

# Eye Injury Incidence in Germany from 2008 to 2022: An Analysis of Hospital Quality Reports

## Die Häufigkeit von Augenverletzungen in Deutschland von 2008 bis 2022: eine Analyse der Qualitätsberichte der Krankenhäuser

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### Keywords

injury, burn, routine data, health services research

### Schlüsselwörter

Verletzung, Verbrennung, Routinedaten, Versorgungsforschung

received 19.6.2024

accepted 5.7.2024

### Bibliography

Klin Monatsbl Augenheilkd 2024; 241: 1145–1155

DOI 10.1055/a-2364-2461

ISSN 0023-2165

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### ABSTRACT

**Background** Eye injuries range from minor to severe and may lead to permanent visual impairment. There is still little in the way of epidemiological data on eye injuries in Germany.

**Aim** The aim of this study was to obtain an objective record of minor and severe eye injuries in Germany by evaluating hospital quality reports. We also investigated the relevance of injuries from fireworks in relation to the total number of eye injuries and the general population.

**Methods** This retrospective routine data study entailed analysing hospital quality reports from 2008 to 2022 in XML format. The R programming language was used for data processing and statistical analysis. The number of ICD-coded eye injuries was exported and analysed together with location data. We also included data from a prospective survey study on fireworks-related eye injuries from 2016 to 2023.

**Results** Eyeball and/or orbital contusions are the most common eye injuries treated in Germany at up to 2,500 cases per year. The most severe injuries comprise traumatic globe rupture with loss of intraocular tissue at up to 990 cases per year. Numbers of eye injuries of any type have been declining since 2020. As a percentage of population, Mecklenburg-Western Pomerania treats the most eye injuries at up to 0.017%; in absolute numbers, North Rhine-Westphalia leads the country at up to 1,600 injuries. Private firework displays are probably responsible for 1.4% of annual globe ruptures and 8.3% of eyeball contusions.

**Conclusion** Our analysis of hospital quality reports has provided the first comprehensive epidemiological record on eye injuries in Germany. Firework-related injuries account for a relevant proportion of total injuries. These results could serve as a basis for preventive measures and health policy decisions.

### ZUSAMMENFASSUNG

**Hintergrund** Augenverletzungen können von leichten bis hin zu schweren Verletzungen reichen und zu dauerhaften Seheinschränkungen führen. Für Deutschland existieren bisher wenige epidemiologische Daten zu Augenverletzungen.

**Ziel** Ziel dieser Arbeit ist die objektive Erfassung leichter und schwerer Augenverletzungen in Deutschland mittels Auswertung der Qualitätsberichte der Krankenhäuser. Zudem soll die Relevanz von feuerwerksbedingten Verletzungen in Relation zur Gesamtzahl der Augenverletzungen und der Bevölkerung gesetzt werden.

**Methoden** In dieser retrospektiven Routinedatenuntersuchung wurden die Qualitätsberichte der Krankenhäuser aus den Jahren 2008 bis 2022 im XML-Format ausgewertet. Die Datenverarbeitung und statistische Auswertung erfolgten mit der Programmiersprache R. Die Anzahl der codierten Augenverletzungen wurde zusammen mit den Ortsdaten auf Ebene der Bundesländer exportiert und analysiert. Zusätzlich

wurden Daten einer prospektiven Umfragestudie zu feuerwerksbedingten Augenverletzungen von 2016 bis 2023 einbezogen.

**Ergebnisse** Die häufigste behandelte Augenverletzung in Deutschland ist die Prellung des Augapfels und/oder der Orbita mit bis zu 2500 Fällen pro Jahr. Bei den schweren Verletzungen treten am häufigsten traumatische Augapfeleröffnungen mit Verlust von intraokularem Gewebe auf (bis zu 990 Fälle pro Jahr). Ab 2020 zeigt sich ein Rückgang aller Augenverletzungen. Prozentual werden in Mecklenburg-Vorpommern mit bis zu 0,017% am meisten Augenverletzungen behandelt, ab-

solut gesehen in Nordrhein-Westfalen mit bis zu 1600 Verletzungen. Private Feuerwerkskörper sind vermutlich für 1,4% der jährlichen Bulbusrupturen und 8,3% der Bulbusprellungen verantwortlich.

**Schlussfolgerung** Die Auswertung der Krankenhausqualitätsberichte liefert erstmals umfassende epidemiologische Daten zu Augenverletzungen in Deutschland. Feuerwerksbedingte Verletzungen machen einen relevanten Anteil der Gesamtverletzungen aus. Die Ergebnisse können als Grundlage für präventive Maßnahmen und gesundheitspolitische Entscheidungen dienen.

## Introduction

Eye injuries range from minor scratches to severe superficial injuries to contusions, globe rupture, and ocular avulsion with or without the optic nerve. Severe injuries often result in permanent and debilitating visual impairment [1]. Severe injuries frequently require extensive reconstruction measures for the surface to stabilise and heal with surgical wound closure and complex vitreoretinal surgery [2]. Patients affected suffer from loss of vision and limitations in quality of life, often extending to occupational disability [3].

Reports from different countries on the incidence of severe eye injuries vary widely. A prospective questionnaire study from Scotland reported an incidence of 1.96 severe eye injuries per 100,000 in 2014 [4]. In contrast, a 2005 analysis of the US injury registry revealed an incidence of 3.15 severe eye injuries per 1,000 [5]. A Canadian telephone survey with a total of 4,974 respondents demonstrated an incidence of 2.09% over a one-year period in 2012. Of these injuries, 30% occurred at home or work compared to 8% while engaging in sports. The respective injury involved sharp trauma in 23% of cases compared to blunt trauma in 6.7% [6].

