similar to estimates for older adults in the US of 5-8%.[36]) Participants who experienced MVC-related persistent pain had a greater burden of new functional limitations or disability, and nearly 1 in 4 had experienced a change in living situation at 6 months. They were also twice as likely to visit the ED in the first 6 months after the MVC.

This study has several strengths: participants were enrolled from EDs in various regions of the US; 20% of participants are minorities, which is similar to the national ED visit proportion for older adults of 24%;[37] and follow-up rates of 89% at 6 months are excellent and limits the potential for non-response bias. Our results add to the growing body of evidence that acute injuries in older adults can have a substantial negative impact on important long-term pain and health outcomes and extend these findings to a population of independently living older adults whom most clinicians would regard as lacking injuries likely to have long-term consequences. Wilber et al. observed functional decline at one month in 35% of older adults seen and discharged from the ED after blunt trauma.[38] Their sample differed from ours in that 85% of that sample presented after a fall, more than half were dependent on others for at least one instrumental activity of daily living prior to the injury, and one third had a fracture or dislocation. Similarly, Siriois et al. observed functional decline in 17% of older adults 6 months after receiving care in the ED after injury, but this sample was also predominantly patients presenting after a fall and 30% had a fracture.[39] We observe high rates of new disability and functional impairment 6 months after injury in a sample of patients who were largely independent in terms of activities of daily living prior to the MVC and did not experience a fracture.

The percentage of participants with moderate to severe pain at 6 weeks in our sample (50%; 95% CI 42%-58%) is similar to that for individuals age 18-65 years receiving care after an MVC from the same 8 sites (51%; 95% CI 48%-54%);[40] outcomes at subsequent time points for the younger cohort have not yet been reported. (Direct comparison of our results to other cohorts of younger adults experiencing an MVC is difficult because these other studies restrict their samples to patients with initial pain symptoms.[41]) In addition to indicating that rates of persistent pain in younger and older adults are similar, our findings suggest that the problem of persistent pain after an MVC in older adults is not just a problem of persistent neck pain. Among younger adults, MVC-related pain in either the neck or back (i.e. axial pain) is associated with pain interference with function.[40] Our findings suggest that in older adults acute pain in the lower extremities is also associated with persistent pain and pain interference. In contrast, chest pain at the time of the ED evaluation is common among older adults experiencing MVC,[42] but was infrequently reported at follow-up and was not strongly associated with either pain or pain interference with function at 6 months. Some of the participants with chest pain likely had radiographically occult rib fractures. Although often very painful in the acute phase, our findings suggest that these rib injuries do not usually result in persistent pain.

The observed association between persistent pain and functional decline in our sample suggests that persistent pain is an important determinant of functional decline among older adults experiencing an MVC. In contrast, pain was less prevalent and not significantly associated with functional decline among older adults presenting to the ED after falls.[39] This difference suggests that the mechanisms leading to functional decline among older adults presenting to the ED after injury differ depending on the injury mechanism. Among younger adults presenting to the ED after MVC and discharged home after evaluation, growing evidence suggests that genetic variations in physiologic systems involved in the stress response, in particular activation of the hypothalamic-pituitary-adrenal system resulting in the release and processing of cortisol and catecholamines, may contribute to the transition from acute to persistent pain.[43-46] Such systems may contribute to adverse outcomes among older adults experiencing MVC as well; studies examining both biological and psychosocial mechanisms mediating adverse long-term outcomes in this population are needed.

In our sample, bivariate analyses identified a number of characteristics readily assessed in the ED that are associated with persistent pain. As has been found in studies of younger adults experiencing MVC,[41,47] the severity of the collision was not strongly associated with persistent MVC-related pain at 6 months. In contrast, both pre-MVC psychological characteristics (depressive symptom) and pain symptoms in the ED and were strongly associated with persistent pain. In our sample, the strength of the association between pain catastrophizing and persistent pain was modest and not statistically significant. The association between depressive symptoms and persistent pain was stronger. The ED characteristics predictive of adverse outcomes identified in this study are potential candidate predictors to test in the development of clinical risk prediction tools to identify older adults at high risk of persistent pain and disability after MVC. In the future, such tools may be useful to identify high risk individuals to test early preventive interventions (e.g., opioid-sparing analgesics, physical therapy, or close PMD follow-up).

