

Older Adults and Unintentional Injury



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KEYWORDS

• Older drivers • Unintentional injury • Driving safety • Fall prevention

KEY POINTS

- Falls and motor vehicle crashes (MCVs) are responsible for the majority of unintentional injuries in older adults.
- Clinicians have an important role in addressing risks for MCVs and falls in older adults with appropriate screening and evidenced-based interventions.
- Interventions for fall and MCV risk reduction reducing impairing medications, improving cognitive and physical capabilities, and augmenting environment when possible.

BACKGROUND

Older adults are the fastest growing population in the United States, with the population of people older than 65 years being nearly 53 million in 2018.¹ Unintentional injuries are a significant cause of morbidity and mortality in this population, with car crashes and falls being the major contributors.

Falls represent a significant cause of preventable injury, and fall-related injuries are the single largest major cause of accidental death and disability among older American adults. Approximately one-quarter of community-residing men and women aged 65 years or older, and almost half of those older than 80 years, fall annually, and risk and prevalence proportionally increases as individuals age.² Alarming, the rate of fall-related mortality has increased over 30% just between 2007 and 2016.³ Fall incidence is expected to continue rising⁴ and carries a considerable financial cost estimated between \$30 and \$50 billion USD annually.⁵

Fall risk is multifactorial and often the result of the interaction of factors including those inherent to an individual and those external or environmental. Examples of conditions that can exacerbate risk, and that increase with aging, include vision problems, cognitive/neurological impairment, depression, medication side effects, drug-drug

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interactions/polypharmacy, hypotensive episodes, muscular weakness, loss of flexibility, and deficits in balance, mobility, and gait.⁶ Environmental considerations include home safety concerns including poor lighting but also neighborhood uneven terrain, lighting, and distractions. Notably and unfortunately, a single fall predicts recurrent falls: between 10% and 44% of elderly patients with a history of falls will sustain additional falls. Aside from the significant risk of morbidity and mortality associated with falls, there is likely a bidirectional association between depression and social isolation with fall risk.⁷

This aging population includes a large proportion of drivers; in 2020, there were 48 million licensed drivers aged 65 years or older in the United States.⁸ Almost 7500 older adults (aged 65 years or older) were killed in motor vehicle crashes in 2020, and over 200,000 treated in emergency departments for crashes. Older adults have higher motor vehicle fatality rates than other age groups except for novice drivers, and those older than 85 years have the highest rates.¹ This increase in crash rates and fatal crash rates per miles traveled starts increasing at approximately age 70 years. Older drivers are more likely to be found at fault in fatal intersection crashes, with the most common errors being inadequate surveillance, misjudgment of vehicle distance and speed, illegal maneuvers, medical events, and daydreaming.⁹ Similar to all other ages, older men have higher crash rates than older women.⁸ Older adults have physical conditions that increase their risk of injury and death in a crash, such as osteoporosis, sarcopenia, and comorbidities.¹⁰

Many older adults maintain robust functional abilities in late life. However, some may experience a decline in visual, cognitive, and/or motor skills, especially in the presence of a disease. Because people are living longer, the number of people with age-associated cognitive impairment and dementia are also increasing. While older patients with cognitive impairment tend to self-limit their driving, a significant number still continue to drive, and dementia may not be recognized by their clinicians.¹¹ Visual impairments associated with aging include cataracts, glaucoma, macular degeneration, and age-related reductions in contrast sensitivity. While hearing loss is associated with aging, the relationship between impaired hearing and driving safety has not been well established.¹² However, frailty, with the associated sarcopenia, osteoporosis, and reduced range of motion, has been associated with crash risk. Driving performance is usually impaired only after a considerable loss of function since most driving patterns are learned and become second nature. Lastly, the comorbidities associated with aging bring increased prescription drug use, with their impairing side effects. Nonetheless, there is consensus among traffic safety experts that older drivers should be kept on the road as long as they can drive safely. In a large meta-analysis, the risk of depressive symptoms after driving cessation was double, in addition to declines in general health, social and cognitive function, and admission to long-term care facilities and mortality, highlighting the importance of a systemic approach to driving retirement recommendations and the important role of clinicians and health care providers.¹³

