U.S. Department
of Transportation

National Highway
Traffic Safety
Administration

NHTSA

DOT HS 812 288 May 2016

Functional Outcomes for Older Adults Injured in a Crash

Disclaimer

Suggested APA Format Citation:

Tison, J., Chaudhary, N. K., Connolly, J. W., Preusser, D. F., & Hutchinson, K. (2016, May). *Functional outcomes for older adults injured in a crash* (Report No. DOT HS 812 288). Washington, DC: National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No. DOT HS 812 288	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Functional Outcomes for Older Adults Injured in a Crash		5. Report Date May 2016 6. Performing Organization Code
7. Authors Julie Tison, Neil K. Chaudhary, Joyce W. Connolly, David F. Preusser, Kimberly Hutchinson		8. Performing Organization Report No.
9. Performing Organization Name and Address Preusser Research Group, Inc. 7100 Main Street Trumbull, CT 06611		10. Work Unit No. (TRAIS) 11. Contract or Grant No. DTNH22-05-D-00047
12. Sponsoring Agency Name and Address U.S. Department of Transportation / NHTSA Office of Behavioral Safety Research 1200 New Jersey Avenue SE. W46-478 Washington, DC 20590		13. Type of Report and Period Covered Final Report, 2012 14. Sponsoring Agency Code
15. Supplementary Notes Dr. Kathy Sifrit was the Contracting Officer's Technical Representative (COTR).		

16. Abstract

This project explored long-term health and quality-of-life implications of crashes among older and middle-age motor vehicle occupants in Connecticut and Indiana. Analysts compared outcomes of a sample of older (65+) injured occupants with those of a sample of similarly involved yet uninjured older occupants in Connecticut. The results, as measured by the eight SF-36 Health Survey scales, indicated that the injured had substantial health decrements approximately two years following the crash. Analyses of cases from Indiana included older (65+) injured occupants as well as middle-age (40-55) injured occupants. Both groups showed continuing health decrements approximately 15 months following the crash, particularly among occupants whose injuries required hospitalization. Although older and middle-age injured occupants showed similar physical effects, the middle-age group showed greater quality-of-life decrements.

17. Key Words Injury, motor vehicle crash, older occupants, long-term		18. Distribution Statement Available to the public from the National Technical Information Service www.ntis.gov	
19. Security Classif.(of this report) Unclassified	20. Security Classif.(of this page) Unclassified	21. No. of Pages 19	22. Price

Form **DOT F 1700.7** (8-72)

Reproduction of completed page authorized

Contents

List of Tables

List of Figures

I. INTRODUCTION

Census data indicates that in 2012 people 65 and older represented 13.7% of the population of the United States, and this group has been projected to account for more than 20% of the U.S. population by 2035 (U.S. Census Bureau, 2013). As the size of the older population increases, one can reasonably expect a parallel increase in the number of older people on the road.

Physical, cognitive and perceptual abilities may decline with age and make the task of driving more challenging. Many older drivers are aware of these changes, and some report avoiding potentially risky conditions such as driving at night, in heavy or high-speed traffic, in bad weather, or in unfamiliar areas (see Braitman & Williams, 2011; Jones et al., 2011; Naumann, Dellinger, & Cresnow, 2011). Despite these self-regulating behaviors, older drivers and occupants tend to be overrepresented in serious injury and fatal motor vehicle crashes. A report by the Organisation for Economic Co-operation and Development (OECD, 2001) notes safety risks resulting from older adults' fragility or increased likelihood of being injured in a crash.

Older drivers tend to have a higher death rate per mile traveled than do their younger counterparts. Crash forces that result in non-fatal injuries in a younger driver may be fatal for a driver over 65 (Li, Braver, & Chen, 2003; see Koppel, Bohensky, Langford, & Taranto, 2011 for a review). Li et al. (2003) examined age differences in fatalities per mile driven to tease apart the contributing roles of fragility and higher crash involvement in older drivers. They reported that fragility, assessed by the rate of driver death per crash involvement, was stable until age 60 and then increased steadily. The rate of increase accelerated beyond age 80. The crash involvement rate per unit of vehicle miles traveled was stable through age 69, started to increase among drivers 70 to 74, and continued to rise with increasing age.