Like mechanical injuries, burns and corrosion injuries also include a high risk of permanent severe visual impairment. Preserving the globe and, where possible, improving vision often require complex reconstruction procedures [7]. Occupational accidents are the usual cause for burns and corrosion injuries [8].

A standardised prospective survey study supported by the German Ophthalmological Society (DOG) collected 2,989 anonymous datapoints on patients that had sustained eye injuries occurring during private fireworks displays at New Year's celebrations between December 2016 and January 2023; around a quarter of these patients were seriously injured and required inpatient treatment [9]. Retail was banned from selling fireworks during the pandemic in Germany. A survey study showed a significant decrease in eye injuries during the New Year's celebrations as a result [10].

German hospitals with inpatient facilities have been keeping quality reports since 2008; these reports provide objective data for evaluating ICD and OPS codes.

The ICD system distinguishes between mechanical eye injuries under code S05 and burn and corrosion injuries confined to eye and adnexa in section T26.

Ophthalmological healthcare research has already performed objective analysis on cataract surgery, vitrectomy, indenting surgery, glaucoma surgery, and keratoplasty [11–16].

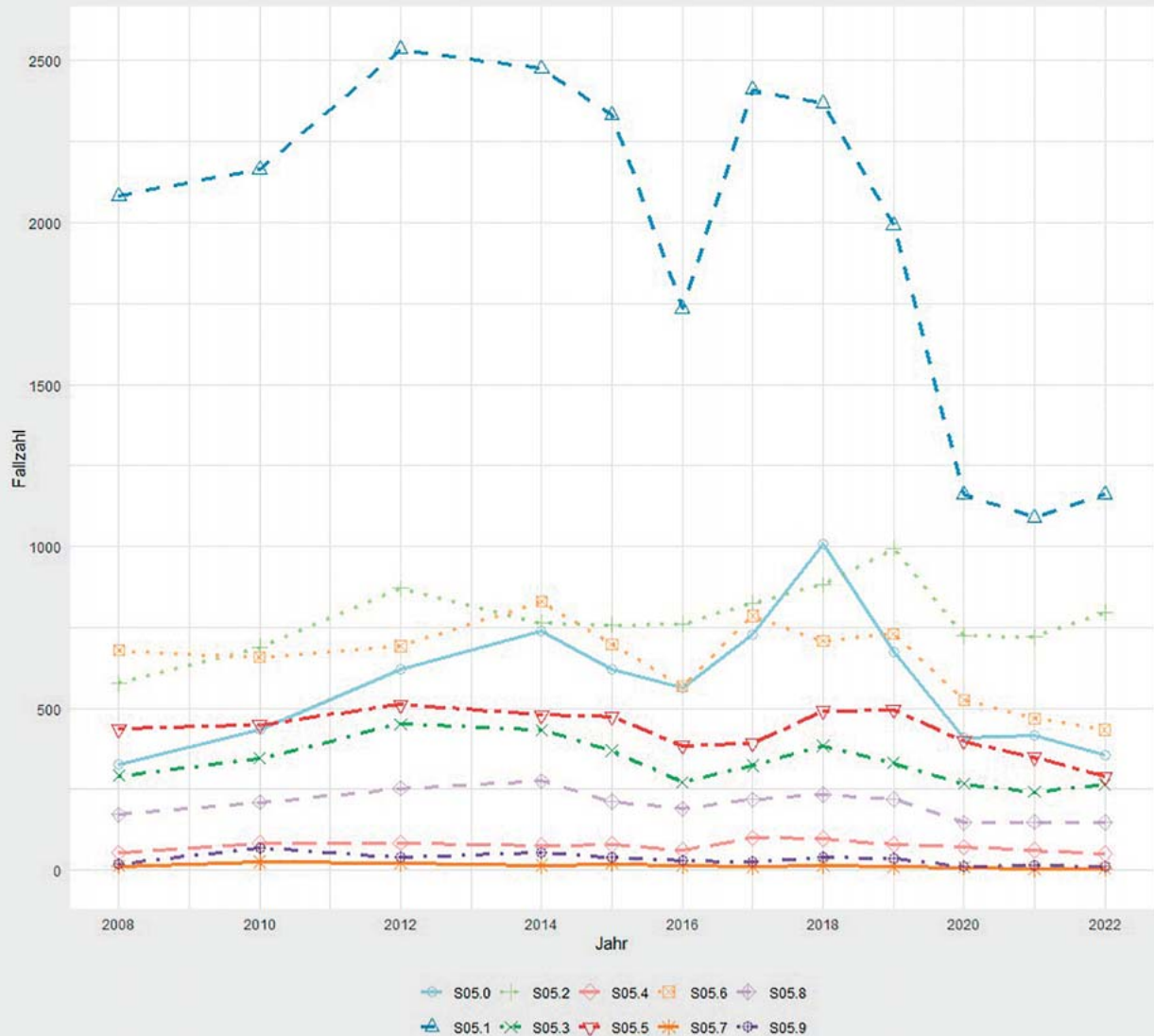
The aim of this study was to provide an objective record on minor and severe eye injuries by evaluating quality reports from hospitals belonging to the Joint Federal Committee (G-BA). Our aim was to include mechanical (S05) and burn and corrosion injuries confined to eye and adnexa (T26) in the record. The study was also to analyse the data by federal state and respective population size to reveal regional differences.

We have also compared the number of eye injuries caused by fireworks to the total number of eye injuries to estimate the relevance of potential protective measures while handling fireworks at private firework displays.

