




## Bite injuries at a level 1 trauma center in Germany

Christina Polan,<sup>1</sup> Steffen C Kraus,<sup>1</sup> Monika Herten ,<sup>1</sup> Heinz-Lothar Meyer ,<sup>1</sup> Bastian Mester,<sup>1</sup> Gero Hilken,<sup>2</sup> Marcel Dudda,<sup>1,3</sup> Max Daniel Kauther,<sup>4</sup> Manuel Burggraf <sup>5</sup>

<sup>1</sup>Department of Trauma, Hand and Reconstructive Surgery, University Hospital Essen, Essen, Germany

<sup>2</sup>Central Animal Laboratory, University Hospital Essen, Essen, Germany

<sup>3</sup>Department of Orthopedics and Trauma Surgery, BG Klinikum Duisburg, Duisburg, Nordrhein-Westfalen, Germany

<sup>4</sup>Department for Trauma Surgery and Orthopedics, Pediatric Orthopedics, Agaplesion Diakonieklinikum Rotenburg (Wümme), Rothenburg (Wümme), Germany

<sup>5</sup>Department of Orthopedic and Trauma Surgery, GFO Clinics Mettmann-South, Langenfeld, Langenfeld, Germany

**Correspondence to**

Dr Monika Herten; Monika.Herten@uk-essen.de

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**ABSTRACT**

**Background** Bite injuries are a common occurrence and may result in significant morbidity. The aim of the study was to investigate bite injuries, their treatment, and consequences in the urban milieu of a European industrialized nation.

**Methods** A retrospective, monocentric analysis was conducted on data of bite injuries during the study period from 2010 to 2020. Factors such as age, sex, vaccination status, injury pattern, injury location, the duration of treatment in outpatient, inpatient, or intensive care settings were investigated together with radiological, laboratory, and microbiological parameters, as well as the therapies employed.

**Results** The majority of the included 442 patients were between the ages of 20 and 50, with a mean age of 37.2±18.4 years (0.7–91). The female sex was more frequently affected (59%). Most bite injuries were caused by dogs (49.9%), followed by cats (36.1%) and humans (9.8%) and were often caused by domestic animals (78%). The hand was the most common site of bites (n=251), followed by the forearms (n=75) and lower legs (n=43). In children under the age of 10, the head was the most common site of bites. In only 5% of patients, injuries extended to deeper structures. Wound infection was observed in 14.7% of the bite wounds. The mean number of treatment days for patients with infected bite wounds was significantly higher than that for patients with non-infected wounds, regardless of whether they were outpatients, inpatients, or intensive care patients (p=0.001, p<0.001, and p=0.003, respectively).

**Conclusions** In accordance with the severity of the injury, a prompt examination, imaging, laboratory diagnostics, and individualized therapy are required. The implementation of an early therapeutic regimen comprising debridement and irrigation, calculated antibiotic therapy, and immobilization can effectively mitigate the risk of developing a fulminant wound infection. Similarly, bite wounds caused by exotic species are to be treated with haste and precision.

**Level of evidence** Level III study: non-experimental descriptive studies.

**INTRODUCTION**

Bite injuries can occur in the context of keeping pets, in contact with farm and wild animals, but also in physical confrontations between humans. Bite wounds are seen as problem wounds because of the high rate of complications. These range from local infections to general intoxication through the transmission of bacterial or viral pathogens, possible

**WHAT IS ALREADY KNOWN ON THIS TOPIC**

⇒ Bite injuries represent a significant global health concern, with notable variations in prevalence and characteristics across different countries and regions.

**WHAT THIS STUDY ADDS**

⇒ It is essential to consider age-specific, injury-specific, and animal-specific factors to facilitate the implementation of rapid and targeted therapy. The present study records epidemiological, diagnostic, and therapeutic factors in a large patient population from a level 1 trauma center in Central Europe and compares these data with data from other countries worldwide.

**HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY**

⇒ The data provide regional treatment recommendations, but also indicate that rare bite injuries may occur due to travel and special exotic animal husbandry. In particular, specialized treatment is required for patients with inflammation, poisoning, and severe concomitant injuries, including vascular-nerve injuries and internal bleeding.

damage to blood vessels and/or nerves, and possible long-term complications, including loss of limbs.