It is generally accepted that older adults have an elevated risk of injury or death from vehicle crashes; however, little is known about the long-term medical outcomes for older adults who survive more than 30 days after a crash. An occupant older than 65 is likely to experience more severe injuries than a younger occupant experiencing a crash of comparable severity. Cook et al. (2000) reported that drivers age 70 and older were 3 times more likely to be hospitalized or killed in a crash than were drivers 30 to 39 years old. In crashes where both younger and older drivers were wearing seat belts, the ratio increased to seven-to-one. Connecticut's crash database shows that 22% of crash-involved drivers 70 and older were reported by police to have injuries that were at least moderate, compared to 18% among crash-involved drivers 35-49 years old (CT DOT, 2009). Conversely, data for 2009 indicates that for all injury and tow-away crashes in the United States, 17% of motor vehicle occupants age 65 and older suffered injury as compared to 18% of occupants 40 to 55 years old (NHTSA, General Estimate System).

Evidence strongly indicates that older adults have an elevated risk of injury or death from vehicle crashes. Moreover, they are much more likely to be hospitalized, though some of this increased hospitalization may be prophylactic. The older person may be more fragile and frail (less able to recover from crash injuries and resume a pre-injury functional level), so should be monitored more closely following trauma. Andersen et al., 2010, reported long-term health consequences for older (65+) and younger (18-64) people who were seriously injured in a motor vehicle crash. Six months following the crash, both age groups showed substantial declines in physical function, vitality and mental health as measured by the Short Form 36 Health Survey (SF-36), a standardized self-report instrument used to measure health status.[1] Conditions improved at 12 months, though not to pre-crash levels. One surprising finding from this study was that while older people had poorer baseline scores on measures of *Physical Function* and *Vitality,* the course of decline and recovery was virtually parallel in the younger and older groups. The same pattern was seen with respect to *Mental Health,* though older people started and ended with better scores.

The current project further examined the extent of long-term consequences suffered by occupants injured in motor vehicles. Specifically, the study evaluated whether (1) older occupants injured in a motor vehicle crash suffered more long-term health consequences compared to an age- and crash-history-equivalent uninjured control group, and (2) whether older occupants injured in a motor vehicle crash suffered long-term health consequences more so than middle-age occupants. The study was retrospective; occupants were contacted one to two years after a crash event in two States: Connecticut and Indiana. For the Connecticut sample, analyses compared injured older adults and similarly exposed yet uninjured occupants of similar age. In Indiana, analyses compared hospitalized and non-hospitalized injured older adults, and hospitalized and non-hospitalized middle-age injured occupants.

II. METHOD

A. Crash Report Collection and Participant Recruitment

Due to a personnel shortage, Connecticut State Police were unable to fulfill the request. State Police covered major limited access highways and some rural areas of the State, accounting for about 23% of the occupants who otherwise would have been in the sample. Therefore, crash reports included in this study cover municipal/local departments only. Analysts identified Connecticut crash reports from the computerized Connecticut crash file (excluding property damage crashes resulting in less than $2,000 in vehicle damage) from 2009. They selected cases that referenced a driver or occupant 65 or older who did not die within 30 days from crash injuries. Connecticut local law enforcement agencies provided paper copies of these crash reports.

Law enforcement agencies in Indiana uploaded crash reports electronically; an outside firm maintained an online database for crash report data management, so paper copies of crash reports were not required. Indiana crash reports did not include names of uninjured passengers involved in crashes. Thus, the Indiana sample included all injured drivers and passengers 65 and older for the year

[1] See www.sf-36.org/tools/sf36.shtml for a description of the SF-36. See also Table 4.

2009. Researchers drew a random subset of crash records for injured occupants 40-55 years old as a control group. Table 1 shows the breakdown of crash reports collected from the two States.

Table 1. Crash Report Collection in Connecticut and Indiana by Age Group

	Connecticut	Indiana	
	Age 65+	Age 65+	Age 40-55
Crash Reports	849	1,548	1,362

Crash reports included names and addresses of crash occupants, but not their full contact information. The research team obtained telephone numbers through searching online databases and using services of a third- party vendor. Records with partial matches or no matches were excluded, as were police officers or other emergency personnel involved in crashes, individuals who were incarcerated or otherwise unavailable, and individuals who had been injured in multiple recent crashes. Individuals who were no longer living were removed from the database. Most of the deceased were in the 65+ group (36 in Connecticut, 131 in Indiana); only 14 were in the 40-55 age group.