## Methods

This contribution drew on two different data sources:

1. The first part comprises a retrospective routine data investigation and includes mechanical (S05) as well as burn and corrosion injuries confined to eye and adnexa (T26) for overall evaluation at both federal and federal state level.
  - The sources in this part were hospital quality reports in XML format from the 2008, 2010 and 2012–2022 reporting years.
  - These hospital quality reports record objective data from the healthcare system. Hospitals are legally required to prepare quality reports. These reports include ICD-10-coded diagnoses.
  - The present contribution only used parts or extracts of the hospital quality reports. Refer to [www.g-ba.de/qualitaetsberichte](http://www.g-ba.de/qualitaetsberichte) for a complete, unaltered presentation of hospital quality reports.
  - The R programming language (R-Project.org, R-Studio) was used for data processing and statistical evaluation.
  - The number of coded eye injuries recorded at German hospitals was exported together with location data. The evaluation was performed at federal state level with to ensure anonymity in the reporting locations; Berlin, Bremen, and Hamburg were taken together for the purposes of analysis.
  - The study included all hospitals to avoid missing any injuries that might have been caused by restricting the study to specialist ophthalmological clinics.



► **Fig. 1** Number of eye injuries at German hospitals with inpatient facilities. S05.0: Injury of conjunctiva and corneal abrasion without foreign body. S05.1: Contusion of eyeball and orbital tissues. S05.2: Ocular laceration and rupture with prolapse or loss of intraocular tissue. S05.3: Ocular laceration without prolapse or loss of intraocular tissue. S05.4: Penetrating wound of orbit with or without foreign body. S05.5: Penetrating wound with foreign body of eyeball. S05.5: Penetrating wound without foreign body of eyeball. S05.7: Avulsion of eye. S05.8: Other injuries of eye and orbit. S05.9: Unspecified injury of eye and orbit.

- Distinguishing between minor and severe injuries is difficult in the ICD system as even superficial injuries and corrosion injuries may involve severe visual impairment. The code alone makes no distinction in this regard, so we have limited the study to injuries involving globe rupture, burns, corrosion injuries, and complete ocular evulsion as severe injuries.
2. We have also included data from the survey study on fireworks-related eye injuries to compare total numbers of injuries to

those resulting from fireworks displays. This is an online-based prospective study that has been conducted in a standardised form since 2016 during the five days around New Year's Eve at all eye clinics involved in the ophthalmological emergency service [9, 10]. The present analysis includes data on eyeball contusions and traumatic globe ruptures. We have included the number of similar injuries for the 2022/23 New Year period in the evaluation at half rate.

► **Table 1** Number of eye injuries in German hospitals with inpatient facilities.

ICD	2008	2010	2012	2014	2015	2016	2017	2018	2019	2020	2021	2022
S05.0	326	434	621	738	622	563	728	1,007	676	408	415	354
S05.1	2,081	2,163	2,535	2,475	2,332	1,735	2,409	2,369	1,992	1,162	1,089	1,160
S05.2	577	689	870	764	758	762	826	881	994	725	720	796
S05.3	292	346	451	433	370	272	323	384	332	267	242	265
S05.4	53	83	84	76	80	63	100	97	79	71	62	51
S05.5	437	449	512	480	475	385	393	493	495	400	349	290
S05.6	679	658	692	830	698	568	785	708	730	526	469	435
S05.7	13	26	23	15	20	14	12	15	12	9	5	6
S05.8	172	210	253	275	212	189	218	233	220	147	149	148
S05.9	20	68	42	53	39	31	27	41	36	13	14	10

S05.0: Injury of conjunctiva and corneal abrasion without foreign body; S05.1: Contusion of eyeball and orbital tissues; S05.2: Ocular laceration and rupture with prolapse or loss of intraocular tissue; S05.3: Ocular laceration without prolapse or loss of intraocular tissue; S05.4: Penetrating wound of orbit with or without foreign body; S05.5: Penetrating wound with foreign body of eyeball; S05.6: Penetrating wound without foreign body of eyeball; S05.7: Avulsion of eye; S05.8: Other injuries of eye and orbit; S05.9: Unspecified injury of eye and orbit

► **Table 2** Number of eye injuries in German hospitals with inpatient facilities per federal state and year.

Federal state	2008	2010	2012	2014	2015	2016	2017	2018	2019	2020	2021	2022
Baden-Württemberg	531	480	628	655	613	619	618	610	637	395	381	383
Bayern	864	1,070	973	1,077	961	1,006	916	802	837	555	560	596
Brandenburg	115	124	114	137	94	0	123	130	117	77	76	84
Hamburg, Bremen, Berlin	375	483	681	506	473	293	508	1,110	460	395	336	278
Hesse	308	333	422	297	344	426	442	430	435	319	283	264
Mecklenburg-Forepomerania	261	200	271	251	262	0	268	229	254	120	121	118
Lower Saxony	367	334	450	414	463	427	492	506	428	379	354	329
North Rhine-Westphalia	926	1,163	1,334	1,624	1,415	1,433	1,380	1,420	1,340	765	746	715
Rhineland-Palatinate	170	125	201	245	162	174	166	145	122	98	114	106
The Saar	57	107	121	126	113	97	99	108	121	92	81	110
Saxony	243	277	352	316	299	0	338	286	320	213	148	212
Saxony-Anhalt	142	136	136	142	125	0	164	123	134	94	101	104
Schleswig-Holstein	118	106	160	119	97	107	120	192	204	67	96	99
Thuringia	173	188	240	230	185	0	187	137	157	159	117	117

