

## ROAD SAFETY OF SENIORS IN LATVIA

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**Abstract.** Population ageing is a global social and economic phenomenon that affects healthcare systems, labour markets and transport safety. As the proportion of seniors in the population increases, an increasing number of older adults participate in road traffic as drivers, pedestrians, cyclists and passengers. The share of seniors involved in road traffic accidents remains high, and the consequences of accidents are often more severe compared to other age groups due to their greater physical vulnerability. Road safety for seniors has therefore become a significant international challenge that requires a comprehensive approach, including data analysis, infrastructure adaptation, educational initiatives and the integration of international best practices. Effective solutions must address both the physical and cognitive limitations associated with ageing, as well as the environmental and behavioural factors that influence mobility and safety of seniors in road traffic. Attention to seniors' road traffic safety in Latvia was drawn by several crashes with fatalities involving seniors as drivers while the safety of seniors in traffic has been discussed much less. The goal of the study was to analyse the role of seniors in road traffic safety both as persons who may have facilitated the occurrence of crashes and as victims who often have more serious consequences in crashes with other road users. This was done by quantifying the risks of seniors in traffic by analysing the active driver database, road crash database and vehicle kilometrage data. Both the share of total distance driven by seniors and the share of involvement of seniors in serious accidents is close to 10%. The relation of percentage of fatalities from other age groups for a senior driver to kilometrage driven by seniors is 0.7 which is lower than for most other age groups. Collision matrixes including seniors as both casualties and other road users are presented. The results highlight the need to develop a nationwide road safety policy for seniors, based on data-driven decision-making.

**Keywords:** seniors, road traffic safety, road fatalities, collision matrix, kilometrage.

### Introduction

Road safety is one of the most important public welfare and public health challenges, as traffic accidents continue to cause a considerable number of fatalities and injuries every year. Population ageing represents one of the most significant demographic developments of the 21st century and has a substantial impact on healthcare systems, economic structures and mobility patterns worldwide. According to the World Health Organization, the global population aged 60 years and older is expected to exceed 2 billion by 2050, which is nearly double the number recorded in 2020 [1]. The ageing trend is particularly pronounced in Europe, where projections indicate that one out of three inhabitants will be over the age of 60 [2]. As a result, a growing share of the population will be involved in road traffic as drivers, pedestrians or passengers, making the safety of older road users an increasingly important concern in both public health and transport policy.

Increasing age is accompanied by various physiological and cognitive changes, such as deterioration in vision and hearing, slower reaction times, and reduced attention and memory capacity [3-6]. As a result, older adults may face greater difficulty in perceiving traffic situations, anticipating potential hazards and responding to them appropriately. While older drivers tend to demonstrate more cautious driving behaviour, their increased physical vulnerability often leads to more severe outcomes in the event of a crash compared with younger drivers. According to reports published by the European Transport Safety Council, older drivers are considered one of the most vulnerable categories of road users [7].

Within global transport policy, the safety of older road users is closely associated with the principles of Vision Zero, which seek to minimise traffic-related fatalities and serious injuries [7]. This framework is based on the assumption that transport systems should be designed in a way that accounts for human error as well as physical limitations [8]. Research conducted by OECD and the International Transport Forum further suggests that, in the context of population ageing, road safety policies should increasingly focus on sustainable mobility by integrating safer infrastructure, advanced vehicle technologies and improved health monitoring measures [2].

In road safety research it is important to distinguish between the risk that older drivers pose to other road users and the risk they face themselves. Studies indicate that older drivers have a higher probability of sustaining severe injuries or fatalities in road crashes, largely due to increased physical frailty and

age-related health conditions. At the same time, evidence suggests that the likelihood of older drivers being involved in crashes that seriously harm other road users is not substantially higher than that of middle-aged drivers. Therefore, older road users are generally considered a particularly vulnerable group in traffic rather than the primary source of risk for other road users [9].

Given the demographic changes and the increasing participation of seniors in traffic, it is important to better understand their role in road safety. This includes analysing both situations where seniors may contribute to the occurrence of crashes and those where they become vulnerable victims in interactions with other road users. A deeper understanding of these patterns is essential for developing effective road safety policies and preventive measures.