Study recruitment began in 2011. The research team sent letters to potential participants that outlined the purpose of the project and indicated that a research team member would contact them by telephone to determine their eligibility and interest in participating. The letter also noted that those who qualified and participated would receive $20 as compensation for the 12- to 15-minute screening process needed to confirm eligibility.

Table 2 provides the number of potential participants who were sent invitations by State and by age group, and how many of those invitations were undeliverable. Note that letters were sent approximately one to two years following the crash and thus it was expected that some would not be deliverable.

Table 2. Participant Recruitment Letters Sent by State and Age Group

	Connecticut	Indiana	
	Age 65+	Age 65+	Age 40-55
Invitations Mailed	779	1,493	1,315
Undeliverable Invitations Returned	50	42	73

B. Participant Pre-Screening

The research team contacted potential participants by telephone approximately one week after recruitment letters were mailed. Researchers first determined whether the person met the study inclusion criteria. Table 3 illustrates the outcome of recruitment by State and by age group.

Table 3. Recruitment Contacts by State and Age Group

Contact Outcomes	Connecticut Age 65+	Indiana Age 65+	Indiana Age 40-55
Total Sample	***645 (329 Injured)***	***1,492***	***1,362***
Eligible Participants	107 (64 Injured)	369	230
Refusals	160	295	82
Inaccurate contact information (disconnected, fax, wrong #, etc.)	89	210	354
Screened Out (no crash, multiple crashes, wrong age)	65	200	102
Language not English	21	34	10
Deceased*	40	29	10
Unable to reach after multiple attempts	163	355	574

*Additional deceased individuals were identified and removed from the sample prior to attempted phone contact.

It is important to note differences in samples from the two States. Connecticut's sample consisted of injured and uninjured occupants, 65 or older. Here the goal was to examine, in 2011, the long-term health differences between injured and uninjured older adults who were involved in a crash during 2009. Indiana's data set included only injured occupants. For this sample, the goal was to compare in 2011 the long-term outcomes for injured occupants 40-55 years old with those 65 and older who were involved in crashes in 2010. The two samples were independent from one another and therefore sample contacts are discussed separately below.

1. Connecticut

The research team recruited 107 occupants from the Connecticut sample who met study criteria and agreed to participate in a study. Participants' ages ranged from 65 to 93; 52% were men. In six cases, the occupant was unable to respond to researchers, so a family member provided information. Some participants (10% of the sample) had been involved in a crash in the years prior to the crash included in this study, but none had been injured in that prior crash. Participants were contacted, on average, 25.7 months following the crash (range 21-33 months).

Researchers used police-reported injury codes on crash reports to identify injury status. Any occupant recorded as having a minimum injury severity of *possible injury* was considered injured for the purposes of this study. Overall, 64 (60%) participants were classified as injured and 43 (40%) as uninjured.

2. Indiana

The final Indiana sample consisted of 599 participants. Of that sample, 369 (62%) were older adults (65 or older) and 230 (38%) were between 40 and 55. Classifying injury severity in the Indiana sample relied on participant self-reports during the health status and functioning screening process (outlined in the following section). Some Indiana participants (n=18) indicated that they had not been injured in the crash and thus were excluded from the final sample. The final sample (N=599) ranged in age from 40 to 94; 41% were men. Participants were contacted, on average, 14.6 months following the crash (range 8-23 months).

In 11 cases (1 from the middle-age group, 10 from the older group) the occupants were unable to respond to researchers, and family members provided information. A small percentage (7%) of participants had been involved in a crash in the years prior to the crash included in this study, but none had been injured in that prior crash.

C. Health Status and Functioning

Researchers asked participants about crash injuries. All Indiana participants, as well as all Connecticut participants who had been injured, completed a screening tool, which included items from the SF-36 and items to assess their use of medical and other services following the crash.