In Germany, it is estimated that over one-third of households keep a pet, with these data not being recorded in a central register,<sup>1</sup> whereas in the USA, the figure is 56% of all households keeping a pet.<sup>2</sup> The pervasiveness of pet ownership contributes to the high prevalence of bite injuries. In Germany, the number of reported bite injuries ranges from 30,000 to 50,000 per year, equating to an incidence of 40–60 per 100,000 inhabitants.<sup>1</sup> A similar incidence was observed in a large Italian city, with an estimated 58.4 dog bite injuries and 17.9 cat bite injuries per 100,000 inhabitants.<sup>3</sup> The incidence of dog bite injuries in the USA is 129 per 100,000 people.<sup>4</sup> In New York, the incidence of dog bites per 100,000 people was reported to be 85.<sup>5</sup>

Bite wounds have the potential to result in bacterial or viral infections, which can have significant or chronic consequences. As with numerous other types of injury, *Clostridium tetani* can be transmitted via bite wounds. Therefore, it is crucial to ascertain the patient's vaccination status and to administer the necessary booster dose at the time of presentation to the clinic.<sup>6</sup> Furthermore, chronic

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infectious diseases, such as HIV and hepatitis C, can also be transmitted through human bites.<sup>7,8</sup> Globally, rabies represents a significant risk associated with both street dog bites and bat bites, with documented cases also occurring in Europe.<sup>9</sup> Moreover, it is possible that other zoonoses, including potential coronaviruses, may be transmitted through animal bites.<sup>10</sup>

With regard to children, case series and reports on dog and large animal bites indicate the occurrence of lethal bite injuries, particularly in young children.<sup>11,12</sup> In comparison to adults, the location of injuries sustained from dog bites in young children is reported to vary due to factors such as body size.<sup>13–15</sup> In the context of snakebite injuries, children are observed to demonstrate a heightened vulnerability to severe and recurrent bite injuries.<sup>16</sup>

The objective of the present study is to examine the incidence, treatment, and consequences of bite injuries in an urban setting within a European industrialized nation. The present study will identify similarities and differences with respect to other regions.

## PATIENTS AND METHODS

The study design of this investigation on animal and human bite injuries is retrospective and monocentric, conducted at a level 1 trauma center in Germany. The data set encompasses all patients presenting with bite wounds at the clinic during a 10-year period, from January 2010 to January 2020.

Epidemiological data were collected, including information pertaining to the demographic characteristics of the subjects. The anatomic region of the bite was examined to identify the parts of the body most vulnerable to injury. In the case of animal bites, the species was assessed, distinguishing between domestic and wild animals. It was also recorded whether the patient presenting with the injury was also the owner of the animal. Snakebites were classified as either venomous or constricting. Furthermore, it was established whether the rabies vaccination status of the animal was known. Additionally, it was documented whether the bite occurred at the site of contact or during a long-distance journey to an area with elevated risk. To ascertain whether there were any seasonal differences, the month in which the bite occurred was documented.

In the case of human bite wounds, the documented infection status regarding HIV or hepatitis infection was analyzed. The investigation also sought to ascertain whether the injuries had occurred during physical altercations, unintentional sexual incidents, or when treating psychiatric or neurological patients.

The efficacy of preclinical first aid, including that provided by the rescue service, and in-hospital care was evaluated. Furthermore, the current study sought to ascertain the infection rate associated with bite injuries. The clinical diagnosis of a superinfection of the bite wound was made, incorporating the following criteria: increasing redness, transmission of pain along the tendons, pronounced edema formation, pus, fever, chills, tachycardia, and hypotension. Indications of an infection may also be indicated by increased laboratory chemical values, for example, leukocyte count, C-reactive protein (CRP), and procalcitonin. However, in patients with acute infection of the fingers, toes, hands or feet, these values may not necessarily be elevated.

Statistical analysis was conducted using SPSS V.29 software (IBM, New York, USA). Descriptive statistics included mean, SD, median, minimum, maximum, IQR, and a two-sided 95% CI. The Shapiro-Wilk test was employed to ascertain the presence of a normal distribution. Non-normally distributed values were evaluated using the Mann-Whitney U test, whereas normally distributed values were evaluated using a two-sample t-test. To

investigate the association between two categorical variables between independent samples, the  $\chi^2$  test was employed for normal-scale and ordinal-scale parameters. The level of significance was set at  $p \leq 0.05$  (two-sided).

## RESULTS

### Demography

A total of 442 patients presenting with bite injuries were included in the study. With regard to the age distribution, the cohort of patients most commonly affected by the condition in the study was that comprising individuals between the ages of 20 and 50 years, with a mean age of  $37.2 \pm 18.4$  years (figure 1). With regard to the gender distribution of patients with bite injuries, the female sex was predominant, with 262 cases (59%) compared with 180 cases (41%) of male patients.