Traffic safety research concludes that the fitness of older drivers should be monitored in a staged system of screening and that a general age-based screening of all drivers is not deemed advisable [9]. Since the fitness to drive frequency in Latvia depends both on age and on decisions of medical doctors and senior mobility differs between countries, it is essential to analyse senior traffic safety in Latvia.

The aim of this study is to analyse the role of seniors in road traffic safety in Latvia both as potential contributors to road crashes and as vulnerable victims in crashes involving other road users. The study is based on the analysis of demographic data, the active driver database, road crash data and vehicle kilometrage statistics.

### **Materials and methods**

Vehicle, driver, kilometrage and road traffic accident data for a 10-year time period from 2016 till 2025 were retrieved from the Latvian Road Traffic Safety Directorate database [10]. Corresponding to Vision Zero strategy accidents with fatalities and seriously injured have been selected for research only. For analysis of total involvement of vehicle drivers in serious accidents, only drivers with known age have been selected. Drivers of cars, trucks (including road tractors), buses, trams, trolleybuses, motorcycles, tricycles and agriculture or forestry tractors are accounted for only, no moped riders, e-scooter riders or cyclists included. Drivers have been split in age groups.

To access risks of age groups for the traffic safety and for the safety of other age groups, some exposure criteria had to be selected. There is no data for vehicle kilometrage split by drivers' age in Latvia. For cars owned, leased or legally used by physical persons (PP user) yearly kilometrage data was retrieved with two methods. First data were retrieved from newly developed vehicle km data tables where kilometrage is shown separate for physical persons and companies – vehicles having zero kilometrage in each year were selected since if the user has been changed it is impossible to find the kilometrage for each user. Vehicles that within the year have not been registered to companies have been selected only. Since the interest was in kilometrage age split rather than total distances, vehicles not having valid odometer readings were omitted. For selected vehicles the age of the PP user was registered along with kilometrage and legal days on the road (registered, having valid technical inspection and insurance). The second method filtered only cars with PP users where the user paid on site for the technical inspection assuming that this is additional evidence that the PP user with known age really is the driver.

Trucks have not been analysed since many trucks run outside country and kilometrage data would not be good to relate to road crashes in Latvia. Bus kilometrage was selected since higher risks to passengers imposed by bus drivers. For age distribution the number of bus drivers by the end of each year having D or DE category licences with professional driver code 95 were selected.

Collision matrixes can be conveniently used in road safety research to analyse interactions between different road user groups involved in traffic crashes. This method enables researchers to identify which combinations of road users are most frequently involved in fatal or serious injury crashes. By presenting crash outcomes in a matrix format, it becomes possible to better understand the relationship between the road user type of the victim and the collision partner involved in the crash. Therefore, the collision matrix represents a useful analytical tool for understanding crash patterns and supporting the development of targeted road safety measures.

The collision matrixes were developed allowing to select the age of fatalities, age of the driver of the vehicle (or pedestrian) having fatalities and the age of the heaviest traffic unit crashed with the traffic unit with fatalities. This is the first time these types of collision matrixes were built for crashes on

Latvian roads. For better comparability the column and row headers were made similar to the ones used by the European Road Safety observatory [11].

**Results and discussion**

In Latvia in the time period between 2016 and 2025 there have been 1 342 road fatalities and 4 414 serious injuries. Seniors accounted for 21.1% (283) of total fatalities and 13.7% (606) of serious injuries.

The distribution of driver involvement in serious road crashes is shown in Fig.1. For crashes with fatalities the age of 2.1% of drivers was unknown, for crashes with seriously injured 3.4%.

