GDV
Unfallforschung
der Versicherer

COMPACT ACCIDENT RESEARCH REPORT NO. 123

The role of farm tractors in traffic accidents

GDV
Unfallforschung
der Versicherer

Gesamtverband der Deutschen Versicherungswirtschaft e. V.
(GDV – German Insurance Association)
Unfallforschung der Versicherer (UDV – German Insurers Accident Research)
Wilhelmstraße 43 / 43 G, 10117 Berlin
Postfach 08 02 64, 10002 Berlin
Tel. 030 2020–5821, Fax 030 2020–6633
www.udv.de, www.gdv.de, unfallforschung@gdv.de

Press date
04/11/2023

Editorial work
Dr.-Ing. Matthias Kühn
Dipl.-Ing. Jenö Bende

Design
zwoplus, Berlin

Photo references
Title: UDV
The usage rights of the other photographs and graphics in this brochure are owned by the UDV (German Insurers Accident Research).

All editions
on UDV.de

Contents

1. Introduction

More than 10 years ago, the German Insurers Accident Research (Unfallforschung der Versicherer / UDV) assessed the accident risk posed by farm tractors in road traffic and identified typical patterns. Initial assessments of the figures currently reported in the German traffic accident statistics and the insurers' accident database (UDB) have shown that the occurrence of accidents involving farm tractors has changed during the intervening period. The emergence of larger and faster farm tractors has also brought about a change in accident occurrence. This was one of the main reasons for repeating the 2011 farm tractor accident analysis project. The aim was to identify changes in the occurrence of accidents involving such tractors, to define particular focuses of attention, to derive measures and to determine their effectiveness in the light of the actual accident occurrence.

Working together with the insurers Allianz Versicherungs-AG and Landwirtschaftlicher Versicherungsverein Münster a.G. (LVM), claims received by these two insurers were gathered together in a joint accident database, analysed, and summarised in a research report. This research report forms the basis for the information presented below.[1]

2. Motorized agricultural vehicle (MAV)

The term "motorized agricultural vehicle" (MAV) designates a motor vehicle that is used to tow trailers, equipment or similar items for agricultural purposes. Such purposes include, for example, crop production, livestock breeding and forestry. To meet the requirements placed on them, motorized agricultural vehicles must possess certain structural characteristics, such as a towbar or power take-off shaft.[2] In general, they take the form of farm tractors, combine harvesters and self-driving agricultural machinery (SAM) such as beet or potato harvesters or self-driving manure spreaders. In addition, vehicles such as quads or trucks may be authorised for use as MAV.

The crucial point here is that MAV constitute mobile agricultural machinery that was not primarily developed to be driven on public roads. They are subject to fewer safety requirements than trucks and this results in a very wide range of incompatibilities in the event of accidents with other road users (see Figure 1).

Farm tractors are not compatible with other road users involved in accidents

Figure 1 · Size comparison of cars and MAV and capacity to inflict damage due to the geometry of the attachments

3. German traffic accident statistics – General information on accident occurrence involving MAV

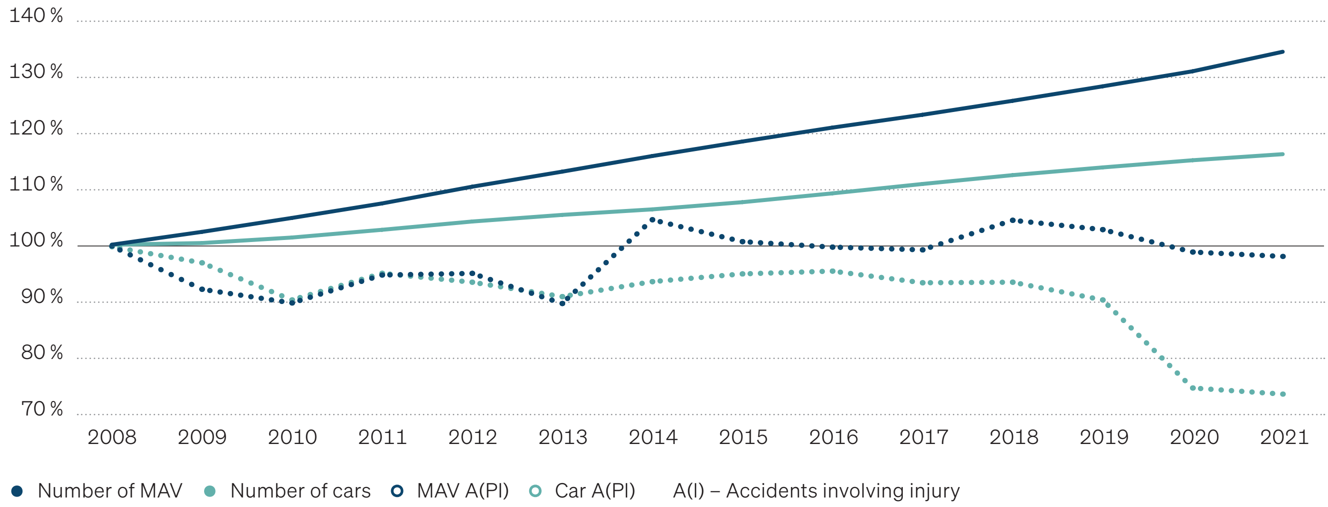
To categorise occurrences of road traffic accidents involving motorized agricultural vehicles in Germany, it is important not only to look at the evolution of the number of accidents but also to consider the change in the number of such vehicles.

In 2019, there were 1.941 A(I) (accidents involving injury) involving MAV. 59 of these cases resulted in a fatality. Accident numbers involving MAV continue to run at approximately their 2008 level, even though considerable fluctuations can be observed due to the relatively small number of cases. Based on the year of comparison 2008, Figure 2 shows the change in the number of MAV as well as in the number of accidents with injuries involving MAV and compares the resulting curves with the corresponding trends for passenger cars. It can be clearly seen that the number of MAV has grown at a faster rate than the number of cars, even though their absolute number remains much lower. Only for the years 2020 and 2021, which were heavily influenced by the Covid-19 pandemic, can a clear decline in the number of accidents involving cars be observed, whereas this influence is practically imperceptible for MAV.[3]

In general, it is positive to note that the increase in the number of vehicles has not been accompanied by an increase in the number of accidents with injuries involving MAV and/or cars.