### Primary care

The majority of patients ( $n=393$ , 89%) received their initial treatment primarily via the emergency department, without prior contact with a doctor. A minority of patients ( $n=12$ ; 2.7%) were treated for bite injuries by a variety of healthcare professionals, including general practitioners ( $n=12$ ; 2.7%), practicing trauma surgeons ( $n=2$ ; 0.5%), other hospitals ( $n=27$ ; 6.1%), other specialist departments within our hospital ( $n=4$ ; 0.9%), and other healthcare providers ( $n=4$ ; 0.9%). A significant proportion of patients presented independently ( $n=430$ ; 97.3%). A mere 2.7% ( $n=12$ ) of patients were conveyed to the emergency department by the ambulance service.

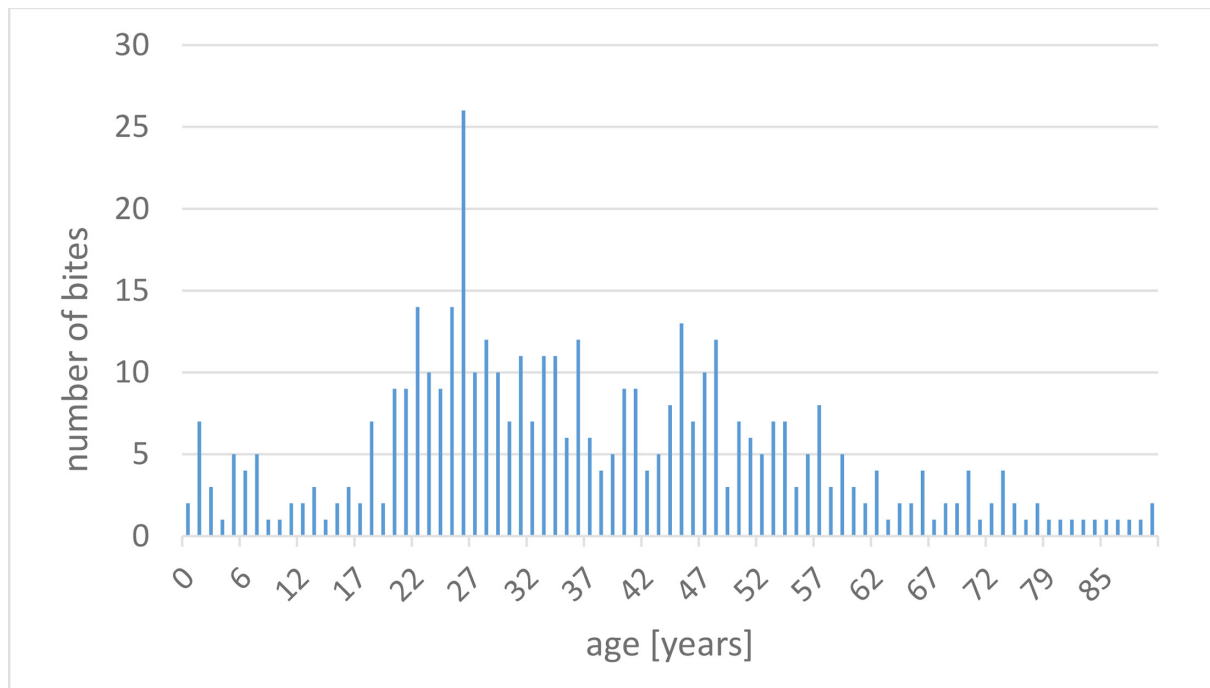
### Who caused the bite injuries?

The majority of bite injuries were caused by animals ( $n=410$ ; 90.1%), whereas only 45 cases (9.8%) were attributed to human actions. Table 1 presents a list of the animal species involved and the bite location by species in number and in percentage of the species. The majority of bites were caused by dogs (49.5%), followed by cat bites (36.1%), with 78% of cases involving animals kept as pets. A total of 10 dog bite injuries were identified as being related to police operations, representing 4.4% of the total number of dog bite injuries. A total of 9.8% of the bites were classified as human bites, three of which were caused by the patient striking the teeth of the opponent with their fist, resulting in perforation of the skin and joint (commonly referred to as fight-bite clenched fist injuries). During the course of the study period, a total of three cases of snakebites were documented. Of these, two were caused by constrictor snakes, and one was by a venomous snake of the black mamba species. In the latter case, the patient survived without any physical limitations. The potential for deleterious consequences arising from the snake venom could be effectively prevented as a result of prehospital troubleshooting conducted by the emergency medical service, in conjunction with the prompt administration of the antivenom.<sup>17</sup>

It is notable that a small proportion of bite injuries occurred in the context of occupational accidents, representing only 3.6% of the total number of bite injuries ( $n=16$ ). In this instance, the victims are covered by the German workmen's compensation insurance scheme. The majority of occupational bites were caused by canines ( $n=6$ ), followed by felines ( $n=5$ ) and human bites ( $n=4$ ). Additionally, one incident involved a bat. In the context of occupational accidents involving human bite injuries, the primary HIV and hepatitis C status of the victims was evaluated. However, no infections were detected.