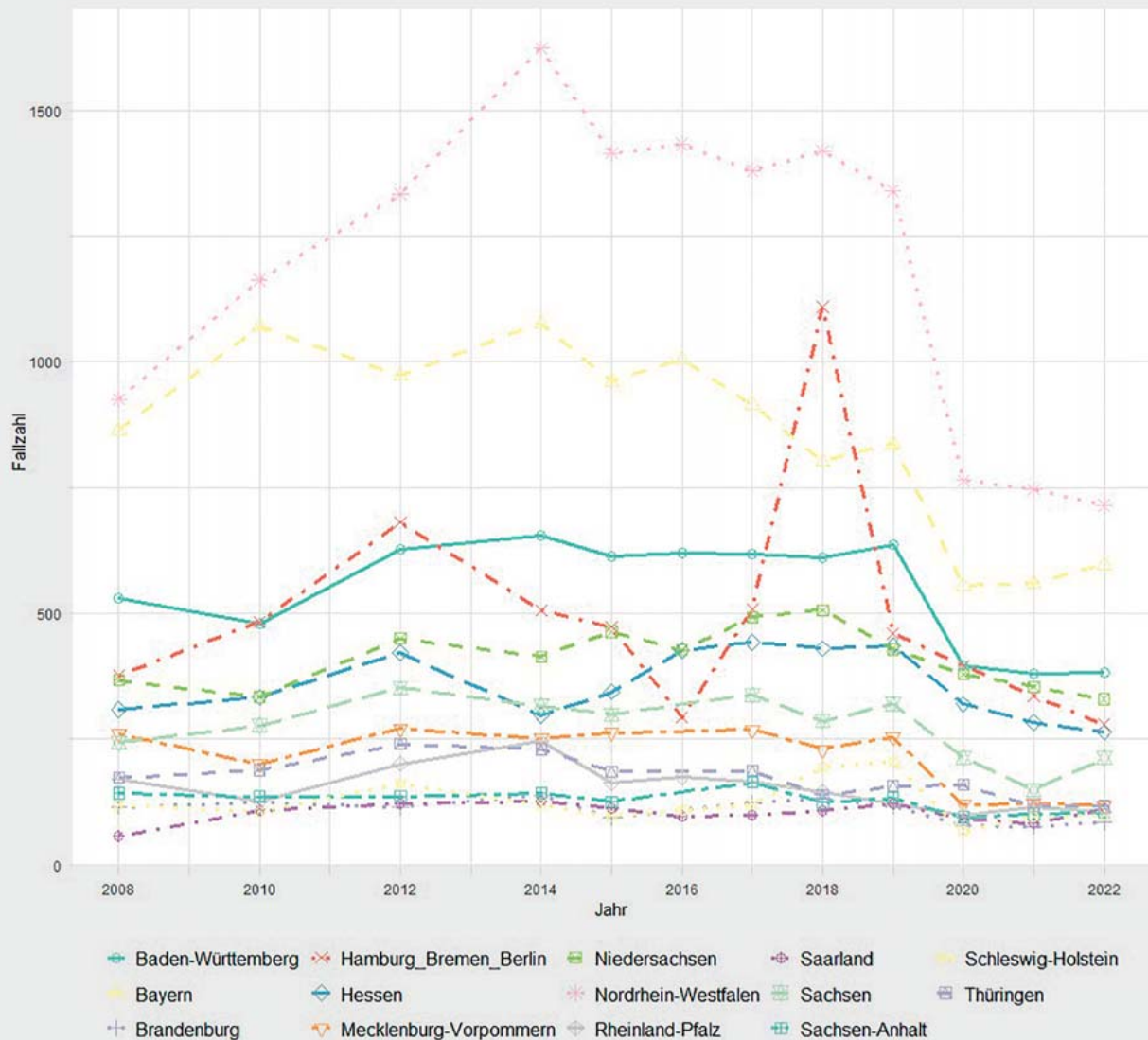
## Results

### Mechanical injuries (S05)

Eyeball and/or orbital contusions are the most frequently treated eye injuries at German hospitals with up to 2,500 cases per year. The most common severe injuries are lacerations to the eye with loss of intraocular tissue at up to 990 cases per year. All eye inju-

ries, both mild and severe, have been declining from 2020 with varying degrees of severity depending on the type of injury (► **Fig. 1, Table 1**).

Mecklenburg-Western Pomerania has the highest percentage incidence of eye injuries by population amongst the federal states at up to 0.017%. In terms of absolute numbers, North Rhine-Westphalia treats the most eye injuries at up to 1,600 in total. All the federal states have been seeing a decline in absolute and rela-



► Fig. 2 Number of eye injuries per state and year.

tive eye injury numbers from 2020 onwards (► Fig. 2, Table 2 and 3). There are no major overall differences in severe eye injury numbers as percentages at up to 0.008% in some federal states. The lowest relative percentage of severe eye injuries is in Brandenburg at up to 0.001%. North Rhine-Westphalia also treats the most eye injuries in absolute case numbers. Interestingly, some of the federal states did not code either minor or severe eye injuries in 2016 (► Fig. 3, Table 4 and 5).

### Burn and corrosion confined to eye and adnexa (T26)

The most common burns and corrosion injuries in Germany comprise corrosion burns to the cornea and conjunctival sac at up to 1,400 cases per year. Severe burns and corrosion injuries such as burns with subsequent globe rupture and destruction of the eyeball are generally rare. Like mechanical injuries, most burns and corrosion injuries also occur most frequently in heavily populated

federal states (► Fig. 4, Table 6 and 7). Burns and corrosion injuries also showed a significant decline in 2020 and 2021 and did not return to baseline by 2022 (► Fig. 3).