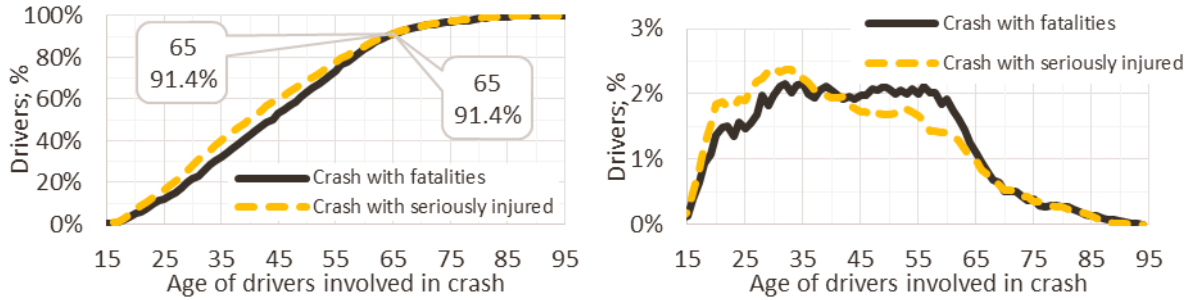


Fig. 1. **Involvement of drivers in serious road accidents according to driver's age:** on left – cumulative distribution; on right – frequency distribution

Senior drivers have been involved in 5.5% of all road accidents. For further analysis driver age has been split in age groups, shown in Table 1.

Table 1

**Drivers' group involvement in serious road crashes**

Crash type	Age group						
	0-14	15-24	25-34	35-44	45-54	55-64	65 +
Crashes with fatalities	0.1%	11.0%	19.6%	19.7%	21.1%	18.6%	9.9%
Crashes with seriously injured	0.5%	13.7%	23.6%	20.8%	17.8%	14.0%	9.5%

For the first method with all PP user cars on average yearly kilometrage for above 600 000 PP user cars per year were retrieved accounting on average close to 8 billion kilometres and over 200 million legal days on road per year. For the second method where users have been present at technical inspection stations over 3.5 billion kilometres and over 95 million legal days on road per year. Cumulative and frequency distributions of both methods is shown in Fig.2.

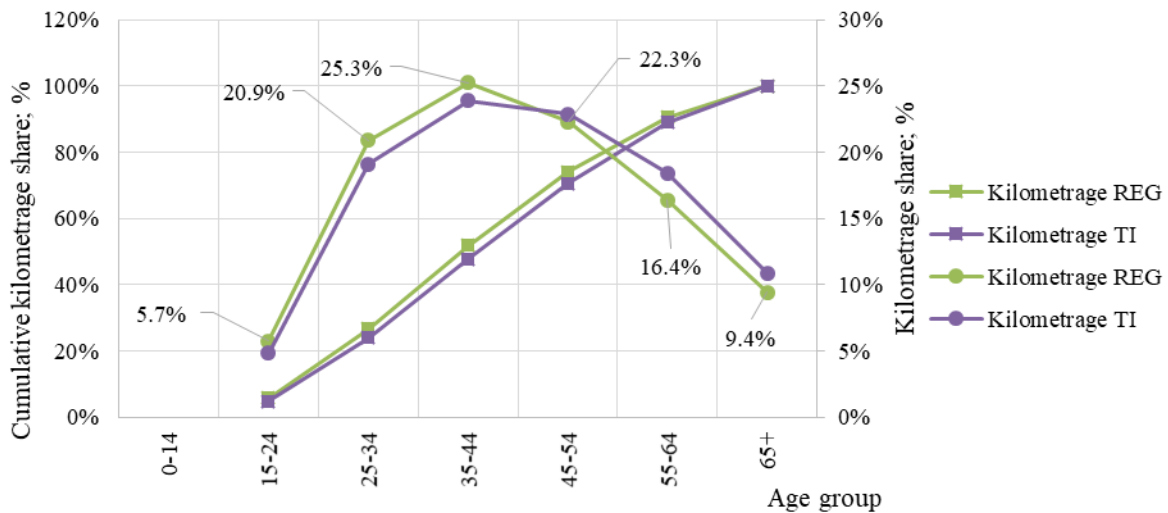
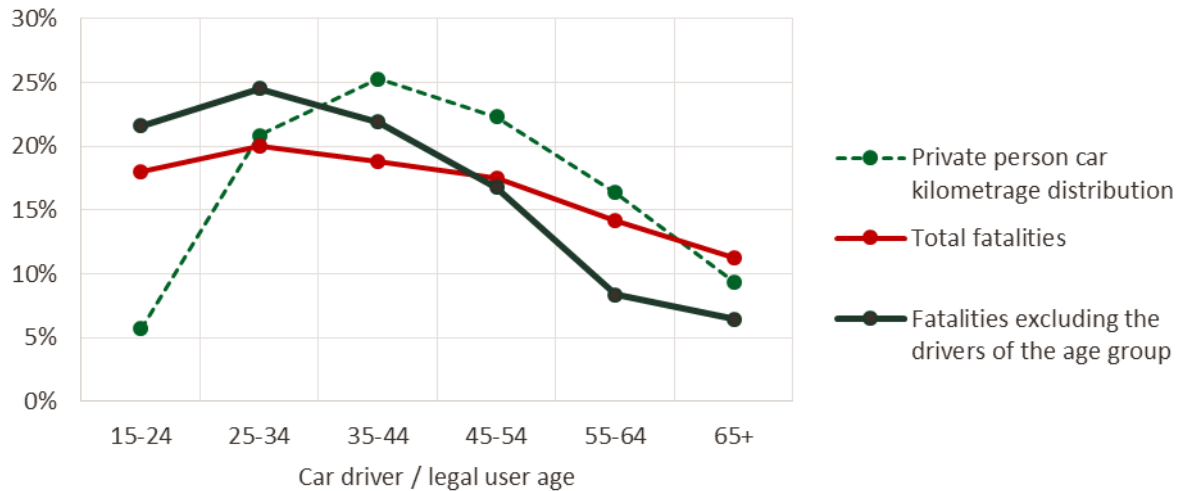