### Localization and extent of the injury

The most common site of injury was the hand, accounting for 251 patients (56.8%). Injuries to the forearm were the



**Figure 1** Number of bites per age.

second most frequent, occurring in 75 patients (17.0%), whereas injuries to the lower leg and head and neck region were less common, occurring in 50 patients (11.3%) and 33 patients (7.5%), respectively. These findings are illustrated in figure 2.

In the younger age groups (up to 10 years old), the head and neck region was affected as the second most frequent site of injury, whereas in older children (aged 11–18 years), the injury pattern observed was similar to that seen in adult patients (figure 3).

In 4.5% of patients with bite injuries were higher-grade injuries present, in which deeper structures such as nerves, tendons, bones, vessels, or fasciae were affected.

Radiological examination revealed the presence of tooth fragments in two patients, whereas evidence of fracture was observed in 10 instances.

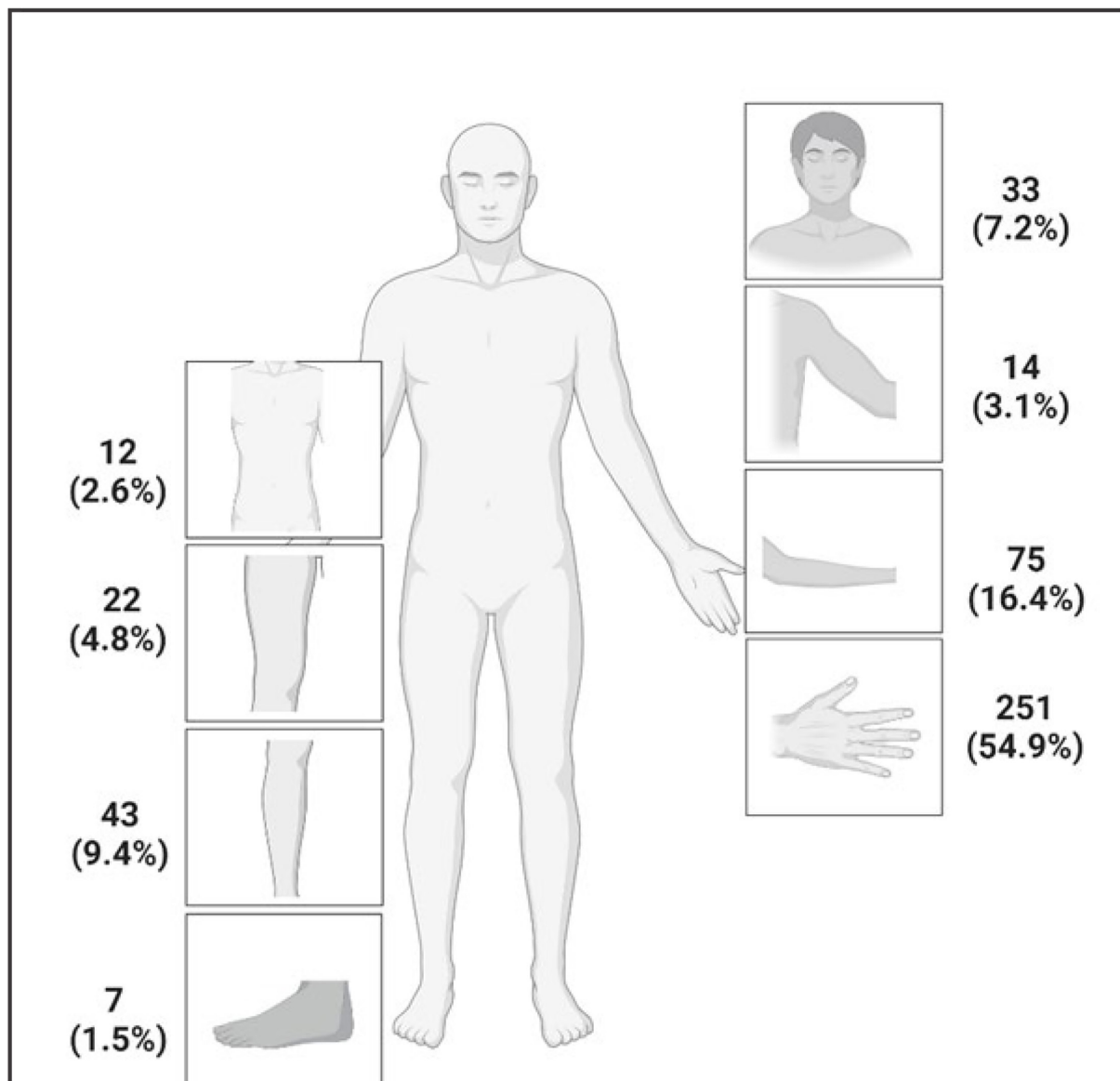
### Infections

As a potential sign for infections, the level of CRP was markedly elevated in 14.7% (65 patients) of infected bite wounds at admission, with a mean of  $2.8 \text{ mg/dL} \pm 4.4 \text{ mg/dL}$ , in comparison to non-infected wounds, which exhibited a mean of  $1.2 \text{ mg/dL} \pm 1.6 \text{ mg/dL}$  ( $p=0.015$ ). In contrast, no significant difference was identified in the leukocyte count (mean  $10.2 \pm 3.6 \times 10^9/\text{L}$  infected vs mean  $10.2 \pm 2.9 \times 10^9/\text{L}$  non-infected;  $p=0.953$ ). Surgical intervention was necessary for 130 patients (29.4%) of the 442 patients. Of these, 51 patients (39.2%) exhibited an elevated CRP.

Pathogens were identified in 65 of the 69 patients in which swabs were taken, representing a prevalence of 14.7% overall. The most prevalent bacteria were derived from the oral flora of canines and felines, with *Pasteurella multocida* identified in 22 patients, *Neisseria subflava*