Evidence regarding the ability of established interventions to reduce persistent pain for individuals experiencing MVC is conflicting. A meta-analysis found some evidence that active physiotherapy reduces persistent pain after MVC,[48] but a recent large trial of active management advice provided in the ED (e.g. encourage return to normal activities, practice neck exercises) did not find improvements in pain-related activity restrictions at one year.[49] Published studies of analgesics, electromagnetic therapy, and acupuncture to reduce persistent pain after MVC are too small to be conclusive.[50-52] Teaching pain coping skills,[53,54] treatment with novel therapeutic agents,[55,56] or using cognitive behavioral therapy to reduce depressive or pain catastrophizing symptoms[10] may have utility in this population. More work is needed to develop and test interventions such as these in the vulnerable and growing population of older adults experiencing MVC. Outcomes of interest in this population include pain and pain interference, disability, and the need for additional health care and care at home.

Conclusion

In this prospective multi-center study, we found high rates of persistent pain and associated disability among older adults discharged home from the ED after experiencing an MVC. These findings add to the growing body of evidence of the clinical importance of seemingly minor injuries among older adults.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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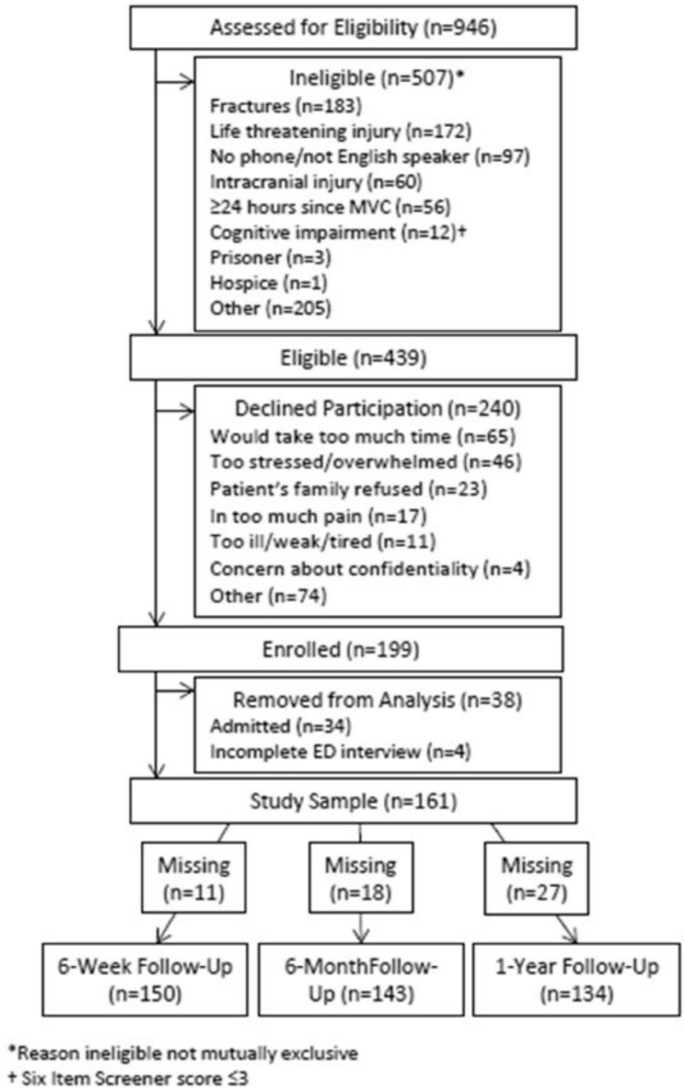


Figure 1.
Flow diagram of screening, enrollment, and follow-up.