The SF-36 screening tool is widely used to measure health-related quality of life. As its name implies, the instrument consists of 36 items designed to assess both mental and physical health. The 36 items are organized into 8 scales, each measuring a distinct concept. Answers for each item carry a weight, and scale scores are obtained by summing the weighted value of items associated with each scale. Each score is based on a scale of 0-100, with higher scores indicating better health. The eight scales are: 1) *Vitality*, 2) *Physical Functioning*, 3) *Bodily Pain*, 4) *General Health Perceptions*, 5) *Physical Role Functioning*, 6) *Emotional Role Functioning*, 7) *Social Role Functioning*, and 8) *Mental Health*. Table 4 provides a brief description of each component scale.

Table 4. SF-36 Scales Descriptions

Scale	Description	Examples
Vitality	Energy level	Feeling energetic/lethargic
Physical Functioning	Ability to perform vigorous, moderate, and basic physical activities	Able/unable to run, play golf, walk, use stairs, bathe, dress without assistance
Bodily Pain	Extent to which pain interferes with normal activities	Able/unable to carry groceries into the house and put them away due to pain
General Health Perceptions	Beliefs about own health, current and prospective	Feeling more/less healthy than others, or as compared to before the crash
Physical Role Functioning	Effect of physical health on carrying out daily activities	Able/unable to carry groceries into the house and put them away due to physical health
Emotional Role Functioning	Effect of emotional health on carrying out daily activities	Maintained/limited interest in formerly rewarding work and daily activities
Social Role Functioning	Effects of physical and mental health on social activity	Unlimited/limited ability to participate in activities with family, friends
Mental Health	Effects of emotional health on psychological distress, social limitations	Feeling calm/nervous, composed/anxious, happy/blue

Adapted from www.sf-36.org/tools/sf26.shtml

The Connecticut sample supported a comparison of injured and uninjured older adults involved in a crash, thus assessing the role of injury in health and functioning. The Indiana sample allowed for a comparison of middle-age and older adults injured in a crash, supporting exploration of the role of age in post-crash health, functioning, and recovery from injuries.

III. RESULTS

A. Connecticut Sample – Older Adults' Health and Injury Status

The Connecticut sample consisted of 107 participants split into two groups based on police-reported injury status: injured (n = 64 [60%]) and uninjured (n = 43 [40%]) older adults. Scores for the eight SF-36 subscales were computed; average scores were compared between the two groups.

The results in Table 5 show that scores were significantly lower for the injured group, as compared to the uninjured group, on five of the scales even two years after the crash. The groups were comparable with respect to age, an average of 75 for the injured group and 74 for the uninjured group, ($t(105) = 0.745$, $p > 0.05$). Thus, the difference in scores cannot be attributed to age.

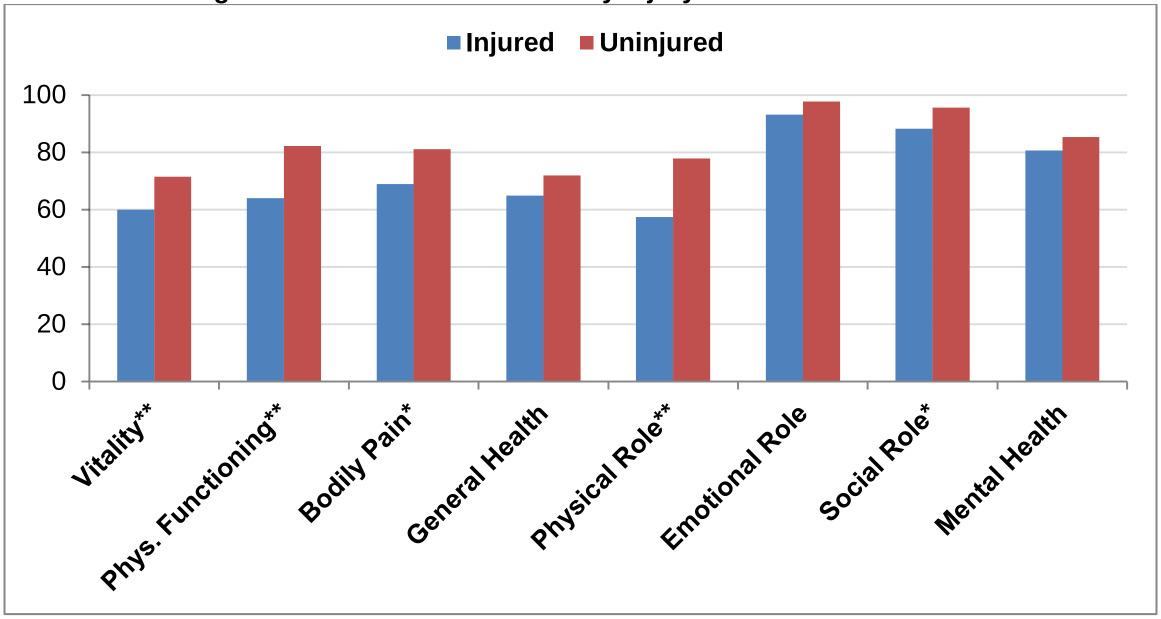
Table 5. Mean Scale Scores (0-100) by Injury Status – Older Occupants