SCREENING GUIDELINES

While fall risk is multifactorial, identification of risk factors and referral to/participation in appropriate fall-risk-reduction programs are established as an effective, evidenced-based approach to reduce fall risk.¹⁴ Specifically, targeted strength and balance exercise have consistently been shown to improve fall risk, and accordingly, the Centers for Disease Control and Prevention has outlined an evidenced-based *clinical* approach to identify those at risk of falls to help assess known risk factors and to refer for community-based fall-prevention programs^{15,16} (**Table 1**). This toolkit, however,

has been slow to penetrate in routine clinical practice, as barriers reported by physicians to implementing comprehensive fall-prevention screening are time constraints, poor reimbursement for falls screening, and that existing toolkit utilization does not easily fit into a Medicare wellness visit.¹⁷ Because of this, only approximately one-third of older adults report being asked about fall risk, and similarly only around a third of those who fall report discussing this with their health care provider.^{18,19}

Considerable research has been done to identify the risk factors for crashes, which include, as outlined previously, gender, medications, declines in vision, cognitive function and frailty, and comorbidities. The identification of those conditions most likely to lead to crashes can guide physicians on early management or even reversal of the impairing condition. The American Geriatric Society (AGS) and National Highway Traffic Safety Administration (NHTSA) have developed a clinicians' guide for older driver safety now in its fourth edition.²¹ Others have outlined alternative screening options.²² Health care providers report that a barrier to discussing driving concerns with their patients is the fear of alienation.²³ However, older adults report that they expect their health care providers to provide guidance.²⁴ A significant barrier for clinician screening is that the current tools available are very blunt in their ability to predict driving safety events **Table 1**.²⁵

MODEL PROGRAMS ADDRESSING DRIVING SAFETY AND FALLS

Falls

As noted previously, assessment for fall risk has notable concerns for robust clinical integration. At the University of California, San Diego (UCSD), internal surveys (via Qualtrics, Provo, UT) conducted at an internal medicine meeting of primary care clinicians (response N = 16, 28% response rate) showed on a Likert scale, when asked "Falls are a common problem in my patients," an average of 4.5 (between strongly

Screening Test	Driving	Falls
Visual acuity	x	x
Visual fields	x	
Range of motion	x	
Rapid pace walk	x	
Timed get up and go	x	x
Time maze	x	
Montreal Cognitive	x	
Trail Making B	x	
Clock Drawing	x	
30-Second chair stand		x
Four-stage balance test		x
Orthostatic blood pressure lying and standing		x
Identify medications that increase risk (eg, Beers Criteria)	x	x
Assess for comorbidities	Neuropathy, arrhythmias, etc.	Depression, osteoporosis

^a Data adapted from the Centers for Disease Control and Prevention (CDC)'s Stopping Elderly Accidents, Deaths and Injuries (STEADI) algorithm.²⁰

agree and agree), but when asked “I am aware of community-based resources to help reduce fall risk,” the average response was a 2.6, between neutral/neither agree or disagree and disagree; and when asked “I regularly refer patients to community resources when appropriate,” the average score was a 2.4, showcasing the need for improved clinical processes. Of interest, shared medical appointments (SMAs) have shown promise in geriatric populations²⁶ and have the potential to create sustainable mechanisms to evaluate for fall risk within a medical practice. Therefore, a workflow for a fall-prevention SMA was established to comprehensively screen and evaluate for fall risk at UCSD internal medicine, which launched in November of 2021, aimed to provide medical advice and community resources or clinical referrals based on fall-risk assessment. To date, this SMA hosted monthly has clinically assessed 45 older adult patients, and of a subgroup of 33 analyzed individuals, 13 (40%) attended virtually (Zoom for telehealth), 30 (91%) were female, and the average age was 77 years (± 7.3 , range 64–94). Polypharmacy was common, and the average timed up and go (TUG) was 11.7 seconds, 30-second chair rise 12.3, 27% experienced orthostatic hypotension, and 15% had abnormal Snellen vision screens. Interestingly, we found asking self-report strength on a 0–10 scale was statistically associated with objectively abnormal cutoffs on the TUG and 30-second chair rise, indicating increased fall risk.²⁷ There is great need to expand and include additional health care members as part of this work and to increase inclusivity for diverse populations including those who have been historically underrepresented in fall-prevention efforts.