**Table 1** Distribution of animal species causing the bites (in total  $n=457$ ) and the bite location by species in number and in percentage (%) of the species

Species	Bites	% total bites	Head/neck	Upper arm	Lower arm	Hand	Upper leg	Lower leg	Foot	Torso
Dog	228	49.9	24 (10.5)	7 (3.1)	31 (13.6)	103 (45.2)	19 (8.3)	32 (14.0)	5 (2.2)	7 (3.1)
Cat	165	36.1	2 (1.2)	4 (2.4)	35 (21.2)	110 (66.7)	3 (1.8)	10 (6.1)	1 (0.6)	0
Human	45	9.8	7 (16.6)	3 (6.7)	8 (17.8)	21 (46.7)	0	1 (2.2)	0	5 (11.1)
Rabbit	3	0.7	0	0	0	2 (66.7)	0	0	1 (33.3)	0
Rat	3	0.7	0	0	0	3 (100)	0	0	0	0
Snake	3	0.7	0	0	1 (33.3)	2 (66.7)	0	0	0	0
Bat	3	0.7	0	0	0	3 (100)	0	0	0	0
Goat	2	0.4	0	0	0	2 (100)	0	0	0	0
Guinea pig	1	0.2	0	0	0	1 (100)	0	0	0	0
Hamster	1	0.2	0	0	0	1 (100)	0	0	0	0
Degu	1	0.2	0	0	0	1 (100)	0	0	0	0
Unknown	2	0.4	0	0	0	2 (100)	0	0	0	0
Total number	457		33	14	75	251	22	43	7	12



**Figure 2** Regions of bites. A total of 457 body regions were affected. For each region, the total number and percentage are given. Created with BioRender.com.

(n=5), *Pasteurella canis* (n=4), and a single instance of *Bergeyella zoohelcum*, *Fusobacterium russii*, and *Staphylococcus intermedius*. Additionally, bacteria from the oral flora of humans, including *Streptococcus oralis* (n=1), *Streptococcus sanguinis* (n=2), *Streptococcus anginosus*, and *Fusobacterium necrophorum*, as well as those from the upper respiratory tract (*Neisseria subflava*), were identified (all n=1). Additionally, bacteria from human skin (*Propionibacterium acnes*, *Cutibacterium acnes*) and from human mucosa (*Staphylococcus epidermidis* (n=2), *Staphylococcus aureus* (n=3), and *Corynebacterium* sp as well as gut microbiota (*Bacteroides uniformis*, *Streptococcus bovis/equinus* and *Bacillus badius*) were present, with n=1. Additionally, some wounds exhibited mixed infections (n=4).

With regard to the animal species most commonly responsible for infections, 28.1% of cat bites (45 out of 115 bites) resulted in infection, whereas only 6.8% of dog bites (15 out of 204) led to infection.

Patients with infected bite wounds exhibited a significantly higher number of outpatient, inpatient, and intensive

care treatment days than patients with non-infected wounds (table 2).