Scales	Injured	Uninjured	Difference
Vitality	60.0	71.5	-11.5**
Physical Functioning	64.0	82.2	-18.2**
Bodily Pain	68.9	81.1	-12.2*
General Health Perceptions	64.9	71.9	-7.0
Physical Role Functioning	57.4	77.9	-20.5**
Emotional Role Functioning	93.2	97.7	-4.5
Social Role Functioning	88.3	95.6	-7.3*
Mental Health	80.7	85.4	-4.7

*indicates $p < 0.05$; **indicates $p < 0.01$.

Independent samples t-tests conducted on the eight SF-36 subscales showed significant group differences on five of the eight scales in the predicted direction. Older adults who were injured in a crash obtained significantly poorer scores than their uninjured counterparts on *Vitality*, *Physical Functioning*, *Bodily Pain*, *Physical Role Functioning*, and *Social Role Functioning* (see Figure 1).

Figure 1. Health Scales Scores by Injury Status – Older Adults



* indicates $p<.05$; **indicates $p<.01$

Results suggest that crash injuries continued to have a negative impact on daily life two years after the injury. Not only were injured occupants more affected by bodily pain, but crash injuries were associated with lower energy levels and increased physical limitations, and affected participants' abilities to perform daily activities, which in turn affected their social lives. The groups' scores did not differ significantly on scales measuring mental and emotional health, or on measures of their perceptions about general health.

Among the injured occupants, the only significant difference between sexes was on the *Social Functioning* scale ($t(62)=2.40$, $p<0.05$). No sex differences among the uninjured group were statistically significant (see Table 6).

Table 6. Health Scale Scores by Sex and Injury Status

Scales	Not Injured			Injured		
	Men	Women	Diff.	Men	Women	Diff.
Vitality	74.7	66.6	+8.1	57.2	62.5	-5.3
Physical Functioning	86.9	75.0	+11.9	61.0	66.6	-5.6
Bodily Pain	85.7	74.1	+11.6	69.8	68.0	+1.8
General Health Perceptions	71.9	71.8	+0.1	60.2	69.2	-9.0
Physical Role Functioning	81.7	72.1	+9.6	49.2	64.7	-15.5
Emotional Role Functioning	100.0	94.1	+5.9	88.9	97.1	-8.2
Social Role Functioning	97.1	93.4	+3.7	82.5	93.4	-10.9*
Mental Health	86.2	84.2	+2.0	80.4	80.9	-0.5

* indicates $p<0.05$

B. Indiana Sample – Injured Occupants, Age, and Health

The Indiana sample consisted of 599 participants, all of whom were injured. Two hundred twenty-eight (38%) of the participants were 40 to 45, and 371 (62 %) were 65 or older. Analysts compared average scores for each of the eight SF-36 scales for older and younger participants. Researchers hypothesized that older injured participants would suffer more long-term consequences of injury than would younger participants.

As Table 7 indicates, the older group scored significantly lower on one of the eight SF-36 scales: *Physical Functioning*. Older participants scored significantly higher on two scales: *Social Role Functioning*, and *Mental Health*. There were no significant differences by sex.