Digitally delivered programs are an opportunity that help balance risks and benefits during times of social distancing, improve dissemination, and possibly improve objective measures of function.¹⁷ Therefore, approaches to improve access to fall-risk-reduction exercise, including balance and strength training opportunities, are imperatively important, and growing data suggest digitally formatted delivery may be G Therefore, we developed a fall-risk-reduction program, *Strong Foundations*, designed to be delivered digitally. While there are many such programs currently available on the internet, especially in the time of COVID-19, the novel feature of this program is the delivery of *semi-individualized* instruction in *real* time within a small group setting. This is accomplished largely by the use of the “breakout room” feature on the Zoom platform, where 2–3 trained intern instructors correct form while the lead instructor teaches the larger group. The program was designed with physician input and by exercise physiologists and a doctor of physical therapy candidate, all with extensive training in both group and individualized exercise for geriatric populations. *Strong Foundations* is a 12-week iterative curricular program with three core components: *postural alignment and control*, *balance and mobility*, and *muscular strength and power*. All the exercises offered over the course of the intervention are appropriate for the target population and are standardized so all participants receive the same basic instruction, but level of difficulty is scaled to participant experience, capability, and musculoskeletal limitations. The program was iteratively designed based on two, 4-week pilot classes with 10–12 participants each, and in 2021–2022, it was expanded for a full 12 weeks across 4 cohorts, with a total $N = 38$. In this pilot, we showcased excellent usability based on the System Usability Scale (SUS),²⁸ a nonpriority validated questionnaire which is designed to understand the ease of use of new systems or programs using a 5-element Likert scale. In general, scores >70 on the SUS are considered to have appropriate acceptability of a program/platform. Aside from finding impressive usability among participants, the majority of the respondents found the *Strong Foundations* subjectively appropriate, and attendance was excellent (average attendance was 9.8/12 session or 82% across the entire group). In addition, the research team observed impressive changes in metrics of physical function that were gathered digitally with

statistically improved pre-post Zoom-based measures of objective fall risk, namely the average pre-*Strong Foundations* chair-stand and TUG times.²⁹

Driving

AAA LongROAD study

In 2015, The AAA Foundation for Traffic Safety funded Columbia University and five participating academic centers (Bassett, University of Michigan, Johns Hopkins, University of California San Diego, University of Colorado) to participate in the largest prospective study of older drivers to date, the Longitudinal Research on Aging Drivers (LongROAD) study. A total of 2990 drivers were recruited at baseline and followed up for 5 years. The study design and population have been described in detail elsewhere.³⁰ While the final analyses are ongoing with the closing of participant data collection in November 2022, preliminary reports have identified predictors of crashes, citations, and cessation.

Frailty and driving were assessed by assessing falls, fear of falls, frailty markers, and physical capabilities and association with driving outcomes. Frailty was positively associated with low-mileage driving status and driving cessation in a dose-response fashion.³¹ Given the known association between low-mileage driver status and increased crash rates and the modifiable nature of the risk factors examined in this study, interventions aimed at improving physical capabilities may lead to an improvement in safety among older drivers.³¹ Chronic conditions were associated with reduced driving. Those reporting reduced driving ($n = 337$) largely attributed reduction to musculoskeletal (29%), neurologic (13%), and ophthalmologic (10%) conditions. Women reported health condition-related driving reduction more often than men (14% versus 8%, $P < .001$).³² The LongROAD study confirmed the very high use of prescription medications and supplements in older adults. The median number of medications taken per study participant was seven, with a range of 0–51. The total number of medications was significantly associated with a higher rapid deceleration rate. Certain medication classes were significantly associated with other driving outcomes, including central nervous system agents (more speeding events), hormones and gastrointestinal medications (more rapid decelerations), electrolytes (fewer rapid decelerations), and antihistamines (greater right- to left-turn ratio).³³ Dietary supplements (DS) were further looked at in this cohort, given the robust nature of the “brown bag” review conducted at baseline and annually to better understand the total “pill-burden” contribution that DS bring. At baseline, the total “pill-burden” was found to be 7.58/participant, approximately 30% explained by the use of a DS (mean 2.28/participant). Looking across study years 1 and 2, we found that 86% of these older adult drivers reported taking a DS at some point and also found that from baseline, 63.8% continued to use supplements at every point of data collection. Participants who had more prescription medications were more likely to report using supplements as well across the length of the study ($P < 0.001$) and those identified as having polypharmacy were more likely to be on a supplement ($P < .0001$).