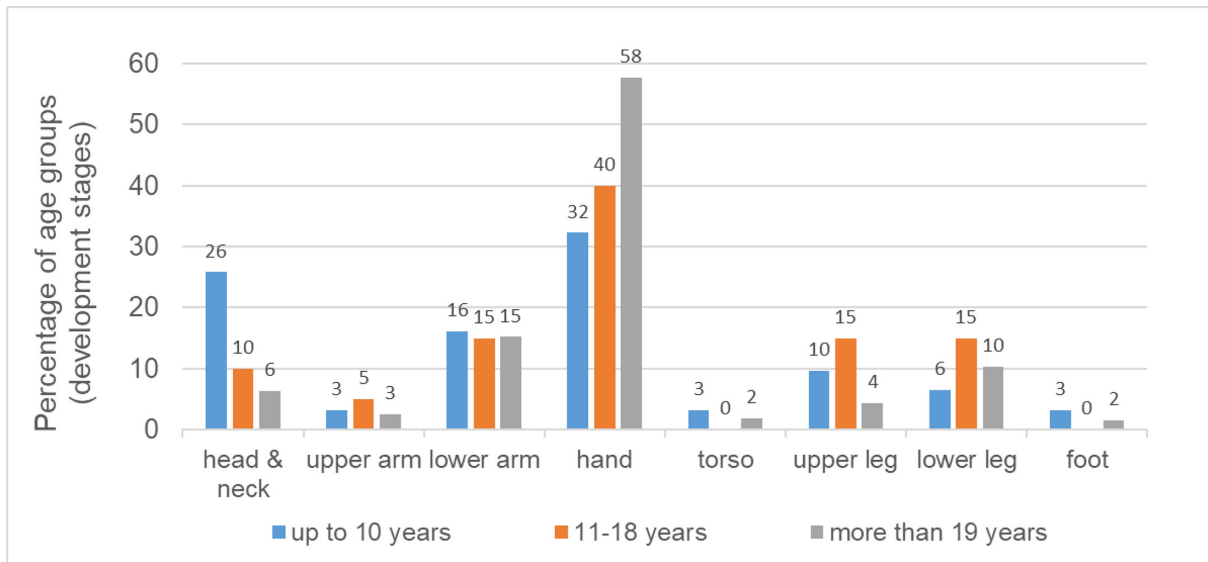
#### Vaccination status

In 30% of patients, valid tetanus protection was available. A booster vaccination was administered in 141 patients (32%), whereas in the remaining patients, no information was available. A total of 23 patients (5% of the total number of patients) required a rabies vaccination after their return from high-risk areas or in the event that the vaccination status of the animal in question was unclear.

#### Therapy and outcome

The treatment regimen included operative wound debridement in 15% of patients (n=66), antibiotic therapy in 74% of patients (n=327), and immobilization in 59% of patients (n=260).

20 out of 442 patients had an injury to the deeper tissue structures. These included 12 bone injuries, 2 nerve injuries, 4 muscle injuries, 4 tendon injuries, 2 nail and nail bed injuries, 3 severe



**Figure 3** Regions of bites within the age groups. Values are in percentage of age groups (developmental stages) up to 10 years, 11–18 years and more than 19 years.

soft tissue injuries, and 1 cleft lip. Two patients with subtotal finger end phalanx amputation were also recorded.

It is fortunate to note that there were no documented deaths or amputations among the entire patient population. According to the available documentation, only two severe restrictions of movement were reported after hand injuries, including one patient with a proximal row carpectomy. Furthermore, five patients reported regional hypesthesia during the course of the disease, although it is unclear whether this was permanent.

## DISCUSSION

### Main biter

In Essen, a major German city, the majority of bite injuries were caused by dogs (49.5%), followed by cats (36.2%) and humans (10%). The majority of bite injuries were caused by animals belonging to the household (78%). The spectrum of bite injuries observed in this study is largely consistent with that reported in other major cities worldwide. As in the USA, Asia, and Africa, dog bite injuries, cat bite injuries, and human bite injuries represent the most common category of bites.<sup>1,2,18</sup> It is exceedingly uncommon for bites from exotic animals or large animals to occur in Germany. Such incidents are exclusively confined to the context of zoo animal keeping, circus performances, and private animal holding.<sup>17,19</sup> Similarly, on other continents such as Africa and South America, as well as Asia and Australia, these bite injuries are also rare and are primarily documented as individual

case reports or in case series.<sup>20,21</sup> Bites from large animals are predominantly sustained in the wild, frequently as a consequence of tourists' negligence in their interactions with wild animals.<sup>22</sup> For example, camel bites, which are frequently described in the context of camel races in the Arab region, often result in severe injuries. In particular, patients with severe vascular injuries (carotid artery and vein, common iliac vein, femoral artery and vein) and nerve injuries (brain infarction, cervical and lumbar spine fractures), abdominal injuries, and skull fractures have been documented.<sup>23–25</sup> Bite injuries from large animals have been reported in zoological settings.<sup>19,20</sup> In the present study, no patients with large animal bites were identified, which is likely attributable to the absence of a zoo in Essen that houses such animals.