Table 7. Mean Scale Scores (0-100) by Age – Injured Occupants

Scales	Injured 65+	Injured 40-55	Difference
Vitality	53.1	53.5	-0.4
Physical Functioning	60.5	70.3	-9.8**
Bodily Pain	62.2	63.5	-1.3
General Health Perceptions	59.8	61.3	-1.5
Physical Role Functioning	50.5	57.3	-6.8
Emotional Role Functioning	84.2	80.1	+4.1
Social Role Functioning	85.7	80.8	+4.9**
Mental Health	78.3	73.8	+4.5**

**indicates $p<0.01$

All Indiana participants were injured as a result of a crash. Researchers did not know the extent and nature of the injuries, only whether the participant was hospitalized; they assumed that hospitalized occupants sustained more serious injuries than those who were not hospitalized.

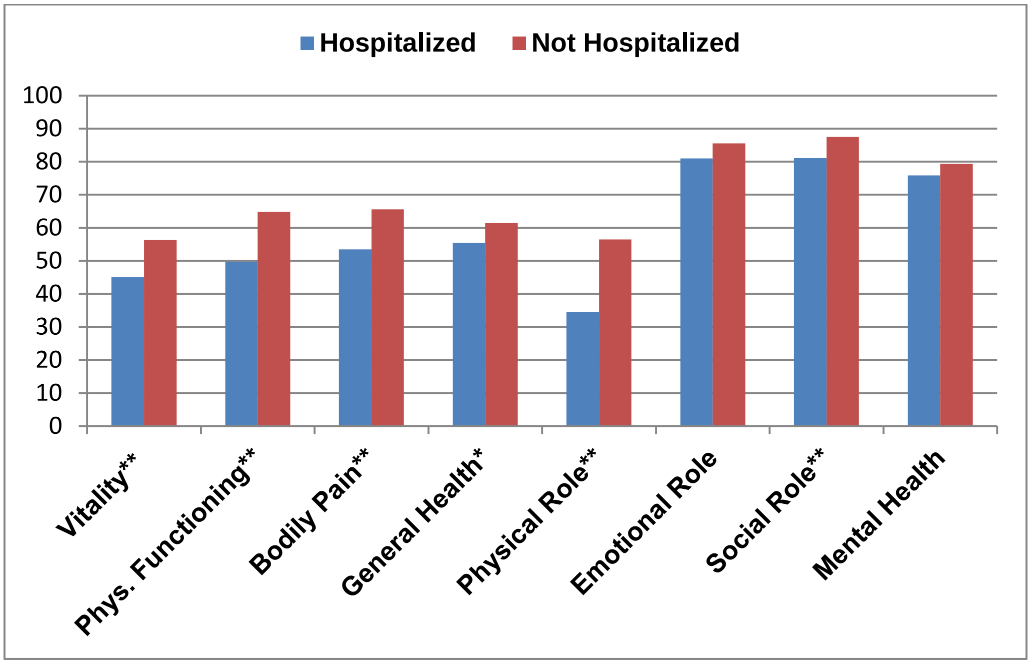
Analysts obtained hospitalization status for 366 older participants, 102 (28%) of whom were hospitalized. Of the 229 middle-age participants for whom hospital status was available, 50 (17%) were hospitalized. Table 8 shows SF-36 scores by hospitalization status for each group. Hospitalized participants demonstrated lower SF-36 scores than the non-hospitalized group for both age groups one to two years following the crash. As Figure 2 illustrates, the older hospitalized and non-hospitalized groups differed significantly on six of the eight scales: *Vitality, Physical Functioning, Bodily Pain*, *General Health Perceptions*, *Physical Role Functioning*, and *Social Role Functioning*.

Table 8. Health Scale Scores by Hospitalization and Age

	Injured 65+			Injured 40-55		
Subscales	**Hospitalized**	**Not Hospitalized**	**Diff.**	**Hospitalized**	**Not Hospitalized**	**Diff.**
Vitality	45.0	56.3	-11.3**	49.1	55.1	-6.0
Physical Functioning	49.7	64.8	-15.1**	56.7	74.5	-17.8**
Bodily Pain	53.5	65.6	-12.1**	52.6	66.9	-14.3**
General Health Perceptions	55.4	61.4	-6.0*	54.8	63.5	-8.7*
Physical Role Functioning	34.5	56.5	-22.0**	31.0	65.0	-34.0**
Emotional Role Functioning	81.0	85.5	-4.5	68.0	84.0	-16.0**
Social Role Functioning	81.1	87.5	-6.4**	72.3	83.7	-11.4**
Mental Health	75.8	79.3	-3.5	66.4	76.3	-9.9**