The increased number of vehicles has not led to increasing numbers of accidents

Figure 2 · Changes in vehicle numbers and accident occurrence from 2008 to 2021 for MAV and cars (2008 = 100 %); Vehicle numbers at 01.01.2021: MAV – 1.55 million; Cars – 47.55 million[3]



A closer analysis of the time course of MAV accidents shows that the number of accidents involving two road users with the MAV as the primary cause has fallen, whereas the number of single-vehicle MAV accidents (i.e., accidents involving no other party) has increased both inside and outside of built-up areas. Overall, the number of accidents outside of and inside of built-up areas has remained at the same level – despite annual fluctuations.

Although MAV accidents are relatively rare, they disproportionately frequently result in serious and fatal injuries. Table 1 illustrates this using the example of the year 2019. However, a look at the time course of accidents over the last 15 years also confirms these typical accident characteristics. Relative to the total number of accidents with injuries, the proportion involving motorized agricultural vehicles is very low at 0.65 %. By contrast, these vehicles account for a disproportionately high proportion of accidents with fatalities (2.05 %) and serious injuries (1.10 %).

Farm tractor accidents occur rarely but are disproportionately severe

Table 1 · Officially recorded traffic accidents and casualties in Germany in total and involving motorized agricultural vehicles in 2019[4]

Inside & outside of built-up areas		Total	of which involving motorized agricultural vehicles	
		Number	Number	Percentage [%]
Accidents involving personal injury	Total	300,143	1,941	0.65
	With fatalities	2,877	59	2.05
	With serious injury	56,358	618	1.1
	With minor injury	240,908	1,264	0.52

In addition to the number of accidents involving MAV, it is also necessary to ask about the party causing these accidents. An examination of the official statistics for 2019 shows that, when involved in accidents with injuries, MAV were the primary cause of the accident in considerably more than half of the cases and this independently of the severity of the injury.

4. Comparative mileage-adjusted accident risk of MAV

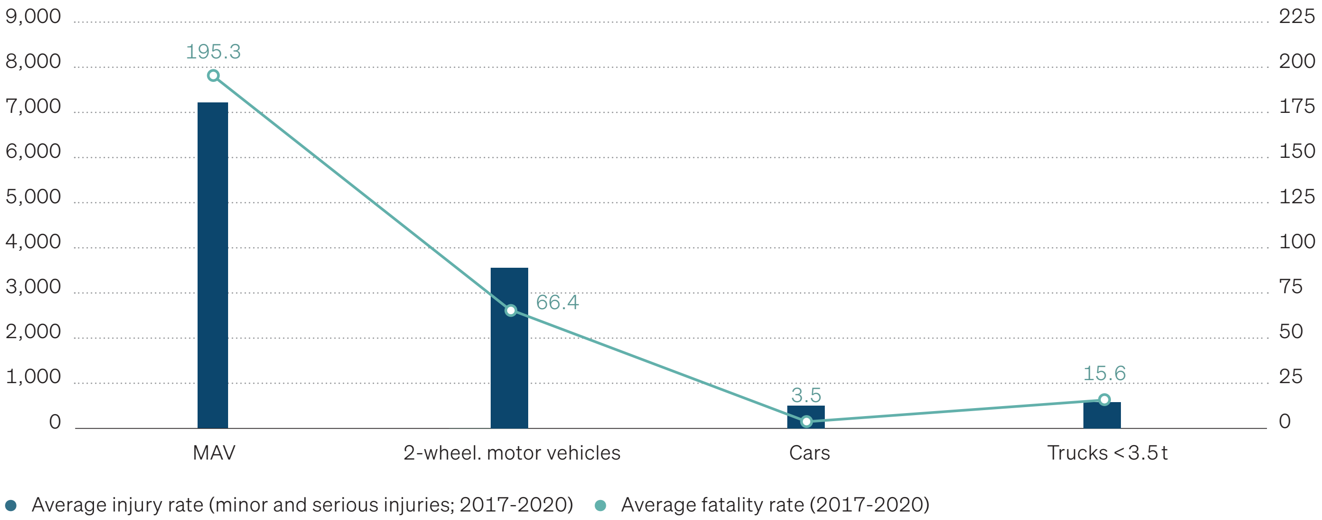
The official traffic accident statistics already clearly indicate that accidents involving motorized agricultural vehicles tend to have more serious consequences. This makes it all the more important to consider the numbers of accidents, injuries and fatalities relative to the number of vehicles and the annual mileage in order to derive the accident risk for MAV or, more precisely, the risk of accidents involving MAV.

It is possible to analyse the risk exposure of the various vehicle classes on German roads on the basis of the annual mileage by all the vehicles of a given class, i.e. the average number of kilometres driven per year and per vehicle multiplied by the number of vehicles in the class. By placing this value in relation to the accidents and/or accident consequences, we obtain the accident risk or accident rate. Figure 3 presents the number of casualties for the considered accidents. It takes account of both the casualties in the considered vehicle class as well as the other road users involved. It should be borne in mind that, in the case of accidents involving two-wheel motor vehicles, bicycles and pedestrians, the fatally and/or seriously injured are generally the least well protected road users.

The German Federal Highway Research Institute (BASt) has published a corresponding survey of mileages for the year 2014 in which, however, motorized agricultural vehicles were not taken into account.5 Consequently, the annual mileage of farm tractors and other motorized agricultural vehicles can only be estimated using other methods. At the same time, it must be remembered that the mileage covered by an MAV is only driven partly on road, with the remainder being driven

The fatality rate for accidents involving MAV is greater by a factor of 56 than that for accidents involving cars

Figure 3 · Comparison of the average casualty rate by injury severity for different types of road users[1]



Source: UDV

out in the fields. For the purposes of a comparative analysis of the accident risk of different vehicle classes on public roads, the mileage of MAV is therefore only taken into account at a conservative proportional value of 50 %. The number of MAV can also not be unambiguously derived from published figures and has had to be estimated based on certain assumptions. Both the mileage and the number of MAV are considerably lower than the corresponding values for trucks, cars and two-wheel motor vehicles. The assumptions made in this regard can be found in the research report.[1]

In general, motorcyclists are considered to exhibit the highest fatality rate in German road traffic. However, the numbers presented here show that much more attention needs to be paid to accidents involving MAV because the risk of dying as a result of an accident involving a farm tractor is considerably higher still. While the fatality rate in accidents involving two-wheel motor vehicles is approximately 19 times higher than for accidents involving cars, the fatality rate in accidents involving MAV exceeds that of accidents involving cars by as much as a factor of 56. The average injury rate for MAV is also approximately 15 times higher than for cars.