### Survey data on eye injuries from fireworks displays

We documented 12–20 globe ruptures from fireworks displays between 2016 and 2020, and 5 and 9 cases, respectively, in the pandemic years from December 2020 to January 2022. We recorded 112–174 firework-related eyeball bruises during the same period from 2016 to 2020, and 25 and 56 cases over New Year in the pandemic years, respectively. This means that private fireworks displays only permitted between 31 December 00:00 h and 1 January 24:00 h were on average responsible for 1.4% of annual globe ruptures and 8.3% of eyeball contusions (► Table 8 and 9).

► **Table 3** Percent of population: Number of eye injuries in German hospitals with inpatient facilities per year.

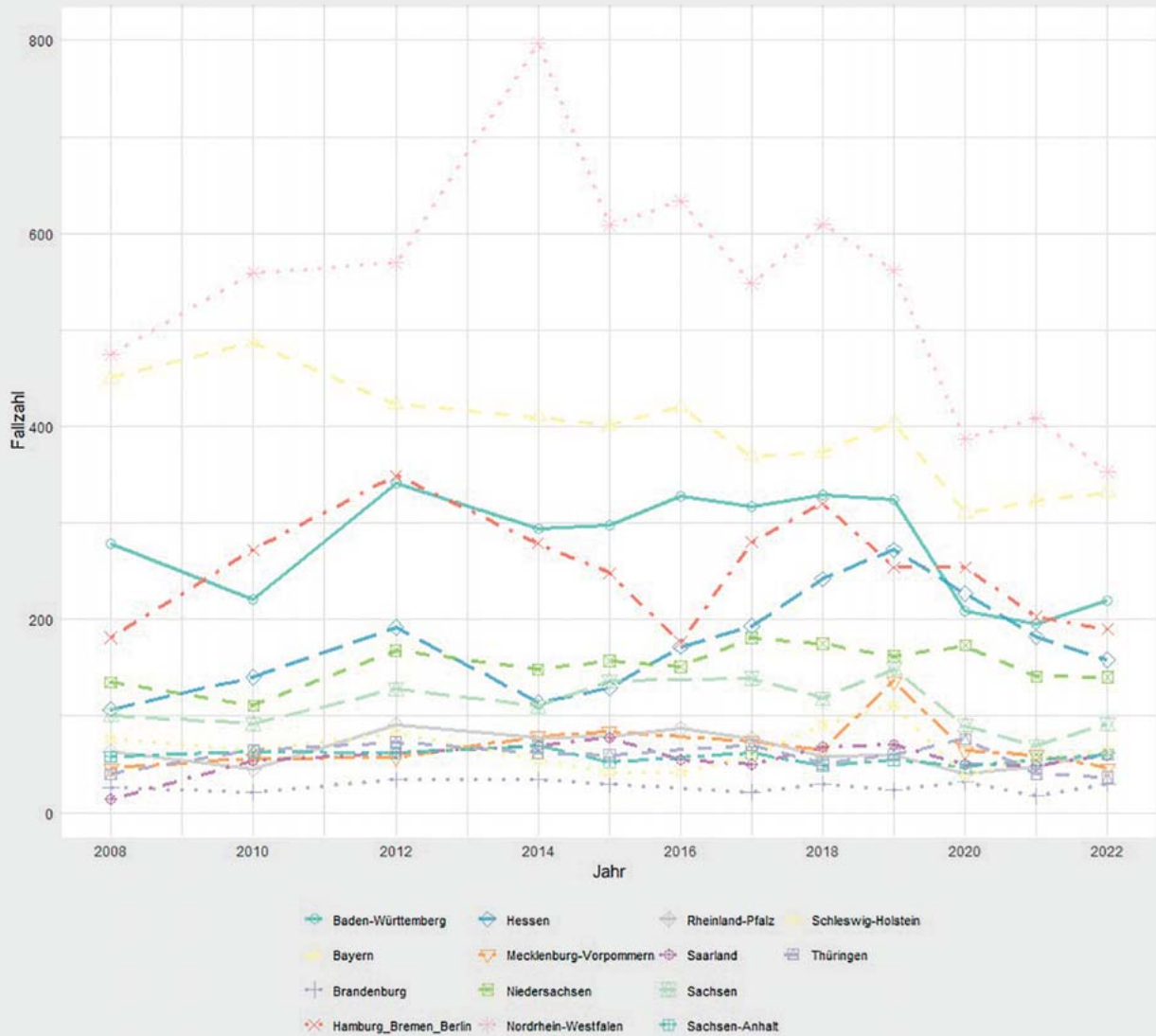
Federal state	2008	2010	2012	2014	2015	2016	2017	2018	2019	2020	2021	2022
Baden-Württemberg	0.005	0.004	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.004	0.003	0.003
Bayern	0.007	0.008	0.007	0.008	0.007	0.008	0.007	0.006	0.006	0.004	0.004	0.005
Brandenburg	0.005	0.005	0.005	0.005	0.004	0	0.005	0.005	0.005	0.003	0.003	0.003
Hamburg, Bremen, Berlin	0.006	0.008	0.011	0.008	0.008	0.005	0.008	0.018	0.007	0.006	0.005	0.005
Hesse	0.005	0.005	0.007	0.005	0.005	0.007	0.007	0.007	0.007	0.005	0.005	0.004
Mecklenburg-Forepomerania	0.016	0.012	0.017	0.016	0.016	0	0.017	0.014	0.016	0.007	0.008	0.007
Lower Saxony	0.005	0.004	0.006	0.005	0.006	0.005	0.006	0.006	0.005	0.005	0.004	0.004
North Rhine-Westphalia	0.005	0.006	0.007	0.009	0.008	0.008	0.008	0.008	0.007	0.004	0.004	0.004
Rhineland-Palatinate	0.004	0.003	0.005	0.006	0.004	0.004	0.004	0.004	0.003	0.002	0.003	0.003
The Saar	0.006	0.011	0.012	0.013	0.011	0.01	0.01	0.011	0.012	0.009	0.008	0.011
Saxony	0.006	0.007	0.009	0.008	0.007	0	0.008	0.007	0.008	0.005	0.004	0.005
Saxony-Anhalt	0.006	0.006	0.006	0.006	0.006	0	0.007	0.006	0.006	0.004	0.005	0.005
Schleswig-Holstein	0.004	0.004	0.006	0.004	0.003	0.004	0.004	0.007	0.007	0.002	0.003	0.003
Thuringia	0.008	0.009	0.011	0.011	0.009	0	0.009	0.006	0.007	0.007	0.005	0.005

► **Table 4** Number of severe eye injuries in German hospitals with inpatient facilities per federal state and year.