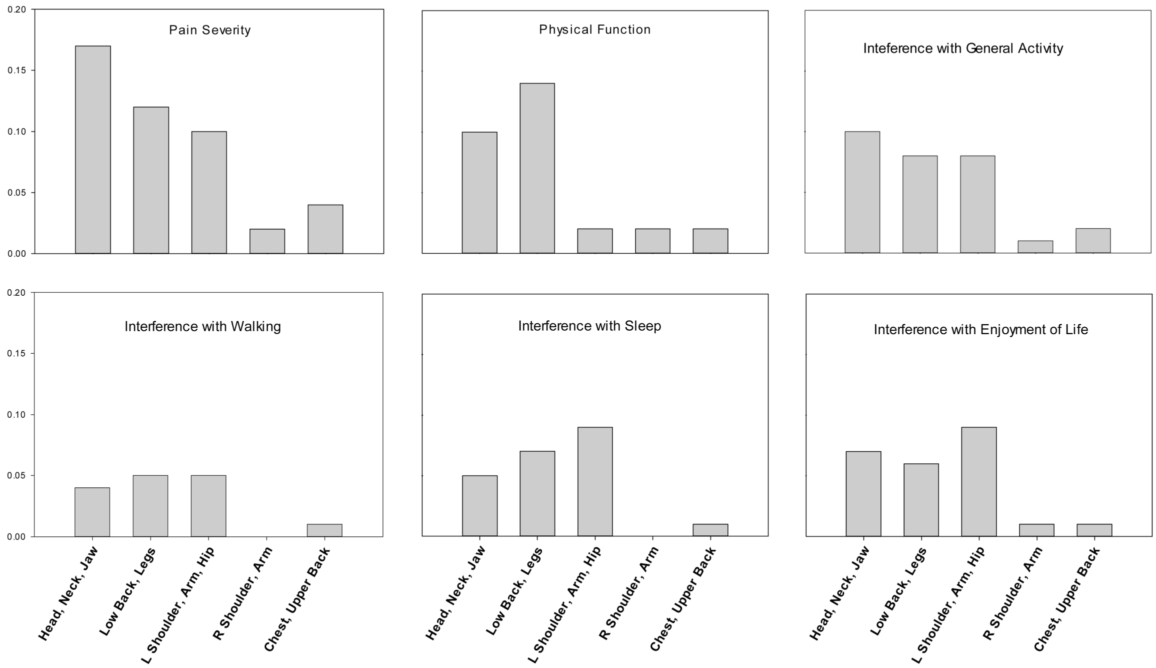


Figure 2.

Proportion of total variance (R-squared) in pain severity, physical function, and pain interference (four domains) assessed 6 months after the motor vehicle collision explained by five pain location components identified at the time of the emergency department evaluation.

Table 1

Characteristics of study participants: individuals aged 65 years or older presenting to the emergency department (ED) after motor vehicle collision (MVC; N=161) and at 6 months (N=143).

	N(%)			
	ED	6 Months		
Characteristic	N=161	Overall N=143	Persistent Pain N=37	No Persistent Pain N=106
Demographics				
Age				
65-74	115 (71)	100 (70)	27 (73)	73 (69)
75-84	40 (25)	35 (24)	7 (19)	28 (26)
≥ 85	6 (4)	8 (6)	3 (8)	5 (5)
Female	95 (59)	84 (59)	21 (57)	16 (43)
Race				
White	129 (80)	117 (82)	27 (73)	90 (85)
Black	26 (16)	21 (15)	8 (22)	13 (12)
Other	6 (4)	5 (3)	2 (5)	3 (3)
College degree	64 (40)	57 (40)	8 (22)	49 (46)
Pre-MVC health				
General health				
Excellent	33 (21)	29 (20)	2 (5)	27 (25)
Very good	56 (35)	50 (35)	11 (30)	39 (37)
Good	48 (30)	43 (30)	15 (40)	28 (26)
Fair	19 (12)	17 (12)	8 (22)	9 (9)
Poor	5 (3)	4 (3)	1 (3)	3 (3)
Disability*	27 (17)	21 (15)	9 (24)	12 (11)
MVC characteristics				
Driver	129 (80)	113 (79)	27 (73)	86 (81)
Damage severity				
None	1 (1)	1 (1)	0 (0)	1 (1)
Mild	16 (10)	15 (10)	3 (8)	12 (11)
Moderate	58 (36)	48 (34)	11 (30)	37 (35)
Severe	80 (50)	74 (52)	20 (54)	54 (51)
Missing	6 (4)	5 (3)	3 (8)	2 (2)
MVC speed				
Stationary	37 (23)	35 (25)	10 (27)	25 (24)
<40mph	82 (51)	72 (50)	22 (59)	50 (47)
≥40mph	42 (26)	36 (25)	5 (14)	31 (29)
Airbag deployment	66 (41)	57 (40)	9 (24)	48 (46)
Seatbelt usage	152 (94)	135 (94)	33 (89)	102 (96)
MVC-related pain†				
None	10 (6)	10 (7)	0 (0)	10 (9)