*indicates p < .05; **indicates p < .01

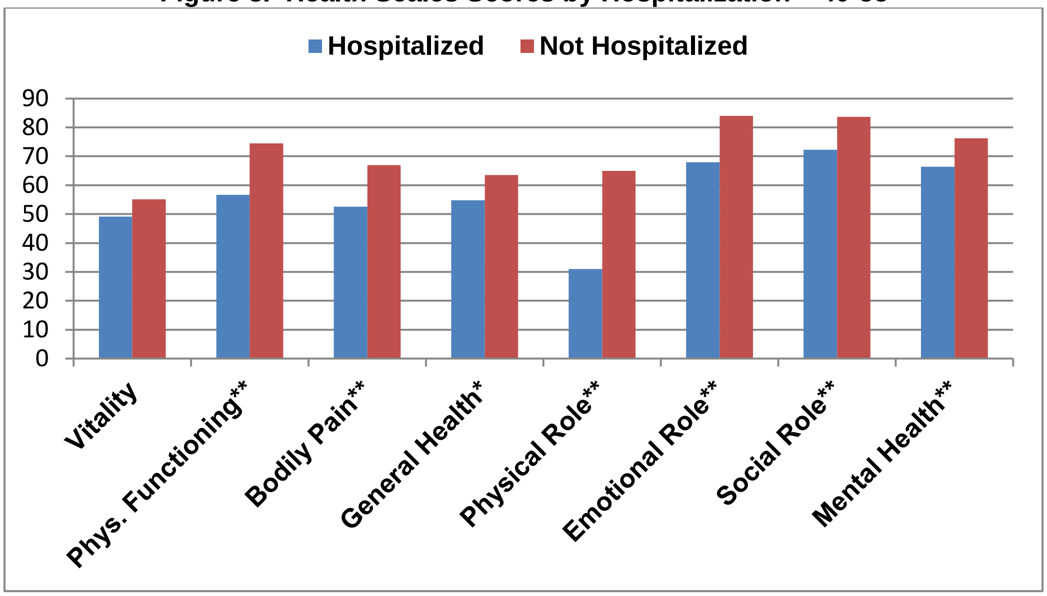
Figure 2. Health Scales Scores by Hospitalization – 65+



* indicates p<.05, ** indicates p<.01

The middle-age hospitalized and non-hospitalized groups differed significantly on seven of the eight scales (see Figure 3): *Physical Functioning*, *Bodily Pain*, *General Health Perceptions*, *Physical Role Functioning*, *Emotional Role Functioning*, *Social Role Functioning*, and *Mental Health*.

Figure 3. Health Scales Scores by Hospitalization – 40-55



* indicates p<.05, ** indicates p<.01

Two (age-group: older, middle-age) by two (status: hospitalized, not hospitalized) analyses of variance (ANOVAs), one for each of the scales, explored the main effects and interactions between age and hospitalization status. The results indicated that hospitalized participants, regardless of age, scored significantly lower than the non-hospitalized with respect to every measure:

- *Vitality* (F(1,591)=14.14, *p<.01),*
- *Physical Functioning* (*F*(1,591)=34.90, *p*<.01),
- *Bodily Pain* (*F*(1,591)=23.28, *p*<.001),
- *General Health Perceptions* (*F*(1,591)=10.71, *p*<.01),
- *Physical Role Functioning* (*F*(1,591)=48.99, *p*<.01),
- *Emotional Role Functioning* (*F*(1,591)=9.72, *p*<.01),
- *Social Role Functioning (F*(1,591)=17.26, *p*<.01, and
- *Mental Health* (*F*(1,591)=11.61, *p*<.01).

Analyses revealed a main effect of age such that older participants scored significantly lower than the middle-age group on *Physical Functioning* (*F*(1,591)=8.98, *p* < .01). Older participants scored significantly higher on *Emotional Role Functioning* (*F*(1,591)=4.93, *p*<.01), *Social Role Functioning* (*F*(1,591)=8.79, *p*< 01) and *Mental Health* (*F*(1,591)=9.77, *p*<.01). None of the main effects for hospitalization status or the interactions between age and hospitalization was statistically significant. These measures, taken one to two years after the crash, are consistent with the results reported by Andersen et al., 2010, taken 6 and 12 months following the crash. That is, the middle-age fare somewhat better than the elderly with respect to physical function health variables; worse than the elderly with respect to the mental health variables.