Fig. 2. **Privately used car calculated kilometrage in Latvia (2016-2025) distribution by user age**

Both methods give similar results. The method based on all registrations gives slightly higher values for younger drivers and slightly lower values for older drivers. This could be because of more younger drivers making electronic payments, therefore the first method results are used further.

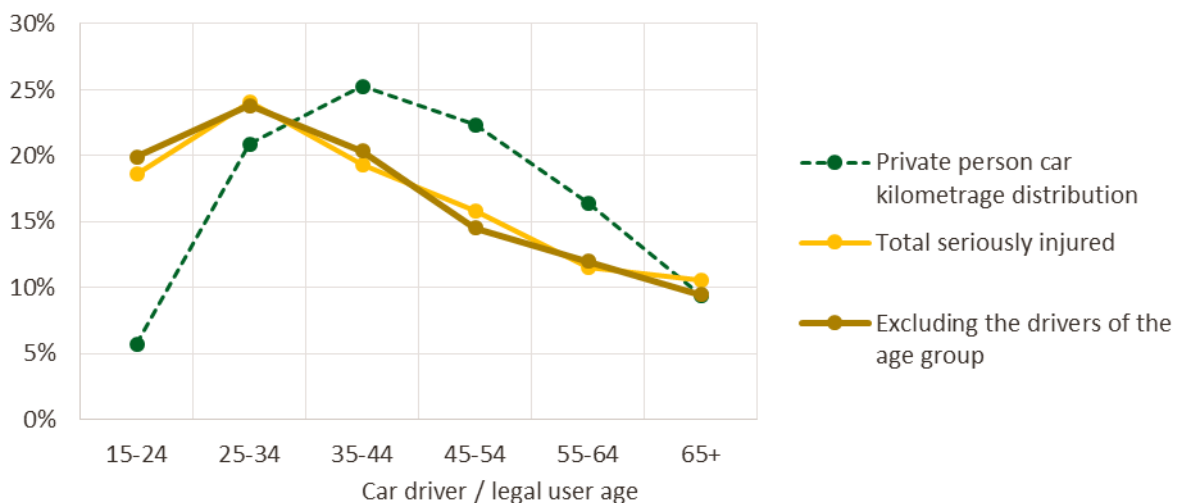
Kilometrage distribution put together with the number of road fatalities for PP user cars is shown in Fig.3. To assess the risks that driver age groups impose to other groups, fatalities numbers are given also for crashes where drivers of the particular group were not involved.