5. Accident database

To permit an in-depth accident analysis, a database of claims received by the insurers Allianz Versicherungs-AG and Landwirtschaftlichen Versicherungsvereins Münster a.G. (LVM) was set up. The following selection criteria were used:

- Claims for the years 2017 – 2020
- Motor third-party insurance claims relating to vehicles of German insurance industry risk category 451 (MAV)
- Accidents with injury (min. one third party was injured or fatally injured)

Claims were only included if the damage costs were € 4,000 or more and the accident took place on a public road. This resulted in a total number of 905 claims. The database comprises 251 features, each of which may be present in different variants, permitting more than 1,000 possibilities for selection.

6. General analysis

More than 90 % of the MAV present in the database are farm tractors and their average age is 16.4 years. It can also be seen that the majority of the agricultural vehicles (66.8 %) were registered in or after the year 2000.

More than half of the agricultural vehicles involved in the accidents were driving with a trailer on a public road. Farm tractors “on their own” were only involved in less than 25 % of the claims. Work equipment was only installed on the back of the MAV in approximately 14 % of the accidents. It was also noted that more than half of the MAV involved in an accident were travelling with front attachments.

In cases where the accident data mentioned a technical defect in the MAV and/or the trailer being towed by the MAV, this defect triggered the accident in a very high proportion of cases – more specifically in 6.6 % of the accidents. This value is considerably higher than the values known for cars, which correspond to a rate of 0.6 % in analyses of accidents with injuries recorded in the insurers' accident database.[6] The MAV defects that most frequently contributed to causing an accident included defective turn signals or the lack of contour markings on overwidth equipment and trailers. Defective load securing represented another problem.

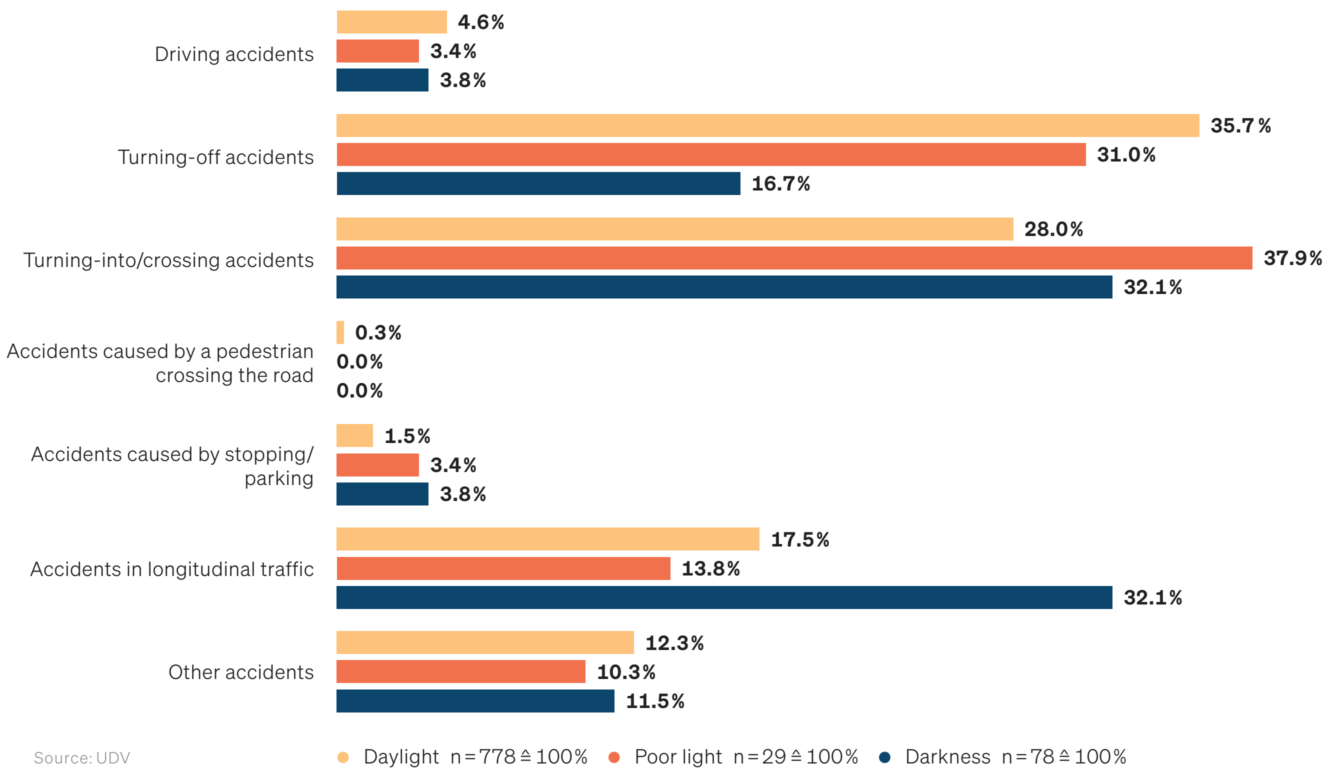
Although almost two thirds of accidents involving MAV occurred outside of built-up areas, a good third of the accident locations were nevertheless inside such areas. The drivers in 97 % of all accidents involving MAV were male, suggesting that MAV are very predominantly driven by men.

Almost 80 % of the analysed accidents took place during the period from April to October. At 88 %, the great majority of MAV accidents took place in daylight and approximately 9 % during the hours of darkness. In more than 91 %, there was no rain or any other adverse weather conditions such as snow or hail.