Furthermore, in the patient population under consideration, snakebites were observed exclusively in the context of illegal animal husbandry or in zoological gardens. Conversely, when considered on a global scale, snakebites represent a substantial public health issue, given their prevalence in Latin America, Asia, and Africa. In total, 5.4 million snakebites are reported worldwide.<sup>16</sup> For example, snakebites result in 2.7 million cases of poisoning worldwide, 81,000–138,000 of which are fatal, and approximately four times as many individuals lose limbs due to these bites.<sup>16</sup> Notwithstanding the markedly lower incidence, it is of the utmost importance that snakebites in Germany are promptly and appropriately managed.<sup>17,26</sup>

### Localization of injuries related to age

In our study, the hand was the most common site of bite injuries, accounting for 56.8% of patients. This was followed by the forearm (17%), lower leg (11.3%), and skull (7.5%). This finding aligns with the results of most other studies, which have identified the upper extremity as the most frequent location in the context of dog bite injuries (42%), followed by the lower extremity (37%) and the head and face (14%).<sup>5</sup> In a recent study on dog bites, the lower limb was the most frequently affected anatomic site (50.6%).<sup>27</sup> As part of the upper extremity, the hand is described as the most frequent location, accounting for approximately 45% of all injuries.<sup>28</sup> The analysis revealed age-specific injury risks for specific body regions, which may

**Table 2** Number of treatments in outpatient, inpatient, or intensive care settings and p value comparing non-infected with infected wounds

Wound situation	Non-infected	Infected	P value
Patient numbers	377	65	
Total treatments outpatients	668	219	0.001
Treatments per patient	1.8	3.4	
Total days inpatients	225	308	0.001
Inpatient days per patient	0.6	4.7	
Total days intensive care	0	9	0.003
Intensive care days per patient	0.0	0.1	

be attributed to human behavior toward animals, body size, and other factors. As is the case elsewhere, children are at an increased risk of sustaining bite injuries to the head and neck region. This finding aligns with data from international studies, such as one from New York, which reported that bite injuries in 1998 affected 41% of individuals under the age of 18.<sup>15</sup> The age group most affected is that of children between 7 and 9 years of age, with male children exhibiting a higher prevalence than female children (ratio of 1.4:1).<sup>5</sup> In the case of childhood dog bite injuries in the head-neck-torso region, the age group most affected is that of children under 5 years.<sup>13 14 27 29 30</sup> It is postulated that the ratio of the large head to a relatively small body, the lack of defensive mechanisms, and the slow reaction time of the child, coupled with the frequency of the child approaching the animal's bowl, may be contributing factors to the high incidence of bites to the head and neck region.<sup>31</sup>

In most studies, males make up the majority of patients with bite injuries.<sup>32 33</sup> However, in this study, females represent the majority (59%). Dogs and cats are the main biting species. According to data from Switzerland, the majority of dog owners are female (approximately 60–65%), and cats are also predominantly owned by women (69% of owners are female).<sup>34</sup>

In the present study, only 5% of all bite injuries resulted in injury to deeper structures. A case series was conducted to investigate severe soft tissue trauma, including vascular and nerve injuries, and fractures resulting from bite injuries from rare large animal bites with a high mortality rate. Such incidents occur in the wild, particularly during safari tourism, or in captivity with zoo, circus, or privately-owned animals. In general, these injuries are uncommon, yet they frequently necessitate comprehensive medical and intricate surgical intervention and reconstruction in patients where multiple injuries are present.

### Infections

The infection rates in Essen were 14.5%, which is lower than the rates observed in other studies, for example, in comparison to the USA. In the USA, infection rates of 20–25% for dog bites, 50% for cat bites, and 10% for human bites have been reported.<sup>2 35</sup> One potential explanation for this discrepancy is insurance coverage, which may prompt patients to seek care in emergency rooms proactively, even before the onset of clinical infection. The relationship between health insurance coverage and healthcare-seeking behaviors, both of which serve as indicators of healthcare access, has been demonstrated in the context of other infection prevalence rates.<sup>36</sup> Other studies have demonstrated that bacterial contamination from saliva is present in over 85% of bite wounds.<sup>37</sup> The occurrence of wound infections is contingent on the causative animal, the localization and extent of the injury, and the time elapsed since the trauma. These infections typically manifest between the first and fifth day after the injury, and are caused by an atypical, species-dependent mixed flora.<sup>37</sup> A recently published review by Cunningham *et al*<sup>35</sup> on the surgical management of pediatric dog bites recommends the avoidance of prophylactic antibiotics for low-risk dog bite wounds with immediate treatment. This refers to wounds without involvement of neurovascular structures, bone, tendons or joints, and adequate cleaning, irrigation, and vigorous debriding within 8 hours of the injury.<sup>35</sup> Given the microbiological diversity of bite wounds, the treatment of choice is frequently a composite of a beta-lactam antibiotic and a beta-lactamase inhibitor.<sup>35</sup> At our clinic, the predominant antibiotic administered is Amoclav (amoxicillin and clavulanic acid), and Unacid (sultamicillin) also being used.