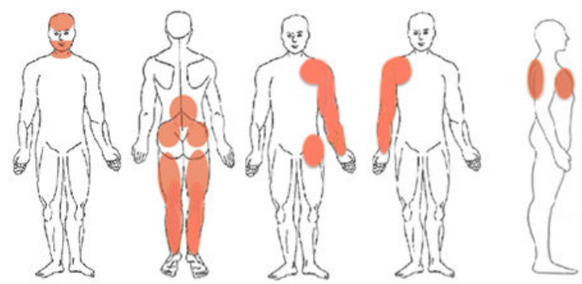
	N(%)			
	ED	6 Months		
Characteristic	N=161	Overall N=143	Persistent Pain N=37	No Persistent Pain N=106
Mild	35 (22)	34 (24)	2 (5)	32 (30)
Moderate	54 (34)	48 (34)	10 (27)	38 (36)
Severe	62 (39)	51 (36)	25 (68)	26 (25)

* Defined as difficulty or inability to perform one or more of six activities of daily living.

† Categories based on numeric pain severity scores of: 0=none; 1-3=mild; 4-6=moderate; 7-10=severe.

Table 2

Loadings of individual pain scores at 15 body locations assessed at the time of the emergency department evaluation on derived principal components.



Location	Pain, %*	"Head, neck and jaw"	"Low back, hips, and legs"	"Left shoulder arm and hip"	"Right shoulder and arm"	"Chest and upper back"
Head	32	0.57†	0.01	0.01	-0.08	-0.02
Neck	36	0.52†	-0.07	0.08	0.10	0.00
Jaw	7	0.35†	0.08	-0.08	0.01	0.18
Left shoulder	17	0.15	-0.08	0.59†	0.01	0.03
Right shoulder	22	0.13	-0.02	-0.00	0.64†	-0.02
Left arm	10	-0.04	-0.04	0.65†	0.03	-0.04
Right arm	12	-0.15	0.09	0.03	0.70†	0.04
Chest	37	-0.25	-0.02	0.01	-0.03	0.83
Upper back	34	0.25	0.00	-0.01	0.04	0.48†
Lower back	32	0.26	0.31†	-0.04	-0.03	0.19
Left hip	11	-0.02	0.40†	0.34†	-0.26	0.02
Right hip	18	0.02	0.47†	-0.09	0.11	-0.02
Left leg	14	-0.19	0.45†	0.23	0.01	0.04
Right leg	17	0.05	0.54†	-0.19	-0.02	-0.03

*Defined as present if ED pain severity ≥4 (0-10 scale).

†Factor loadings ≥0.30.

Table 3

Pain, pain interference, and treatment of pain 6 weeks, 6 months, and 1 year after the motor vehicle collision (MVC).

	% (95% CI)		
Symptom	**6 Weeks (N=151)**	**6 Months (N=143)**	**1 Year (N=134)**
Pain			
Moderate to severe	50 (42-58)	33 (26-41)	35 (27-44)
Severe	22 (16-29)	16 (11-23)	11 (6-17)
MVC-related pain			
Moderate to severe	42 (35-50)	26 (19-34)	25 (18-33)
Severe	17 (12-24)	13 (9-20)	9 (5-15)
Pain interference[*]			
General activity	45 (36-54)	31 (24-39)	43 (32-55)
Walking ability	44 (35-53)	30 (23-38)	47 (36-59)
Sleep	39 (31-48)	31 (24-39)	40 (29-52)
Enjoyment of life	36 (28-45)	25 (19-33)	43 (32-54)
MVC-related pain interference[†]			
General activity	40 (32-49)	25 (18-33)	34 (24-45)
Walking ability	36 (29-46)	23 (17-31)	29 (20-39)
Sleep	33 (26-42)	27 (20-35)	27 (19-38)
Enjoyment of life	31 (23-40)	19 (13-26)	29 (20-40)
Treatment of pain[‡]			
Any analgesic	68 (60-76)	54 (44-62)	53 (42-63)
Opioid	23 (17-32)	18 (12-27)	16 (10-25)
Non-pharmacologic	48 (43-59)	40 (32-48)	35 (27-44)
Healthcare use			
New ED visits	9 (5-14)	19 (13-26)	24 (17-33)
Hospitalizations	7 (4-13)	13 (9-20)	17 (12-25)

[*] Pain interference considered present if rated by participant with a score ≥4 on a scale of 0 to 10 for each domain.