Federal state	2008	2010	2012	2014	2015	2016	2017	2018	2019	2020	2021	2022
Baden-Württemberg	279	221	341	294	298	328	317	329	324	209	195	219
Bayern	450	487	423	410	401	420	369	373	404	311	323	332
Brandenburg	26	21	34	34	29	0	21	30	23	32	17	30
Hamburg, Bremen, Berlin	181	272	349	279	248	176	280	320	254	254	203	190
Hesse	107	140	192	114	129	172	193	242	272	227	182	158
Mecklenburg-Forepomerania	46	56	57	79	84	0	74	65	136	64	60	46
Lower Saxony	135	111	168	148	157	151	181	175	162	173	141	140
North Rhine-Westphalia	474	559	569	797	608	633	548	609	562	387	408	353
Rhineland-Palatinate	63	45	91	78	79	87	77	58	60	40	48	62
The Saar	14	54	62	69	78	55	50	68	70	50	49	59
Saxony	101	92	128	110	136	0	139	118	149	90	69	92
Saxony-Anhalt	58	63	62	69	52	0	62	49	55	47	55	60
Schleswig-Holstein	77	65	83	55	42	42	58	91	111	38	57	65
Thuringia	40	65	73	62	60	0	70	51	60	76	40	37

The table encompasses the following codes: S05.2: Ocular laceration and rupture with prolapse or loss of intraocular tissue; S05.3: Ocular laceration without prolapse or loss of intraocular tissue; S05.4: Penetrating wound of orbit with or without foreign body; S05.5: Penetrating wound with foreign body of eyeball; S05.6: Penetrating wound without foreign body of eyeball; S05.7: Ocular avulsion





► **Fig. 3** Number of severe eye injuries per state and year. Including: S05.2: Ocular laceration and rupture with prolapse or loss of intraocular tissue. S05.3: Ocular laceration without prolapse or loss of intraocular tissue. S05.4: Penetrating wound of orbit with or without foreign body. S05.5: Penetrating wound with foreign body of eyeball. S05.5: Penetrating wound without foreign body of eyeball. S05.7: Avulsion of eye.

## Discussion

The present contribution has shown eye injuries in Germany to occur at similar frequencies in all federal states with slight regional differences.

International comparison demonstrates that our figures are comparable to those of the published Scottish study at an incidence in the range of 0.001% to 0.007% in Germany and 0.0019% in Scotland [4]. Note also the slight variation in how severe eye injuries are defined: We have referred to the injury type, whereas the authors of that study drew their distinction from the need for hospitalisation.

The frequencies we recorded are substantially lower than those of North America. Severe eye injury incidence in the USA is 0.3% [5]. A telephone survey revealed an incidence of more than 2% for Canada [6]. There are also limitations to this comparison: Comparability between objective register data are available from the USA and a telephone survey from Canada is limited.

A registry study from the USA recorded the frequency of corrosion injuries at an incidence of 51.1 per 1,000,000 per year [17]. The highest incidence in the present study was 20.6 per 1,000,000.

The incidence of eye injuries from fireworks in Germany was reported to be 0.6 per 100,000 in the years before the pandemic, which decreased substantially to 0.15 per 100,000 between

► **Table 5** Population percentage of severe eye injuries in German hospitals with inpatient facilities per federal state and year.

Federal state	2008	2010	2012	2014	2015	2016	2017	2018	2019	2020	2021	2022
Baden-Württemberg	0.003	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002
Bayern	0.003	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.003
Brandenburg	0.001	0.001	0.001	0.001	0.001	0	0.001	0.001	0.001	0.001	0.001	0.001
Hamburg, Bremen, Berlin	0.003	0.004	0.006	0.005	0.004	0.003	0.005	0.005	0.004	0.004	0.003	0.003
Hesse	0.002	0.002	0.003	0.002	0.002	0.003	0.003	0.004	0.004	0.004	0.003	0.003
Mecklenburg-Forepomerania	0.003	0.003	0.004	0.005	0.005	0	0.005	0.004	0.008	0.004	0.004	0.003
Lower Saxony	0.002	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
North Rhine-Westphalia	0.003	0.003	0.003	0.004	0.003	0.004	0.003	0.003	0.003	0.002	0.002	0.002
Rhineland-Palatinate	0.002	0.001	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.002
The Saar	0.001	0.005	0.006	0.007	0.008	0.006	0.005	0.007	0.007	0.005	0.005	0.006
Saxony	0.002	0.002	0.003	0.003	0.003	0	0.003	0.003	0.004	0.002	0.002	0.002
Saxony-Anhalt	0.003	0.003	0.003	0.003	0.002	0	0.003	0.002	0.002	0.002	0.002	0.003
Schleswig-Holstein	0.003	0.002	0.003	0.002	0.001	0.001	0.002	0.003	0.004	0.001	0.002	0.002
Thuringia	0.002	0.003	0.003	0.003	0.003	0	0.003	0.002	0.003	0.004	0.002	0.002

