

Traffic Safety Facts

Traffic Tech – Technology Transfer Series

Multiple Medications and Vehicle Crashes: Analysis of Databases

By 2030, over 70 million Americans will be over age 65. Older adults have a higher rate of fatality and injury in motor vehicle crashes per mile driven than any other age group except for teenagers. Since driving is a complex behavior, many age-related factors may impair driving ability, including age-related decrements in cognitive and physical functioning, increased prevalence of medical conditions or age-related medical conditions, and increased use of multiple medications. The National Highway Traffic Safety Administration implemented a study to examine factors relating to crash-involvement among older adults to devise strategies to address these concerns.

This study examined the association of the impairing effects of multiple medication use, drug/drug interactions, and drug/disease interactions on motor vehicle crashes in individuals age 50 and older. Fifty was selected as a cut-off age (a) to maximize sample size, and (b) because age-related changes and corresponding increased medication use begins to occur at this age (i.e., drugs to treat ailments like high blood pressure, osteoarthritis, hypercholesterolemia, and adult-onset diabetes), along with taking multiple medications.

Methodology

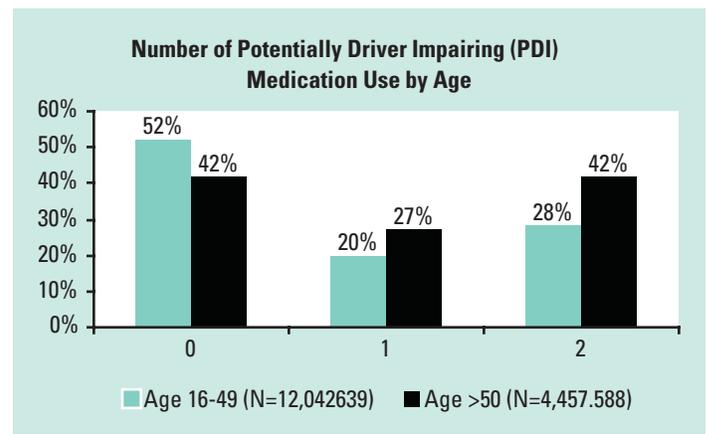
This study examined two databases: (1) the National Ambulatory Medical Care Survey (NAMCS) database, and (2) the PharMetrics database. The NAMCS provided information on patients' demographic characteristics and medical services received, including information on diagnostic procedures, patient management, and planned future treatment. This database could not link, longitudinally, the medical and pharmaceutical data on a patient-specific basis. From 1998-2000, the NAMCS data included 71,468 physician/patient visits. The PharMetrics database is an anonymous, proprietary patient-level medical insurance claims database, which contains longitudinal medical and pharmaceutical data for thousands of individuals with motor vehicle crash diagnoses and the medications and diseases in a proximal time period to the crash. From January 1998 to March 2002, the PharMetrics patient-level database included 81,408 cases (patients with a diagnosis code for motor vehicle crashes) and 244,224 age-, sex-, and date-matched controls. With this database, hundreds of drugs and diseases, along with combinations

of drugs and diseases, were examined using a case-control matched pair design or logistic regression analysis of possible associations of medication use among older adults and motor vehicle crashes.

The main objectives of this study were to determine the relative frequency of various combinations of medications used by those who have experienced motor vehicle crashes (MVCs) and those who have not by analyzing proprietary and non-proprietary databases; and to conduct a case-control study and regression analysis of possible associations between the use of medications (and combinations thereof) and MVCs amongst older drivers.

Results

The results of the study showed an association between the kinds and number of medications taken by older adults and the risk of having MVCs. Drugs considered to impair the driving ability of older drivers were the most commonly used by older adults involved in MVCs. Over one-third of the NAMCS group over 50 years old mentioned the use of two or more drugs. Over half of the over-50 group mentioned using one or more potentially driver impairing (PDI) medications. To qualify as a PDI medication, the medication had to be associated with known effects on the central nervous system, blood sugar levels, blood pressure, vision, or otherwise have the potential to interfere with driving skills. Possible PDI effects include sedation, hypoglycemia, blurred



vision, hypotension, dizziness, fainting (syncope), and loss of coordination (ataxia).