An examination of the accident type makes it possible to gain a detailed understanding of how each accident came about. The accident type describes the conflict situation that led to the accident and thus also the phase of the traffic situation in which a driving error or other cause made it impossible to control the subsequent course of events.[7]

The great majority of MAV accidents take place during daylight hours. Turning-off accidents are the most prominent accident type

Figure 4 · Accident type by lighting conditions



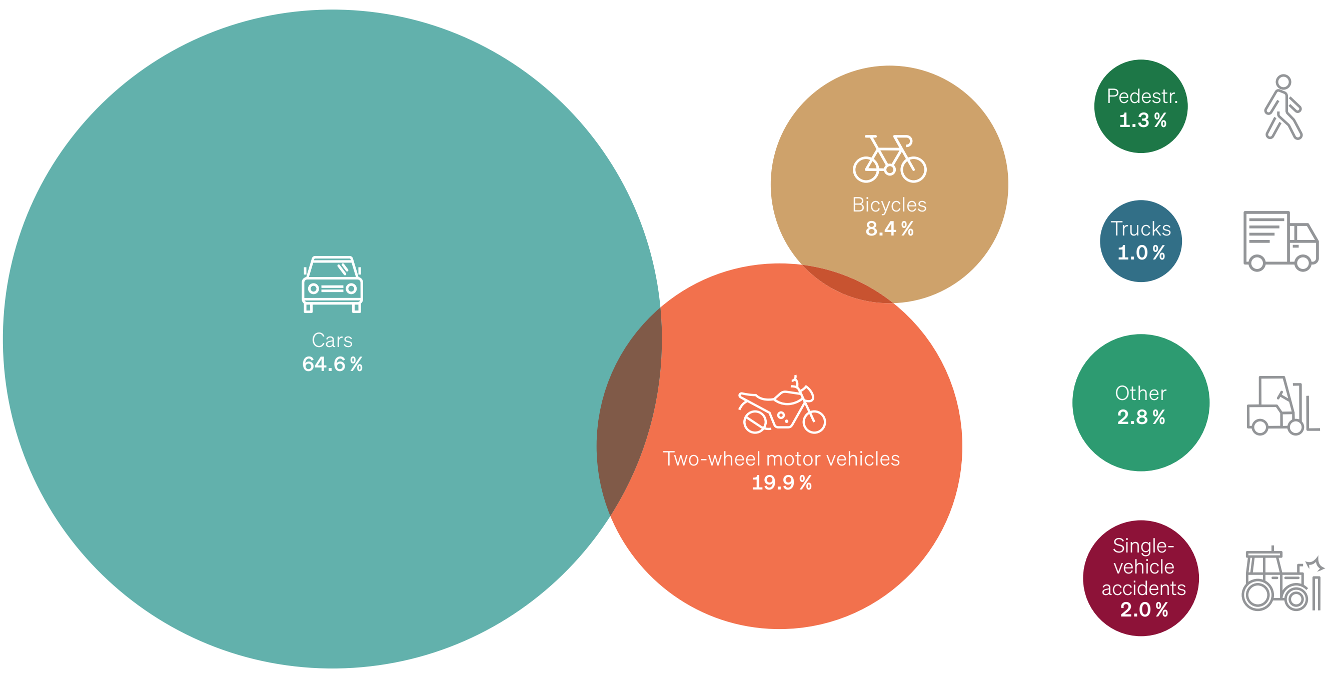
Source: UDV

In general, it can be seen that the most frequent accident types affecting MAV were turning-off accidents, turning-into/crossing accidents and accidents in longitudinal traffic. If we consider the accident types as a function of the lighting conditions, it can be seen that, unlike accidents in daylight, accidents during the hours of darkness more frequently occurred in longitudinal traffic. 60 % of these were front-on collisions and 40 % rear-end collisions.

In 65 % of cases, the other vehicle involved in the accident was a car, followed by two-wheel motor vehicles at 20 %. When the values are adjusted to take account of the smaller number of vehicles and their lower mileage relative to cars, two-wheel motor vehicles were disproportionately often involved in accidents with farm tractors, a finding which replicates that of the previous project. One explanation may lie in the fact that farm tractors and motorcycles mostly tend to use public roads at similar times, resulting in relatively frequent potential conflicts on the road. At 9 %, cyclists were the third most frequent other road users to be involved in accidents with MAV.

Passenger cars and two-wheel motor vehicles are the most frequent other road users involved in accidents with MAV

Figure 5 · Ranking of other road users involved in accidents with MAV as represented in the data (n = 905 accidents)



Source: UDV

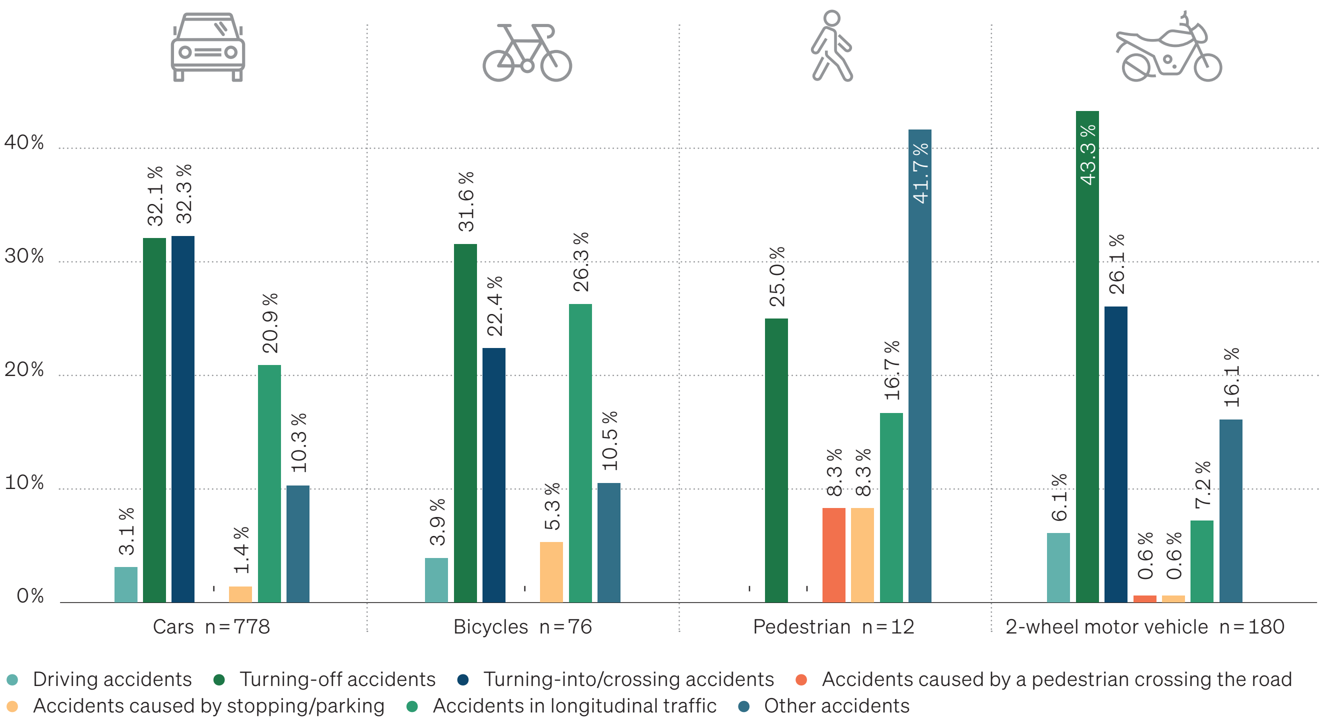
7. Key aspects of MAV accident occurrence