[†] MVC-related pain interference considered present if pain interference rated by participant with a score ≥4 and overall pain score ≥1 and attributed to MVC at that time point.

[‡] Analgesic and opioid use considered present if patients reported daily use. Use of any analgesic, opioid, and non-pharmacologic therapies are not mutually exclusive

Table 4

Percentage of participants with MVC-related persistent pain, defined as a pain score ≥4 attributed to the MVC at 6 months, overall and by subgroups.

Characteristic	Total N	Persistent Pain % (95% CI)	Persistent Pain Adj.* % (95% CI)
All patients	143	26 (19-33)	--- ---
Age			
65-74	100	27 (19-36)	--- ---
≥75	43	23 (13-38)	--- ---
Gender			
Female	84	25 (17-35)	--- ---
Male	59	27 (17-40)	--- ---
Race			
White	117	23 (16-32)	23 (16-31)
Black	21	38 (21-59)	39 (20-61)
Other	5	40 (12-77)	43 (11-83)
Education level			
College	57	14 (8-25)	14 (7-26)
No college	86	33 (28-43)	33 (24-44)
Damage severity			
Moderate/minor	69	22 (14-33)	22 (13-33)
Severe	74	27 (18-38)	27 (18-38)
ED pain severity			
None/mild	44	5 (1-15)	4 (1-16)
Moderate	48	21 (12-34)	21 (12-35)
Severe	51	49 (36-62)	49 (36-63)
Peritraumatic distress†			
<23	46	24 (14-38)	23 (13-38)
≥23	82	26 (17-36)	26 (17-37)
Missing	15	--- ---	--- ---
Expected recovery			
≤30 days	88	22 (15-32)	22 (15-32)
>30 days	26	46 (30-62)	47 (31-64)
Missing	29	--- ---	--- ---
Self-rated health			
Good, very good, or excellent	122	23 (16-31)	23 (16-31)
Fair or poor	21	43 (24-63)	43 (24-64)
Pain catastrophizing‡			
<15	56	23 (14-36)	23 (14-36)
≥15	72	28 (19-39)	28 (19-39)
Missing	15	--- ---	--- ---
Depressive symptoms			
Yes	36	46 (29-65)	48 (29-68)

Characteristic	Total N	Persistent Pain % (95% CI)	Persistent Pain Adj.* % (95% CI)
No	107	23 (15-33)	22 (15-32)
Average sleep prior to MVC			
≥7 hours	92	23 (16-33)	23 (16-33)
<7 hours	46	30 (19-44)	30 (18-44)
Missing	5	--- ---	--- ---

*Adjusted for age, sex, and ED enrollment site.

†Peritraumatic distress inventory score.

‡Pain catastrophizing score.

Table 5

Outcomes for participants 6 months after the motor vehicle collision (MVC), for the entire sample and for those with and without MVC-related persistent pain, defined as a pain score ≥4 attributed to the MVC at 6 months.

	% (95% CI)		
Outcome	**All (N=143)**	**Persistent pain (N=37)**	**No persistent pain (N=106)**
Decline in physical function	47 (37-56)	73 (56-86)	36 (26-47)
New disability (1 pt or more)*	24 (17-33)	42 (26-59)	17 (10-27)
New disability (2 pt or more)*	12 (8-20)	26 (14-43)	7 (3-15)
Reduced self-rated health†	37 (29-45)	54 (38-69)	30 (22-40)
Change in living situation	11 (8-20)	23 (12-39)	8 (4-16)
Driving anxiety‡	22 (16-29)	41 (26-57)	15 (10-23)
ED visit since MVC	19 (13-26)	30 (17-46)	15 (9-23)
Hospitalization since MVC	13 (9-20)	24 (13-40)	9 (5-17)

*Defined as a 1 or more or 2 or more point increase in summary score based on participant's self-reported ability to bathe, dress, transfer from bed to chair, rise from chair, use toilet, or eat.

†Defined as a decline in a participant's self-rated health by one or more level (e.g. from very good to good, good to fair, etc.).

‡Defined as participants reporting feeling quite a bit or much more nervous about driving than prior to the accident. Percentage calculated among those still driving (N=136).