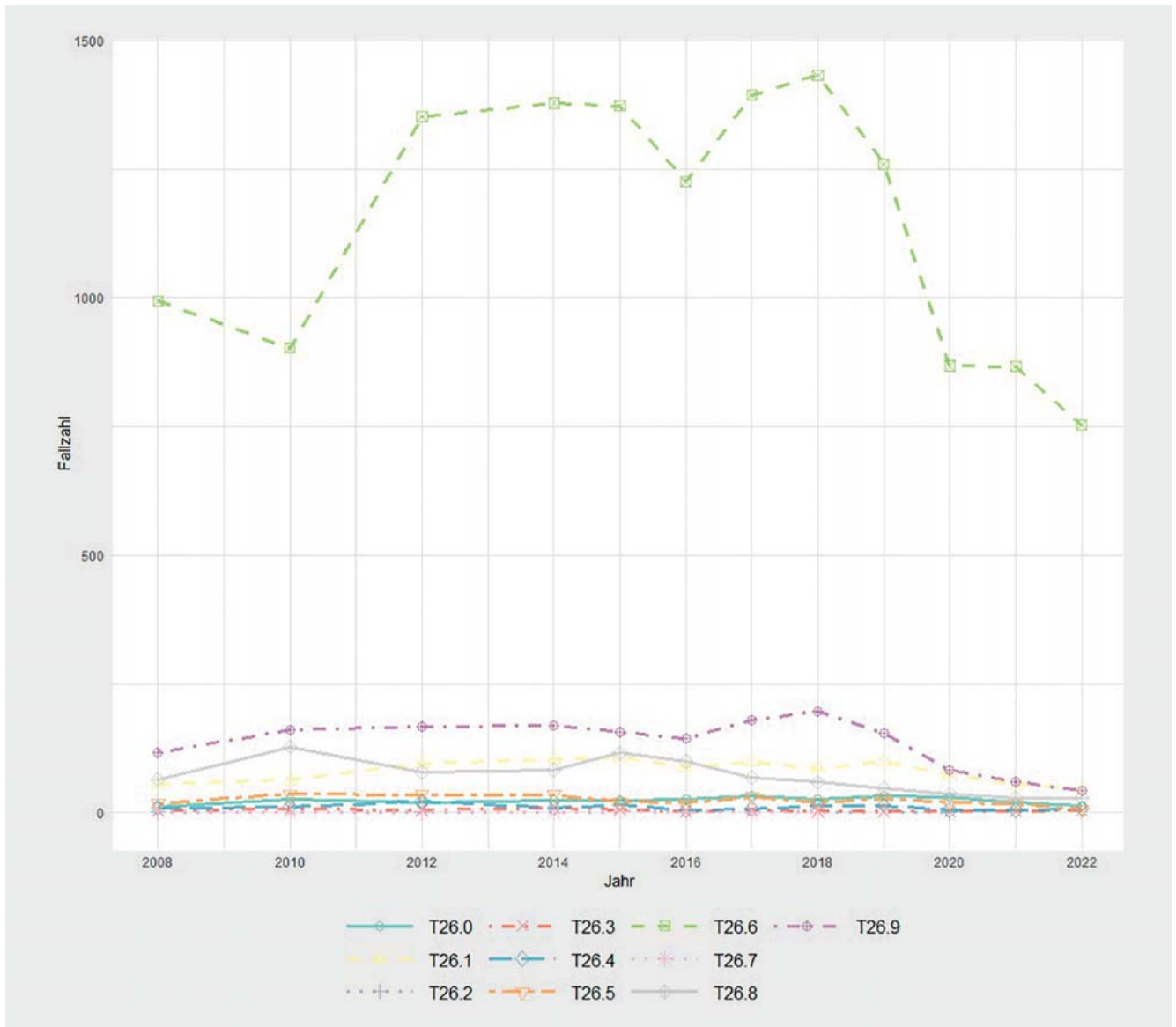
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► **Table 6** Burns and corrosion injuries per year in hospitals with inpatient facilities in Germany.

ICD-10	2008	2010	2012	2014	2015	2016	2017	2018	2019	2020	2021	2022
T26.0	12	25	20	24	23	26	32	26	32	31	19	14
T26.1	56	63	96	105	108	89	99	86	99	75	55	44
T26.2	1	0	1	1	0	2	0	0	0	1	0	0
T26.3	5	7	5	9	6	3	4	3	3	3	2	4
T26.4	9	11	21	9	16	4	7	14	14	5	5	8
T26.5	18	36	35	35	21	19	30	20	28	19	17	6
T26.6	993	902	1,351	1,378	1,372	1,225	1,393	1,432	1,259	867	866	752
T26.7	3	1	3	1	2	1	1	1	0	0	0	0
T26.8	65	128	79	83	116	100	68	59	48	36	28	29
T26.9	117	160	167	170	157	145	179	197	155	82	60	42

T26.0: Burn of eyelid and periocular area; T26.1: Burn of cornea and conjunctival sac; T26.2: Burn with resulting rupture and destruction of eyeball; T26.3: Burn of other parts of eye and adnexa; T26.4: Burn of eye and adnexa, part unspecified; T26.5: Corrosion of eyelid and periocular area; T26.6: Corrosion of cornea and conjunctival sac; T26.7: Corrosion with resulting rupture and destruction of eyeball; T26.8: Corrosion of other parts of eye and adnexa; T26.9: Corrosion of eye and adnexa, part unspecified.