Accident patterns depending on the other road user involved

Clear patterns can be observed in the accident types and therefore also in the course of the accidents depending on the other road user involved (see Figure 6). MAV/car accidents primarily took the form of turning-off and turning-into/crossing accidents, each of which accounted for 32 % of the total, followed by accidents in longitudinal traffic.

Typical accident patterns exist depending on the other party involved

Figure 6 · Accident type as a function of road user category



Source: UDV

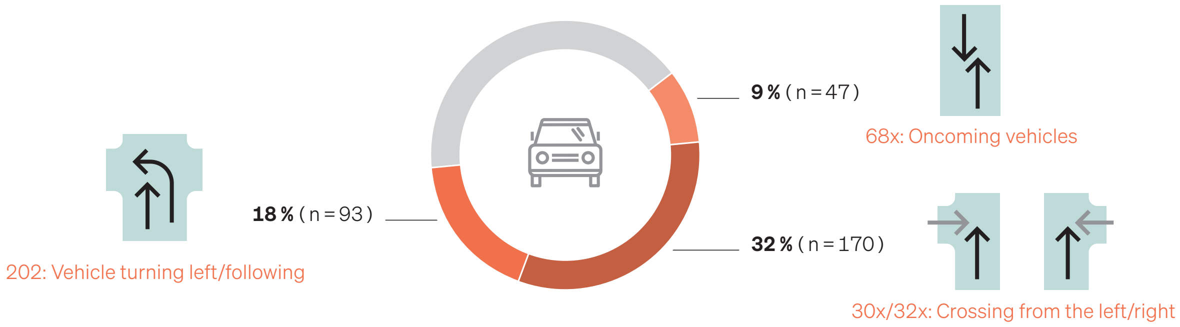
MAV/bicycle collisions (incl. pedelecs) frequently took the form of turning-off and turning-into/crossing accidents. One striking aspect of accidents involving cyclists is that such accidents often took place in longitudinal traffic. Many of these accidents were due to the MAV not leaving sufficient lateral clearance when overtaking a cyclist and/or pulling in again too soon afterwards.

In the case of riders of two-wheel motor vehicles, we can note the disproportionately high number of turning-off accidents, in which the motorcycle collided with the turning MAV while attempting to overtake it.

If, in our search for clear accident patterns, we consider the accidents by category of other road user involved in which the MAV bore at least 50 % of the responsibility for the accident, we obtain the following results:

MAV vs. Car

Figure 7 · Most frequent accident constellations (according to UDV accident type catalogue[7]) for accidents between MAV and car with the insured party (MAV) bearing ≥ 50 % responsibility; n = 526

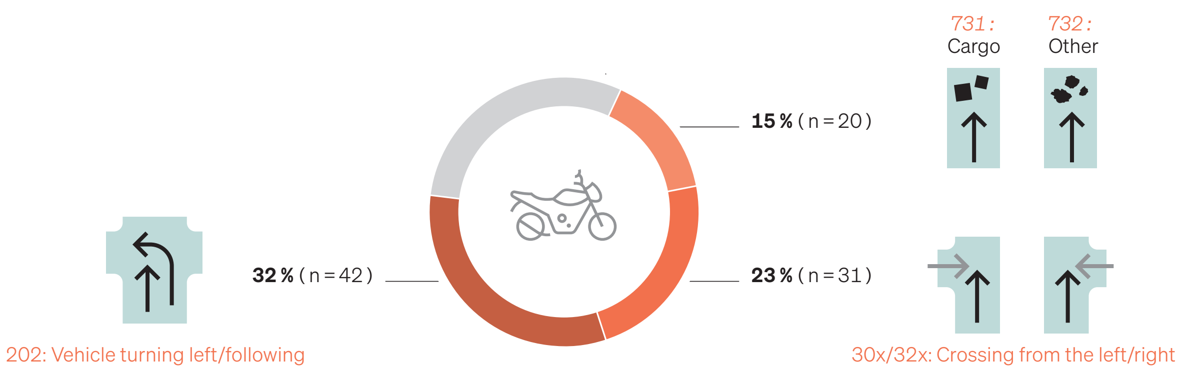


Source: UDV

32 % of turning-into/crossing accidents (30x/32x), which constituted the most frequent accident constellation at 32 % (n=170), were linked to infrastructural limitations to visibility. In 31 % of the turning-off accidents (202) between MAV and cars (n=93, 18 %), the MAV's turn signals were either not visible or not functioning correctly. The MAV disproportionately often had a trailer or attachments. Among the accidents in longitudinal traffic, there were a strikingly high number of head-on collisions (68x) (n=47, 9 %), a quarter of which took place at dawn/dusk or during the hours of darkness. Such accidents also involved a high proportion of young MAV drivers, namely 39 %. They frequently occurred on bends and in narrow roads. In almost half of these accidents, the collision took the form of the vehicles scraping against one another.