The descriptive analysis of the proprietary database identified higher rates of drug use than the NAMCS results. Over half of the older adult study subjects received two or more medications. Almost 65 percent of the older adult study subjects received PDI medications. Over half of the older adult study subjects suffered from a PDI condition, and almost a quarter of the older adult study subjects concomitantly used medications that are known to interact. Almost a tenth of the older adult study subjects appeared to be using medicines that presented therapeutic conflicts with diseases/conditions for which they were being treated.

The Case Control Analysis suggested an association between motor vehicle crashes and many PDI medications, PDI diseases, and various combinations of drugs and diseases. Thirty-five of the ninety PDI drug classes had odds ratios over 1.2 ($p < .05$). Seven of the fifteen medication classes with the highest odds ratios are classes that have been reported to be especially problematic in older patients.

Seventy-nine of 200 driver impairing disease classes had statistically significant odds ratios over 1.4. The results supported previous studies linking Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), Angiotensin-Converting Enzyme (ACE) Inhibitors, Anticoagulants, Antidepressants, and Benzodiazepine use with motor vehicle crashes, corroborating previous studies linking depression, alcoholism, arthritis, history of falls, back pain, diabetes, heart disease, stroke, arrhythmias, coronary artery disease, and sleep apnea with MVCs. Most of the drug interaction pairings had higher odds ratios for MVCs than when the drugs were used alone. Some drug-disease conflicts had a statistically significant elevated odds ratio; however, these were such small numbers of cases and controls, making it difficult to conclude risk increases.

The number of total medications, PDI medications, PDI diseases, drug-drug interactions, and drug-disease conflicts were used in a regression analysis examining their role in MVCs. For patients with one or two PDI diseases, the risk was 1.49 times greater than for older adults without any PDI diseases. For those with three or more PDI conditions, the risk for MVCs increased to 2.20 times. Drug interactions were also associated with a statistically significant increased risk of MVCs (odds ratio of 1.47 for 1-2 drug interactions and 1.92 with patients with 3 or more drug interactions). The risk for MVCs among study subjects with at least one drug-disease conflict was 1.2 times that for older adults without any drug-disease conflicts.



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Limitations

While older drivers are at increased risk of a crash when they take multiple PDI medications, this study cannot isolate the cause of these crashes and determine the relative contributions of the medication, medical condition, and age. This study also did not address the association of MVCs with de novo exposure (initiation of drug therapy when individuals are most likely to experience side effects) and prolonged exposure to prescribed medications (when individuals may become tolerant to side effects).

Furthermore, this analysis cannot predict whether an individual with an underlying medical condition who takes multiple PDI medications can drive safely. The limitations of the data, which include sample size and inherent weaknesses of administrative claims data, make it difficult to gauge the strength of the association between PDI medications and MVCs.

Discussion and Conclusions

This study suggests that both the kind and number of medication exposures, and the characteristics of diseases/disorders present among study subjects, are associated with an increase in risk for MVCs among older adults. As the population continues to age, many factors will impact driving safety. Older adults may develop chronic diseases that may have driver impairing characteristics. Layered on to the underlying chronic diseases are the medications used to treat those conditions along with their potential to exacerbate other coexisting conditions, induce side effects, and promote dangerous drug interactions. By demonstrating the potential link between multiple drug therapies and MVCs, this study serves to highlight the need for a thorough examination of the relationships among drugs, diseases, and the older driver.

This study suggests the need for further research on the interplay of factors affecting the aging adult and driving ability. The results of this study supports the development of educational programs to increase awareness about the potential driver impairing effects of increasingly complex medical and pharmaceutical therapies in older adult drivers.

How to Order

To order *Multiple Medications and Vehicle Crashes: Analysis of Databases* (55 pages plus appendices), prepared by Iatrogen, LLC, write to the Office of Behavioral Safety Research, NHTSA, NTI-130, 1200 New Jersey Avenue SE., Washington, DC 20590, fax 202-366-7096, or download from www.nhtsa.dot.gov. John Siegler, Ph.D., was the Contracting Officer's Technical Representative for this project.

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