**Fig. 3. Private car driver participation in road crashes with fatalities comparison with kilometrage for driver age groups**

It can be seen that involvement in crashes with fatalities for the youngest driver group is several times higher than the share of kilometrage driven. For three age groups from 15 to 44 there are more fatalities from other age groups than from the age group itself while for age group 55-64 and for seniors the share of fatalities including the drivers from the age group is higher than if excluding. These two lines demonstrate how elderly people have more serious consequences in road crashes. The share of kilometrage travelled for drivers from age of 35 to 64 is higher than the share of fatalities, showing lower risk with equal distance driven. For seniors the share of being involved in accident with fatalities is very close to the share of kilometres driven.

The distribution for crashes with seriously injured is shown in Fig.4.



**Fig. 4. Private car driver participation in road crashes with serious injuries comparison with kilometrage for driver age groups**

The main difference from fatalities distribution is that data for total seriously injured and data when excluding the drivers of the age group are very close. This may come from more serious consequences

of older groups and lighter injuries incurred by people from younger groups. The seriously injured graph also proves that seniors are imposing less risks to other age groups than the young drivers.

Having much less numbers of fatalities and serious injuries for crashes involving buses, both fatalities and serious injuries are shown together in Fig.5.

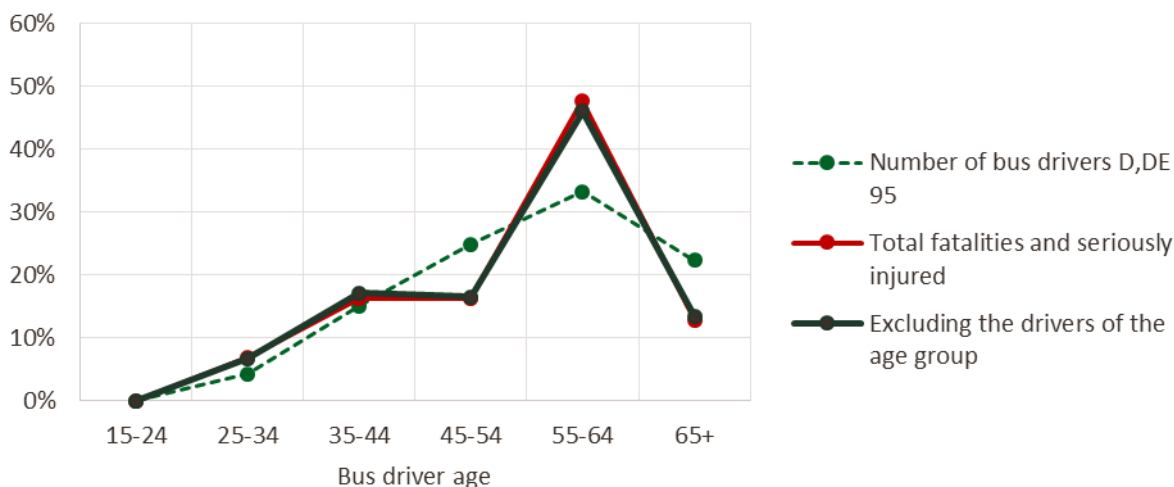


Fig. 5. Bus driver participation in road crashes with fatalities or/and serious injuries comparison with kilometrage for driver age groups

The graph shows higher involvement in serious crashes of bus drivers aged 55-64 and also that this is the driver group with highest representation having active driver licences with professional driver D95 code. Since the exposure is measured by the number of licences and the total kilometrage of senior drivers may be lower than for other groups, there is no evidence that senior drivers impose essentially higher risks while in absolute numbers the involvement of senior bus drivers in crashes with fatalities and serious injuries is even lower than for the age group 35-44.

The total number of fatalities for the analysis period is shown in the collision matrix in Table 2. The matrix includes both PP user vehicles and vehicles used by companies.