MAV vs. two-wheel motor vehicle

Figure 8 · Most frequent accident constellations (according to UDV accident type catalogue[7]) for accidents between MAV and two-wheel motor vehicle with the insured party (MAV) bearing ≥ 50 % responsibility; n = 133



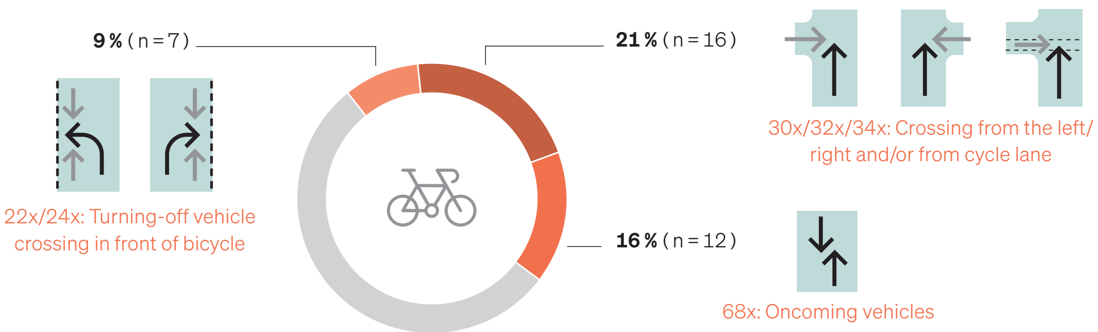
Source: UDV

32 % (n=42) of the accidents took the form of a turning-off accident in which an MAV that was turning left collided with a two-wheel motor vehicle that was attempting to overtake it. The most frequent cause of accident on the part of the MAV was an error while turning off. In the same way as for accidents with cars, the great majority of the accidents took place outside of built-up areas and involved limitations to visibility due to the blind spot when looking from the MAV.

23 % (n=31) of the turning-into/crossing accidents were collisions between an MAV that was turning into or crossing the road and a two-wheel motor vehicle with priority approaching from right or left. These collisions were very often due to the failure of vehicles coming from farm or forest tracks to observe the priority of the other vehicle. The proportion of infrastructural limitations to visibility in these accidents was high.

MAV vs. Bicycle

Figure 9 · Most frequent accident constellations (according to UDV accident type catalogue[7]) for accidents between MAV and bicycle (incl. pedelec) with the insured party (MAV) bearing ≥ 50 % responsibility; n = 75



Source: UDV

21 % of the accidents were assigned to the category of turning-into/crossing accidents (30x/32x/34x). The great majority of these accidents occurred outside of built-up areas, something that is more surprising in the case of bicycles than, for example, two-wheel motor vehicles. Of the accidents that occurred outside of built-up areas, just about half took place at intersections between farm tracks and country roads or trunk roads.

The accident types 22x and 24x describe an MAV turning off to the left or right and a cyclist crossing the carriageway into which the MAV was turning. These accounted for approximately 9 % of the accidents. All the accidents were due to turning-off errors by the MAV driver. The high proportion of accidents outside built-up areas is again striking.

Head-on accidents between farm tractors and bicycles occurred predominantly on narrow roads or narrow road sections and accounted for approximately 16 % of accidents. If we attempt to identify accident patterns for pedelecs within the group of cyclists, it can be seen that pedelecs were more highly represented (proportion above 30 %) in the turning-into/crossing accidents (30x/32x/34x) and turning-off accidents (202). For all the other accident types, the proportion was between 20 % and 30 %.

8. Serious accidents with life-threatening injuries involving MAV

For the group of seriously injured road users, the categorisation of casualties into minor injuries, serious injuries and fatalities as found in the official traffic accident statistics does not make it possible to draw adequate conclusions concerning accident occurrence. The reason for this lies in the definition according to which the injured person only has to be treated for 24h or more as a hospital inpatient in order to be classified as seriously injured. As a result, all kinds of injuries are subsumed within this large, heterogeneous group; from persons with minor injuries who are only kept in hospital for a day for observation through to persons with life-threatening injuries who are left fighting for their lives in intensive care departments.

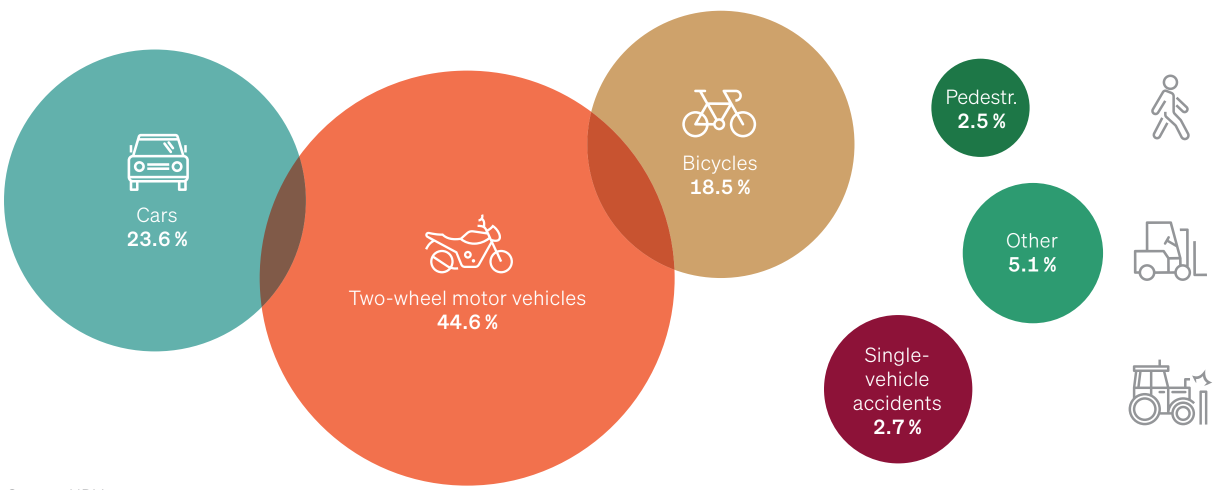
To better understand the circumstances characterising the accidents experienced by those persons with life-threatening injuries, the injuries of the persons present in our sample were coded using the well-established AIS feature. The AIS (Abbreviated Injury Scale) specifies the probability of survival on a scale from 0 (uninjured) to 6 (fatal).[8] The most serious injury of all the injuries in any given body region is designated on the Maximum Abbreviated Injury Scale (MAIS).