► **Fig. 4** Burns and corrosion injuries per year in hospitals with inpatient facilities in Germany. T26.0: Burn of eyelid and periocular area. T26.1: Burn of cornea and conjunctival sac. T26.2: Burn with resulting rupture and destruction of eyeball. T26.3: Burn of other parts of eye and adnexa. T26.4: Burn of eye and adnexa, part unspecified. T26.5: Corrosion of eyelid and periocular area. T26.6: Corrosion of cornea and conjunctival sac. T26.7: Corrosion with resulting rupture and destruction of eyeball. T26.8: Corrosion of other parts of eye and adnexa. T26.9: Corrosion of eye and adnexa, part unspecified.

2020 and 2022 and rose again to 1 per 100,000 after the end of the restrictions imposed during the pandemic (Gabel-Pfisterer et al., DOG 2023, und Graefes Archive submitted 2024).

Unfortunately, hospital quality reports do not include time periods more granular than a year, making a specific analysis of injuries sustained during New Year's celebrations impossible. Even so, comparison with the New Year's celebration surveys shows an interesting parallel.

Linking to the firecracker register held by the German Ophthalmological Society (DOG) [9] provides a basis to estimate that at least 8% of eyeball contusions and 1.4% of globe ruptures are

caused by private New Year's fireworks displays. Around every tenth event is associated with a New Year's fireworks display, which may explain why the COVID-19 pandemic saw a decrease in eye injuries in our analysis [9,10]. The sales ban and cautious behaviour amongst the population during the pandemic cut the numbers by more than half. However, it seems unlikely that the effect seen in the quality reports resulted from the ban on fireworks sales alone. Fist injuries also cause blunt eyeball trauma, for example. The decline here may possibly be explained by the contact restrictions imposed for several weeks.

► **Table 7** Number of all chemical and thermal eye injuries in German hospitals with inpatient facilities per federal state and year.

Federal state	2008	2010	2012	2014	2015	2016	2017	2018	2019	2020	2021	2022
Baden-Württemberg	128	70	182	193	190	207	118	130	128	84	80	56
Bayern	150	202	205	331	321	304	273	218	196	162	186	196
Brandenburg	16	17	23	24	22	0	25	32	42	11	25	14
Hamburg, Bremen, Berlin	35	55	121	83	96	62	89	112	85	66	48	35
Hesse	121	210	163	202	199	227	176	182	180	153	141	114
Mecklenburg-Forepomerania	152	96	147	99	88	0	130	115	134	38	27	47
Lower Saxony	109	84	141	144	138	159	151	167	127	110	97	54
North Rhine-Westphalia	333	371	510	440	444	505	530	525	400	227	227	170
Rhineland-Palatinate	50	38	49	59	72	69	70	71	78	59	54	31
The Saar	46	58	41	44	45	44	40	30	27	17	22	22
Saxony	44	35	67	78	70	0	96	89	73	68	63	80
Saxony-Anhalt	61	51	50	41	67	0	46	57	57	52	37	29
Schleswig-Holstein	21	22	30	39	36	37	41	66	87	34	29	24
Thuringia	13	24	49	38	33	0	28	44	24	38	16	27

► **Table 8** Absolute number of globe ruptures from fireworks displays (ICD S05.2 and S05.2) at New Year in relation to the number of G-BA injuries.

New Year	Globe ruptures from fireworks	G-BA ruptures	%	Year
2016/17	15	1,034	1.5	2016
2017/18	20	1,149	1.7	2017
2018/19	12	1,265	1	2018
2019/20	13	1,362	1	2019
2020/21	5	992	0.5	2020
2021/22	9	962	0.9	2021
only 2022	19	1,061	1.8	2022

G-BA: Gemeinsamer Bundesausschuss (Joint Federal Committee)

Our own study has the following limitations: The analysis from hospital quality reports is objective, but the small case numbers may lead to a loss of accuracy due to anonymisation. Complete coverage in recording cannot be guaranteed. In particular, the lack of eye injuries in some federal states in 2016 is striking; incomplete recording would seem to be the culprit here. The data structure prevents any connection between diagnoses (ICD) and treatment (OPS). Comparing ICD-10 data and online questionnaire results may raise a certain amount of uncertainty especially due to the differences in the way complex injuries are recorded,

► **Table 9** Absolute numbers of eyeball contusions from fireworks displays (ICD S05.1) at New Year in relation to the number of G-BA injuries.

New Year	Eyeball contusions from fireworks	G-BA eyeball contusions	%	Year
2016/17	134	1,735	7.7	2016
2017/18	139	2,409	5.8	2017
2018/19	112	1,369	8.2	2018
2019/20	174	1,992	8.7	2019
2020/21	25	1,162	2.2	2020
2021/22	56	1,089	5.1	2021
only 2022	128	1,160	11	2022

and fireworks accidents often cause complex injuries. However, we only compared the two ICD codes from leading diagnoses in the present study, so this should only have a minor impact. The ICD code W49.9 is non-specific and does not allow differentiation amongst injuries caused by fireworks detonating. Coding for injuries with ICD codes S05.0–S05.9 may also be inaccurate. This is due to the similarities in the individual digits in the designation in some cases, and the patient's physician not necessarily always performing the coding.

The large number of severe eye injuries and substantial increase during the days around New Year given the currently prevailing legal situation in Germany shows the need for reliable and highly qualified ophthalmological care, including emergency ser-

vices, in all federal states, and therefore also the need to train highly qualified ophthalmologists in all federal states.

In summary, our retrospective analysis of routine data shows a rather uniform incidence of eye injury throughout Germany. The most common severe injuries are lacerations to the eye with loss of intraocular tissue. Intriguingly, the decline in eye injuries during the pandemic continued into 2022.

### Conflict of Interest

The authors declare that there is no conflict of interest.

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