In addition, it was found that 542 (18.5%) used at least one potentially impairing medication (PIM) of the 2932 drivers with medication data. The most commonly used therapeutic category of PIM was benzodiazepines (accounting for 16.6% of the total PIMs identified), followed by nonbenzodiazepine hypnotics (15.2%), antidepressants (15.2%), and first-generation antihistamines (10.5%). Older drivers who were female, white, or living in urban areas were at significantly heightened risk of PIM use.³⁴ Use of PIMs was associated with a 10% increased risk of hard-braking events. Compared to drivers who were not using PIMs, the risk of hard-braking events increased 6% for those using one PIM and 24% for those using two or more PIMs.³⁵

Impairing substances are also used by this older driver cohort. Fifty-four drivers (9.0%) reported past-year use of cannabis. Past-year users were four times as likely to report having driven when they may have been over the legal blood-alcohol limit (adjusted odds ratio [aOR] = 4.18; 95% confidence interval [CI]: 2.11, 8.25) but were not more likely to report having had a crash or citation (aOR = 1.36; 95% CI: 0.70, 2.66) in the past year.³⁶ Rate of alcohol use was also higher in this cohort than it had been reported elsewhere. Of the 2990 participants, 72.7% reported consuming alcohol, 15.0% reported high-risk drinking, and 3.3% reported driving while intoxicated (DWI). High-risk drinking (OR = 12.01) and risky driving behaviors (OR = 13.34) were significantly associated with at least occasional DWI. Avoidance of hazardous driving conditions (OR = 0.71) and higher level of comfort during challenging driving scenarios (OR = 0.65) were less likely to be associated with DWI.³⁷

The LongROAD study completed data collection in November 2022, and the final data set has been released. With 5 years of data on 2990 older participants enrolled at baseline, we anticipate additional analyses will shed light on medical, psychological, sociological, and technological issues influencing driving safety in older adults. The project welcomes inquiries from outside researchers on potential collaboration.

Training, Research, and Education for Driving Safety

The Training, Research, and Education for Driving Safety (TREDS) program is a translational community outreach project to address driving safety (treds.ucsd.edu). Founded in 2004, the program has been funded by the California Office of Traffic Safety, the California Department of Transportation, the UC Institutes for Transportation Studies, and the National Institutes of Health.

Clinician Education

Reducing motor vehicle injuries and fatalities by educating physicians and clinicians to better identify impairments in older drivers and take appropriate action has been a goal of TREDS since 2004. TREDS developed a 1-hour curriculum, "Screening and Management of Age and Medically-Related Driving Disorders," to train clinicians to screen and manage conditions and medications that could impair driving. The program, primarily delivered through grand round lectures, has been presented over 110 times to train more than 6900 physicians and clinicians. The program is also available online.³⁸ Curriculum topics include the epidemiology of older driver safety, methods for screening for medical risks, management and mitigation of risk, reporting laws, and counseling guidance. Risk management is an important component of the training; currently, six states (California, Delaware, Nevada, New Jersey, Oregon, and Pennsylvania) have mandated reporting laws, and most other states have permissive reporting laws. In the mandated reporting states, physicians and health care providers can be held liable for failure to report impaired drivers. On post-training surveys, physicians and health care providers reported intent to change older driver management, and changes in behavior were reported 3 months after training.³⁹⁻⁴¹ In total, TREDS clinical trainings have reached more than 10,500 health professionals.

Older Driver Education: Drive Safe, Drive Longer

TREDS recognized that education of older drivers would improve self-regulation and driving skills. This inspired the development of "Drive Safer, Drive Longer," a one-hour, interactive program designed to educate aging road users. The class is delivered in-person by instructors at community centers, senior centers, and other community venues.