An AIS value of 3 or higher indicates the presence of a very serious injury. The definition MAIS3+ has become established both inside and outside of Germany to designate these life-threatening injuries.

The particular severity of MAV accidents is reflected by the high proportion of MAIS3+ accidents at 17 %. A comparison with the total sample of accidents involving MAV (see Figures 5 and 10) also reveals a shift in the ranking of road users involved in accidents with MAV. The most frequently affected road users are now two-wheel motor vehicles at 45 %, followed by passenger cars at approximately 24 % and bicycles at about 19 %, including a higher proportion of pedelecs. We

Shift in the ranking of road users in accidents resulting in life-threatening injuries. Two-wheel motor vehicles are now at the top of the list

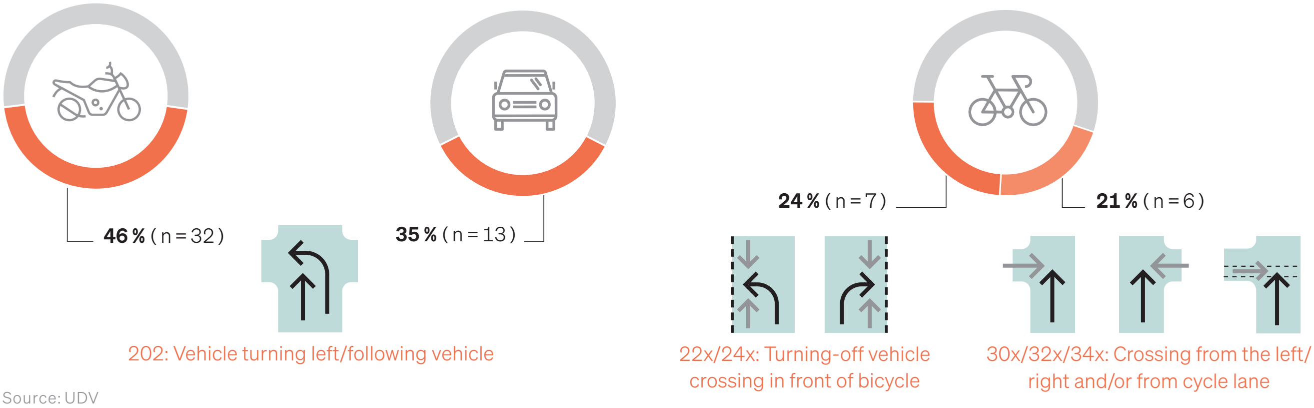
Figure 10 · Ranking of road users involved in MAV accidents resulting in life-threatening injuries (MAIS3+) in the analysed data (n = 157 accidents)



Source: UDV

MAIS3+ – Most frequent accident types

Figure 11 · Most frequent accident constellation (according to UDV accident type catalogue[7]) as a function of the other road user involved in MAV accidents resulting in life-threatening injuries



Source: UDV

clearly recognise the higher proportion of unprotected road users compared to the total number of casualties resulting from accidents in which MAV are observed, in which cars predominate and cyclists are barely perceptible.

These cases are characterised by the fact that they occurred more frequently outside of built-up areas (69 % MAIS3+ vs. 54 % MAIS<3) and at intersections between farm tracks and main roads (30 % MAIS3+ vs. 17 % MAIS<3). It can be seen that almost 70 % of the other road users involved were two-wheel motor vehicles. More than two thirds of the accidents were turning-off (45 %) or turning-into/crossing (23 %) accidents. The main driving errors of MAV drivers consisted in turning-off errors (41 % MAIS3+ vs. 26 % MAIS<3), whereas the main driving error of the other road users involved consisted in overtaking errors (30 % MAIS3+ vs. 13 % MAIS<3) and driving at inappropriate speeds (12 % MAIS3+ vs. 6 % MAIS<3).

9. Damage prevention measures and their impact on accident occurrence

To determine the effectiveness of a given measure, a retrospective analysis of the accident database was performed to identify whether the damage prevention measure in question could ideally have had an impact on accident occurrence. It is therefore only possible to speak of addressability here and no explicit claims can be made about the potential mitigation or even the avoidance of the consequences of accidents or of accidents themselves. Selection criteria for addressability with regard to accident occurrence on public roads were defined for the discussed measures on the basis of the accident characteristics stored in the database (accident category, accident type, vehicle configuration etc.). The two tables below indicate the proportional addressability of the proposed measures for MAV Special emphasis was placed on advanced driver assistance systems of the type that are already sometimes available in passenger cars and trucks. In addition, other measures were also defined and analysed. The temporal horizon for implementation of the measures is also indicated in colour in the following tables. See the research report for a detailed description of the respective damage prevention (DP) measures.[1]

Advanced driver assistance systems for MAV can be effective

Table 2 · Measures relating to advanced driver assistance systems for MAV and their impact on accident occurrence

DP measure/Advanced driver assistance system for MAV		Addressability* of accidents on public roads			
		Accidents [%]	MAIS3+ accidents [%]	Killed + Seriously Injured [%]	All casualties [%]
1**	● Front-mounted camera system	17	17	18	17
	● Turning-in/crossing assistance system	27	22	27	27
2**	● Lane change assistance system	22	32	30	23
3**	● Emergency brake assistance system, longitudinal traffic 2	9	0	1	9
	● Emergency brake assistance system, longitudinal traffic 1	9	0	1	9
4**	● Left-turn-off/oncoming-traffic assistance system	6	8	6	5
5**	● Reversing camera 2	3	2	1	3
	● Reversing camera 1	2	0	0	1
6**	● Turning-off/blind spot assistance system Pedestrians/cyclists	0	0	1	0

* Effectiveness dependent on the technical implementation (for information, warning, intervention)
** ADAS groups can theoretically be summed, no summing permitted within the ADAS groups