IV. Discussion

Analyses of Connecticut data revealed that crash-injured occupants obtained poorer scores on five of the eight SF-36 scales one to two years after the crash event. Participants who had been injured, as compared to their uninjured counterparts, reported lower energy levels, difficulty performing physical tasks, more physical pain, and more limitations in performing daily activities and interacting socially. These findings suggest that crash injury negatively affects the long-term functional abilities of older persons. The Connecticut data included only older adults, so does not support conclusions about effects of injuries on older, as compared to younger, occupants.

Data from Indiana supported comparisons between older (65+) and middle-age (40-55) participants. The older participants scored lower on one of the physical health scales, but higher on two of the mental health scales. The Indiana sample was further separated with respect to whether the participant had been hospitalized. The results indicated that those who were hospitalized for crash injuries obtained substantially poorer scores—one to two years after the crash—on every Health Scale. Older participants showed markedly poorer scores on the physical scales; middle-age participants scored more poorly on both the physical and mental measures.

Reasons for the injured middle-age participants' poorer performance on measures of mental health are not clear, but the disparity may result from differences in the roles of middle-age, as compared to older, adults. Many of the older participants may have been retired, and therefore better able to adapt their schedules and responsibilities to meet their post-crash limitations. This may have been a more difficult task for those middle-age participants who were still balancing work and family obligations.

The study sample was not representative. The research team was unable to reach a number of potential participants because they had moved since the crash, they were institutionalized, or for other reasons. Further, many persons did not want to, or were advised not to, discuss the crash event, and subsequently opted not to participate. The extent to which these factors influenced the eventual representativeness of this study is unknown.

A. Conclusions

The study documented health and functional decrements one to two years following motor vehicle crash injury. These decrements should be considered when estimating costs for quality of life lost as a result of crash involvement.

The results demonstrated decrements across adult age groups. Older adults were expected to show more long-term effects than the middle-age, but this was not the case. While older participants had poorer physical abilities before the crash, the findings suggest that they had performed better than their middle-age cohorts on the mental measures before, as well as after, the crash (see also Andersen et al., 2010).

V. References

Anderson, A., Ryb, G., Dischinger, P., Kufera, J., & Reed, K. (2010). Self-reported health indicators in the year following a major vehicle crash: A comparison of younger versus older subjects. *Annals of Advances in Automotive Medicine*, *54*, 359-367.

Braitman, K. A., & Williams, A. F. (2011). Changes in self-regulatory driving among older drivers over time. *Traffic Injury Prevention*, *12*, 568-575.

Connecticut Department of Transportation. (2009). Accident File. Available: Connecticut Department of Transportation, Division of Systems Information.

Cook, L. J., Knight, S., Olson, L. M., Nechodom, P. J. & Dean, J. M. (2000). Motor vehicle crash characteristics and medical outcomes among older drivers in Utah, 1992-1995. *Annals of Emergency Medicine*, *35*(6), 585-91.

Jones, C. V., Cho, J., Abendschoen-Milani, J., & Gielen, A. (2011). Driving habits and risk exposure in older drivers: Lessons learned from the implementation of a self-regulation curriculum. *Traffic Injury Prevention*, *12*, 468-474.

Koppel, S., Bohensky, M., Langford, J., & Taranto, D. (2011) Older drivers, crashes and injuries. *Traffic Injury Prevention*, *12*, 459-467.

Li, G., Braver, E. R., and Chen, L. (2003). Fragility versus excessive crash involvement as determinants of high death rates per vehicle-mile of travel among older drivers. *Accident Analysis and Prevention*, *35*, 227-235.

Organisation for Economic Co-operation and Development. (2001). *Ageing and Transport. Mobility Needs and Safety Issues*. Paris, France: OECD Publications.

Naumann, R. B., Dellinger, A. M., & Kresnow, M. (2011). Driving self-restrictions in high risk conditions: How do older drivers compare to others? *Journal of Safety Research*, *42*, 67-71.

DOT HS 812 288
May 2016

U.S. Department
of Transportation

National Highway
Traffic Safety
Administration

NHTSA

12377-060616-v1c