TREDS has partnered with the California Highway Patrol (CHP) since 2010 to provide officers with evidence-based curriculum, training modules, and technical support for delivery of driving safety programs. TREDS collaborated with the CHP as they adopted the “Drive Safer, Drive Longer” content for their “Age Well, Drive Smart” program. Using a train-the-trainer model, CHP Public Information Officers were trained to deliver the “Drive Safer, Drive Longer” education program across California. To date, over 3400 members of the public have been reached through more than 70 classes.⁴²

Distracted Driving

While older drivers are generally more law-abiding than their younger counterparts, unfortunately distracted driving is ubiquitous. Using the experience from TREDS surveys of college/university students and middle-aged drivers, TREDS deployed a survey to older adults.^{43,44}

A total of 363 older drivers completed the survey; the mean age was 73 years, and 56% were female. Sixty percent of older adults reported using their cell phone while driving at least some of the time. Participants perceived their own ability as capable or very capable when driving and using the following: handheld phone (40%); hands-free phone (78%); other tasks (38%) while driving. Thirty-two percent of older adults who drive minors reported driving while distracted. Thirty percent of those who were employed felt obligated to take work-related calls. Clinicians should not assume that their older patients are making safe choices on the road and provide appropriate counseling.

Law Enforcement's Role in Older Driver Safety

Law enforcement officers identified the need to increase their competency in identifying medical impairments that impact driving fitness, as well as to improve utilization of reporting mechanisms for appropriate driver re-examination. Motivated by this need, TREDS partnered with the CHP and the California Department of Motor Vehicles (DMV) to address this problem. Law enforcement officers lacked training to identify signs of medical driving impairment, manage the situation at roadside, and appropriately refer the driver to the DMV for re-examination. The TREDS team undertook development of a training curriculum and diagnostic tool based on NHTSA's “Older Driver Law Enforcement Course,” released in 2007.

Working with the CHP, the TREDS team developed a 2-hour training, “Law Enforcement's Role in Older Driver Safety,” as well as a roadside screening tool, the “Driver Orientation Screen for Cognitive Impairment,” or DOSCI, to assess for disorientation.⁴⁰ The curriculum covers an introduction to older drivers; medical conditions (eg, vision, frailty, cognitive impairment, hypoglycemia, hyperglycemia) and methods for assessment; strategies to employ during traffic contacts (eg, observation, questioning, use of the screening tool, communication, and referral); use of the DMV reporting mechanism requesting driver re-exam; and community resources for driver evaluation and education.⁴⁰ Since the inception, over 5300 officers have been trained.⁴⁵ In posttraining interviews, officers stated that the use of the DOSCI tool has been helpful and feasible.⁴⁶ Six states across the country (Iowa, Kansas, Minnesota, Missouri, Pennsylvania, Tennessee) and the province of Quebec have adopted the DOSCI tool. The use of the tool was expanded to the DMV/Department of Transportation in the state of Iowa, with favorable results and widespread adoption across the state.⁴⁶ The collaboration of the medical system and law enforcement system resulted in feasible and evidence-based management of cognitively impaired drivers.

SUMMARY AND NEXT STEPS

Clinicians play an important role in the prevention of unintentional injuries. Falls and MVC have predictable and overlapping antecedents. Systematic screening for and management of vision impairment, frailty, cognitive impairment, polypharmacy, and inappropriate medications will reduce both falls and MVC risks. Fall-prevention measures, such as strength training, need to be more widely prescribed by physicians and implemented by older adults. Technologically tailored approaches are needed to leverage fall-reduction programs at home, as well as education of older adults regarding home hazards. Physicians need to improve screening and management of sarcopenia.

Fully autonomous vehicles are still at least 15 years away, so both clinicians and their older patients will need better clinical screening guidelines for driving risk. Society needs to address alternative transportation for older adults and improve self-regulation and decision-making support for older drivers.

CLINICS CARE POINTS

- Clinicians need to be more aware of the preventable nature of injuries in older adults related to driving and falls.
- Screening and counseling can be done in clinical settings for fall risk as well as driving impairment related to aging.
- Interventions should address strength, balance, cognitive capabilities and self-regulation.

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