● Short-term implementation conceivable/Technology available for cars/Easy to transfer to MAV
● Medium-term implementation conceivable/Technology present in cars/Possible to transfer to MAV
● Presumed long-term implementation/Technology present in cars, but complex/Difficult to transfer to MAV

As Table 2 indicates, it is, in theory, permissible to sum the determined addressabilities for ADAS groups 1 to 6. In total, this results in a maximum addressability of 67 % of the accidents on public roads and 66 % of the fatally and seriously injured road users for the considered advanced driver assistance systems for MAV. On their own, the technologies that could be implemented in the short term already address 20 % of accidents and 19 % of fatal and serious injuries. The transfer to

Even simple measures can be effective

Table 3 · Various DP measures for MAV and their impact on accident occurrence

DP measure for MAV		Addressability* of accidents on public roads			
		Accidents [%]	MAIS3+ accidents [%]	Killed + Seriously Injured [%]	All casualties [%]
MAV visibility	● Functional and robust rear-mounted turn signals	4	4	5	5
	● Optimisation of MAV signals***	2	5	3	2
	● Optimisation of trailer signals***	2	3	3	2
	● Optimisation of equipment signals***	2	3	3	2
MAV safety systems **	● Side underrun protection for trailers***	4	8	6	4
	● Front underrun protection for MAV***	3	6	6	3
Other for MAV	● Widening of rear-view mirror	2	4	3	2
Networking	● MAV-to-vehicle communication	68	65	70	69

* Effectiveness dependent on the technical implementation (for information, warning, intervention)
** Safety systems: The extent to which injury severity could have been influenced cannot be assessed on the basis of the available information
*** Summing within the group is possible in theory, not permitted across groups

● Short-term implementation conceivable/Technology available for cars/Easy to transfer to MAV
● Medium-term implementation conceivable/Technology present in cars/Possible to transfer to MAV
● Presumed long-term implementation/Technology present in cars, but complex/difficult to transfer to MAV

motorized agricultural vehicles of advanced driver assistance systems that are already established in other vehicle classes can therefore be examined as a potentially effective measure. At the same time, it is necessary to remember that the long period necessary for the measures to be incorporated in the vehicle fleet will delay their effectiveness.

When we consider the accidents leading to life-threatening injuries (MAIS3+), it can be seen that lane-change assistance systems gain greatly in significance because they address more accidents involving two-wheel motor vehicles, whose riders account for a high proportion of MAIS3+ injuries. In addition to the ADAS, measures that are technically easy to implement in order to improve the visibility of MAV and/or their trailers are already showing positive effects. For example, functional and robust rear-mounted turn signals are able to address 4 % of accidents and 5 % of fatalities and serious injuries.

Other damage prevention measures

Infrastructural measures could, in particular, help reduce the potential risks of turning-into and turning-off situations. Although they cannot be implemented nationwide, they should nevertheless at least be considered when looking at areas with high levels of accidents and it should therefore be possible to implement them in the medium term:

- → Introduction of no-overtaking zones and/or speed limits
- → Extended manoeuvring area for MAV in order to increase safety when turning off to the left
- → Intersections between farm tracks and main roads (relevance for accident occurrence: 6 % of accidents, 9 % of fatalities and serious injuries):
  - Examine visibility of position of field entrances relative to the course of the road
  - Optimise the position of field entrances or group entrances together
- → Create improved visibility for turning-into/crossing situations (relevance for accident occurrence: 13 % of accidents, 19 % of fatalities and serious injuries, in combination with infrastructural limitations to visibility)
- → Examine the installation of traffic mirrors at entrances to property
- → Examine the location of bridges, roundabouts, acceleration lanes for MAV

The familiarisation of all road users with the particular risks posed by motorized agricultural vehicles in road traffic should continue to be a fixed component of driving lessons and the object of general communications regarding traffic safety. In addition, road safety training for MAV drivers in order to increase familiarity with the risks caused by and risks to MAV in road traffic. In this regard, it is also highly advisable to respect the accident prevention regulations set out by the agricultural trade associations.[9]

Bibliography

1. **M. Borrack, D. Unger, Th. Behl, R. Hegerfeld (2023).** „Unfallrisiko von Traktoren", AZT Automotive GmbH – Allianz Zentrum für Technik, Forschungsbericht im Auftrag der UDV, unveröffentlicht.
2. **Bundesinformationszentrum Landwirtschaft (BZL) (2020).** Broschüre „Landwirtschaftliche Fahrzeuge im Straßenverkehr 2020" (24. Auflage).
3. **Statistisches Bundesamt (Destatis) (2022).** „Verkehrsunfälle – Zeitreihen 2021", Wiesbaden.
4. **Statistisches Bundesamt (Destatis) (2020).** „Fachserie 8 Reihe 7 – Verkehr – Verkehrsunfälle 2019", Wiesbaden.
5. **M. Bäumer, H. Hautzinger, M. Pfeiffer, W. Stock, B. Lenz, T. Kuhnimhof und K. Köhler (2017).** „Fahrleistungserhebung 2014 – Inländerfahrleistung" (Heft V 290), Fachverlag NW in der Carl Schünemann Verlag GmbH, Bremen.
6. **J. Bende, M. Kühn (2023).** „Mängel als Unfallursache. Analysen der UDB", unveröffentlicht.
7. **Gesamtverband der Deutschen Versicherungswirtschaft e. V. (1998).** Unfalltypen-Katalog – Leitfaden zur Bestimmung des Unfalltyps, Informationen des Institutes für Straßenverkehr, Köln.
8. **K. Loftis, J. Price und P. Gillich (2023).** „Evaluation of the Abbreviated Injury Scale: 1990 - 2015," Traffic Injury Prevention, pp. 109-113, 13 Dezember 2018.
9. **SVLFG (2023).** Sozialversicherung für Landwirtschaft, Forsten und Gartenbau, https://www.svlfg.de/startpage-9c6f922753b7a1d8 (31.03.2023).

GDV
Unfallforschung
der Versicherer

Gesamtverband der Deutschen Versicherungswirtschaft e. V. (GDV – German Insurance Association)
Wilhelmstraße 43 / 43 G, 10117 Berlin
Postfach 08 02 64, 10002 Berlin
Tel. 030 2020–5000, Fax 030 2020–6000
www.gdv.de, berlin@gdv.de