In only 5% of patients included in this study was rabies vaccination counseling deemed to be an appropriate course of action. This essentially comprised patients with bite injuries where the vaccination status of the animal was unknown or where the individual had returned from a risk region and had been bitten.<sup>35 38</sup> Indeed, in Germany, consistent vaccination of pets with the rabies vaccine rarely makes rabies prophylaxis necessary.<sup>37</sup> This is undoubtedly a discrepancy when compared with the circumstances prevailing in developing countries, where rabies infections in street dogs continue to result in fatal bite-related complications.<sup>39 40</sup> Consequently, in the event of a patient being bitten during a period of travel, it is imperative that the vaccination history of the animal in question is ascertained, as it is otherwise necessary to ensure that the individual is adequately protected by an appropriate vaccination.<sup>9 41</sup> Other infections, including those caused by lyssaviruses, have been documented in humans after bites from bats.<sup>42 43</sup> However, no such cases occurred in Essen during the study period.

### Limitations

It should be noted that the study was conducted in an urban environment within a geographically limited region, which may limit the generalizability of the findings to the whole of Germany. As a result of the retrospective study design, there is a possibility of variations in data quality, including potential selection and information bias. In particular, subsequent wound infections cannot be ruled out, as patients may also present to other clinics or general practitioners. Furthermore, it is probable that the prevalence of the condition is higher than the figures indicate, given that only patients requiring treatment presented themselves at the emergency department.

### SUMMARY

Bite injuries are a prevalent form of injury globally, with the potential to result in a range of complications at the site of the wound. It is therefore essential that they receive time-critical and individualized care. Children are a high-risk demographic, with the head and neck region being particularly susceptible to injury. In addition to the common dog, cat, and human bites, there are regional differences in the species of domestic and wild animals that may inflict bites. Infection rates also exhibit regional variation, which is likely attributable to differences in the rates of presentation or injury severity.

### MEDICAL ADVICE FOR FIRST TREATMENT

#### Treatment recommendations for bite wounds:

- ⇒ Immediate presentation and treatment of the bite wound.
- ⇒ Debridement and irrigation with isotonic electrolyte solution.
- ⇒ X-ray to exclude fractures or foreign bodies.
- ⇒ Preferably open wound treatment, but loose-fitting sutures for large defects.
- ⇒ Immobilization in a plaster cast or splint.
- ⇒ If the epidermis is not intact, general broad-spectrum antibiotics.
- ⇒ Consider tetanus vaccination.
- ⇒ Consider rabies vaccination if travel history or risk area is positive.
- ⇒ Contact the poison control center in case of venomous snakebite and obtain antidote if necessary.
- ⇒ Medical wound check via general practitioner.

### If the bite wound is infected:

- ⇒ Early surgical treatment of hand or foot phlegmons.
- ⇒ Thorough surgical debridement.
- ⇒ Second-look surgery for severe findings.
- ⇒ Cast immobilization.
- ⇒ Intravenous broad-spectrum antibiotics and later adjustment to the resistogram.
- ⇒ Laboratory tests need not be abnormal.
- ⇒ Daily medical check-ups until infection-free, conducted by hospital doctors or general practitioners.
- ⇒ Occupational therapy and physiotherapy for hand phlegmon after the infection has subsided.

**Contributors** CP, MD, MDK and MB conceived and designed the study. SCK, H-LM, BM and GH recorded and analyzed the data. CP, SCK and MH interpreted the data and drafted the manuscript. CP is the guarantor. All authors read and approved the final manuscript.

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**Patient consent for publication** Not applicable.

**Ethics approval** This study was approved by Ethics Committee of the Medical Faculty of the University of Duisburg-Essen, Germany (19-8713-BO), and written consent for publication was obtained from all participants.

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**Data availability statement** Data are available upon reasonable request. The datasets analysed during the current study are available from the corresponding author on reasonable request.

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#### ORCID iDs

Monika Hertzen <http://orcid.org/0000-0001-9697-0287>  
 Heinz-Lothar Meyer <http://orcid.org/0000-0002-3472-4758>  
 Manuel Burggraf <http://orcid.org/0000-0002-6191-7360>

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