

Driver's age and road crash

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It has been widely reported that younger and older drivers have an excess risk of causing a road crash. Two casual hypotheses may coexist: the riskier driving behaviors and age-related mechanisms in extreme age groups (direct path) and the different environmental and vehicle circumstances (indirect path). Our aim was to quantify, through a mediation analysis, the percentage contribution of both paths. A case-control study was designed from the Spanish Register of Road Crashes with victims from 2014 to 2017. Assuming a quasi-induced exposure approach, controls were non-responsible drivers involved in clean collisions between two or more vehicles ($n = 52,131$). Responsible drivers for these collisions plus drivers involved in single crashes constituted the case group ($n = 82,071$). A logit model in which the outcome was the log (odds) of causing a road crash and the exposure was age groups was adjusted for driver, vehicle and environmental factors. The highest crash risk was observed in extreme age groups, compared to the 35-44 year old age group: the youngest (18-24 years old, odds ratio = 2.14, 95% confidence interval: 2.06-2.24) and the oldest drivers (>74 years old, odds ratio = 3.30, 95% confidence interval: 3.04-2.58). The mediation analysis identified the direct path as the main explanatory mechanism for these increases: 89% in the youngest and 93% in the oldest drivers. These data support the hypothesis that the excess crash risk observed for younger and older drivers is mainly related to their higher frequency of risky driving behaviors and age-related loss of capabilities. Preventive strategies in extreme-aged drivers should focus on decreasing these behaviors.

Keywords: younger drivers ; older drivers ; road crash ; risk factors ; mediation analysis

Introduction

1.1. Literature Review

Several studies have reported increased road crash rates for both younger and older drivers (under 25 and over 65 years old, respectively), compared to middle-aged drivers. The reasons given for both increases have been widely explored. For younger drivers, these are mainly related to inexperience and risk-taking behaviors (driving under the influence of alcohol and other drugs, speeding, etc.). This excess of riskier behaviors and higher traffic incident rates has also been suggested for younger cyclists. As for older drivers, their excess risk has usually been related to their reduced ability to cope with the inherent complexities of driving—a situation causally associated with three age-related factors: (a) the physiological loss of capabilities and age-related fragility, (b) the pathological loss of capabilities derived from age-related illnesses such as dementia and other mental pathologies, visual and hearing defects, etc., and (c) the frequency of driving under the influence of drugs that affect the driver's abilities—a frequency reported to be higher in older drivers.

However, some researchers have proposed several alternative hypotheses to partially or even completely explain these age-related risk increases. They all share a common background: a significant part of the risk posed by each category of driver is related to the amount and type of exposure to the risk, which is linked to an intrinsically high crash risk, regardless of the driver's characteristics. Therefore, to compare the crash risks yielded by, for example, the age categories of drivers, it is first mandatory to adjust this risk by the amount and type of exposure yielded by each driver's age category. A common example to illustrate the failure of the above requirement is the low mileage bias: although crash rates for different driver subgroups were estimated for a fixed amount of exposure (measured as time spent on the road, or more frequently, as distance traveled), this is not a fair comparison, as distances traveled on highways or motorways, and long journeys in general, are associated with lower crash risk than distances traveled in urban areas and short journeys.

It is well-known that older drivers, unlike younger ones, accumulate their travel distances in short (low-mileage) trips mostly in urban areas, where the risk of being involved in an accident is intrinsically higher. Another example is the type of vehicle driven: if, for example, extreme age groups of drivers use older vehicles more frequently (intrinsically associated with a higher crash risk) compared to middle-aged drivers, a biased comparison between age-related crash risks would result.

1.2. Assumptions

A general formulation of all previous causal associations regarding age-related increases in crash risk implies the a priori assumption of two causal paths linking age with a high risk of causing a road crash:

- A direct causal path (DCP). In this path, the driver's age is associated with the risk of a crash regardless of the amount and type of exposure (the road, the time of the day, the type of vehicle driven, etc.). The reasons for this DCP would be those described in the first paragraph of this introduction for both younger and older drivers. Ultimately, all of these circumstances lead to a loss of optimal driving capabilities or to riskier driving behavior;
- An indirect causal path (ICP). In this path, the driver's age is associated with an increased crash risk because it is causally associated with a riskier driving environment or a riskier vehicle: for example, younger drivers tend to drive more frequently at night, while aged drivers tend to drive more frequently on urban roads.

1.3. Hypotheses and Objectives

The research question of this work, therefore, is what percentage of the excess of risk in extreme-aged groups corresponds to each of the two casual paths. Our hypothesis was that non-related vehicle and environmental factors (that is, the DCP) are the main explanatory cause of excess risk in extreme-aged drivers. To our knowledge, no previous studies aimed at this purpose, although investigating this would be relatively easy by applying an analytic approach known as mediation analysis. The novelty of this study lies in the use of this method in a large sample of drivers in Spain. Therefore, the objectives of the present study are:

- To confirm the excess risk of younger and older drivers of causing a crash compared to middle-aged drivers;
- If this excess risk is confirmed, the second aim is to quantify which part of this higher risk is related to a DCP and which part depends on an ICP, by applying a mediation analysis based on a decomposition method.

Conclusions

In conclusion, our results support the hypothesis that most of the excess crash risk observed for the youngest and oldest drivers is primarily related to their higher frequency of risky driving behaviors or loss of capabilities and is much less dependent on the driving environment or on the vehicles they drove. This association was no different between men and women, or between crashes with minor or major victims. These results should be considered in order to prioritize preventive strategies intended to decrease road crashes among the youngest and oldest drivers. Future studies should be designed to focus on analyzing the concrete elements of these riskier driving behaviors, the identification and control of the potential loss of capabilities and exploring the usefulness of preventive programs for extreme-aged drivers.

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