Table 2

Collision matrix with fatalities in Latvia in 2016-2025

All crashes with fatalities	IN A COLLISION WITH ...											
	Pedestrian	e-scooter	Bicycle	Moped	Motorcycle	Car	Lorry (≤3.5 t)	Heavy goods vehicle (HGV)	Bus	Other/unknown	No other vehicle	TOTAL
FATALITIES												
Pedestrians						276	39	55	17	28		415
e-scooter riders						1		1		3	4	9
Cyclists			1		1	52	6	24	4	6	9	103
Moped riders				1		11	2	10	2		7	33
Motorcyclists					3	23	2	4	1	3	47	83
Car occupants	1				1	118	22	166	15	16	252	591
LCV occupants						6	1	9	2		5	23
HGV occupants						6		13			13	32
Bus occupants								3			1	4
Other/unknown						1	1	3		1	43	49
TOTAL	1		1	1	5	494	73	288	41	57	381	1 342

The highest number of senior fatalities is pedestrians as shown in collision matrix in Table 3 where 51% of fatalities are pedestrians, 20% car drivers, 11% cyclists and 10% passengers. 51% of other traffic units involved in the crashes with fatalities are cars. Only 12% are with no other vehicle involved.

Table 3

**Collision matrix with senior fatalities in Latvia in 2016-2025**

Age of the person killed 65 +	IN A COLLISION WITH ...											
	Pedestrian	e-scooter	Bicycle	Moped	Motorcycle	Car	Lorry (≤3.5 t)	Heavy goods vehicle	Bus	Other/unknown	No other vehicle	TOTAL
FATALITIES												
Pedestrians						103	11	16	6	7		143
e-scooter riders											1	1
Cyclists						17		8	1	2	4	32
Moped riders						1	1	5			1	8
Motorcyclists											3	3
Car occupants						22	7	31	2	3	17	82
LCV occupants						1		2				3
HGV occupants						1		1			1	3
Bus occupants								1			1	2
Other/unknown											6	6
TOTAL						145	19	64	9	12	34	283

To contribute to the evaluation of seniors imposing risks to other road users, a collision matrix is shown in Table 4 where seniors are the drivers of the heaviest vehicle in the collision with a traffic unit with fatalities of all ages.

Table 4

**Collision matrix with fatalities 2016-2025 where the driver of the other vehicle is a senior**

Age of the driver in the heaviest vehicle 65 +	IN A COLLISION WITH ...											
	Pedestrian	e-scooter	Bicycle	Moped	Motorcycle	Car	Lorry (≤3.5 t)	Heavy goods	Bus	Other/unknown	No other vehicle	TOTAL
FATALITIES												
Pedestrians						40	1	2	1			44
e-scooter riders												
Cyclists						5			3			8
Moped riders						2						2
Motorcyclists						1		1				2
Car occupants						7		10	4	1		22
LCV occupants												
HGV occupants								4				4
Bus occupants								1				1
Other/unknown												
TOTAL						55	1	18	8	1		83

21% of all fatalities were seniors while 6% only with a senior as a driver of the other vehicle.

Analysing road traffic accidents in which other road users were killed in collisions with senior drivers revealed that a total of 83 fatalities were recorded. The most frequently killed were pedestrians (53%) and car occupants (27%). A smaller number of killed were cyclists (10%), heavy goods vehicles occupants (5%), P2W riders (5%). The number of killed passengers in a vehicle having drivers from all age groups shown in Table 5 also confirms that senior drivers are not the main risk for passengers.

Table 5

**Number of passengers killed in a vehicle with a driver from age groups**

Age group	0-14	15-24	25-34	35-44	45-54	55-64	65 +
Passengers killed in the crash	0	28	34	22	12	6	13

### Conclusions

1. Both the share of total distance driven by seniors and the share of involvement of seniors in serious accidents is close to 10% being less than for most of the other age groups.
2. The Latvian data of seniors' traffic safety for the ten-year period from 2016 to 2025 do not show high risks imposed by senior drivers to road users from other age groups
3. The relation of percentage of fatalities with a senior driver to kilometrage driven by seniors is 1.2, which is higher than for most other age groups except for drivers below 25 year age.
4. The relation of percentage of fatalities from other age groups for a senior driver to kilometrage driven by seniors is 0.7 which is lower than for most other age groups except for drivers of 55-65 year age.
5. The results highlight the need to develop a nationwide road safety policy for seniors, based on data-driven decision-making.

### Author contributions

Literature review and draft preparation N.K; formal analysis, writing – review and editing G.Z.; conceptualization, methodology and data processing J.K. All authors have read and agreed to the published version of the manuscript.

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