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AN OVERVIEW OF HUMAN-SNAKE CONFLICT FROM 2015 TO 2023 IN INDONESIA

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Abstract
Human-snake interactions are one of the most common forms of human-wildlife conflict since many snakes are known to be adapted to anthropogenic environments. We gathered evidence from social media and online newsletters on conflicts among 109 species, 56 genera, and 12 families throughout 38 provinces in Indonesia between 2015 and 2023. West Java emerged as a hotspot for human-snake conflicts, followed by other regions on the island of Java. *Malayopython reticulatus* had the highest conflict rates in Indonesia (n=165, 8.81%) and had the highest tendency to enter human settlements (n=138, 10.92%). *Naja sputatrix* is reported to have the highest rates of being killed (n=44, 11.76%), while *Calloselasma rhodostoma* and *Trimeresurus insularis* are reported to show the highest incidence of bites (both n=37, 16.30%). Our data provides fundamental information for the Indonesian government to inform human-snake conflict mitigation programs.

Keywords: Human-wildlife conflict, Indonesia, Java, snakebites, urban habitat, venomous

Introduction
Indonesia is home to many snake species, leading to frequent encounters between humans and snakes. Human-snake conflict in Indonesia is deeply rooted in the country's rapid urbanization and the destruction of natural habitat, which brings people increasingly in contact with snakes (Gibbons *et al.* 2000). Increased contact inevitably results in conflicts, because all snakes are typically perceived as dangerous (WHO 2016). The lack of awareness and proper education on snake behaviour and conservation in Indonesia exacerbates this issue, leading to fear and often unnecessary killings of snakes. As a result, there is an urgent need for advanced research and intervention strategies to mitigate human-snake conflicts in Indonesia (Anita *et al.* 2023), not only for biodiversity conservation but

also for human safety and well-being (WHO 2016).

Problematically, many Indonesian snake species thrive in heavily modified habitats and are abundant in residential areas (Andrews *et al*. 2005, Burbrink & Crother 2011, Carpenter 1977). Human-snake conflict frequently culminates in snakebite envenoming, a neglected tropical disease (Bagcchi 2015). Although not uncommon in other countries such as Malaysia (Sidi *et al*. 2022), India (Longkumer *et al*. 2016), and Tanzania (Nonga & Haruna 2015), we considered that several factors contribute to the severity of snakebite envenoming in Indonesia when compared to some other tropical countries.

One of them is the lack of widespread knowledge regarding appropriate pre-hospital practices for snakebite management (Werner & Soffa 2023). Furthermore, the restricted availability and limited species coverage of antivenom in Indonesia likely contribute to the severity of snakebite Neglected Tropical Diseases (NTD) envenoming in Indonesia (Permana & Shalihin 2023, Tan *et al*. 2016) when compared to countries like Thailand, with robust snakebite management programs (Ratanabanangkoon 2023, Suchonwanich & Wananukul 2018). Indonesia has struggled with the prevalence of ineffective pre-hospital practices. Studies have documented the widespread use of ineffective pre-hospital treatments globally, including self-amputation (Benard-Valle *et al*. 2015), constricting bandages/tourniquets (Amaral *et al*. 1998, Bush & Kinlaw 2015), incising the bite wound (Hall 2001), and mouth suction or generic suction kits (Holstege 2006). Applying ice packs or cold compresses (Canul-Caamal *et al*. 2020, Frank 1971), using "medicinal" stones (Baldwin 1995), and relying on herbal remedies (Martz 1992, Gomes *et al*. 2010, Puzari *et al*. 2022) are also concerning trends (Adiwinata & Nelwan 2015). Movie portrayals can also contribute to misleading information on snakebite management (Kakunje *et al*. 2019), compounded by the prevalence of local myths that lack any scientific basis.

Additionally, inaccurate folk methods for identifying venomous snakes persist, with people relying on unreliable criteria such as head shape, coloration, pupil shape, behaviour, or sounds produced (Hernawati *et al*. 2019, Perry *et al*. 2020). These methods are proven to be ineffective and can lead to delayed or inappropriate treatment for snakebite victims. Addressing these knowledge gaps and misconceptions through public education campaigns is necessary for mitigating the severity of snakebite in Indonesia. Emphasizing the importance of seeking immediate medical attention following a snakebite and promoting evidence-based pre-hospital care protocols are essential steps towards improving public health outcomes.

Currently, Indonesia has 375 recognized snake species (Suborder Serpentes), and 21.8% of these are medically significant venomous snakes. These venomous snakes are from three families consisting of 22 viperids (*Calloselasma*: 1; *Craspedocephalus*: 4; *Daboia*: 1; *Ovophis*: 1; *Trimeresurus*: 12; *Tropidolaemus*: 3). 59 elapids (with 27 recognized species comprising land elapids from 13 genera; *Acanthophis*: 3; *Aspidomorphus*: 2; *Bungarus*: 3; *Calliophis*: 2; *Cryptophis*: 3; *Demansia*: 1; *Micropechis*: 1; *Naja*: 2; *Ophiophagus*: 1; *Oxyuranus*: 1; *Pseudechis*: 1; *Pseudonaja*: 1; *Toxicocalamus*: 4; and another 32 sea snake species from four genera; *Aipysurus*: 3; *Laticauda*: 4; *Hydrophis*: 23; *Microcephalophis*: 1; *Parahydrophis*: 1), and one colubrid (*Rhabdophis subminiatus*) (Uetz *et al*. 2023). Specific venom studies for certain species and genera are lacking (Anita *et al*. 2022, Tan *et al*. 2017, Weinell *et al*. 2020). Moreover, venoms from several species exhibit geographical variation (Rusmili *et al*. 2019, Tan *et al*. 2020).

Previous research on human-snake conflict in Indonesia has often been geographically restricted, focusing on specific administrative regions with limited timeframes and sample sizes (Yuniasih *et al*. 2020, Khoerunisa *et al*. 2021, Uyeda *et al*. 2022, Kurniawan *et al*. 2021). This highlights a critical gap in comprehensive data for understanding the national scope of this phenomenon. This study aimed to address that data gap by providing a large-scale analysis of human-snake conflict events in Indonesia. We suggest this information will serve as a foundational resource for understanding snakebite prevalence in Indonesia and for informing future studies. Our data encompasses conflict events involving 109 snake species across 56 genera and 12 families, documented across 38 provinces in Indonesia between 2015 and 2023.

Materials and methods

Data Collection. Search Engine Optimization (SEO). We collected data from newsletters using keywords in Bahasa Indonesia related to snake conflicts: "Snake Bite," "Snake Killed," "Snake eats man," and "Snakes" + "House." This approach was adapted from Yuniasih *et al*. (2021) and Rifaie *et al*. (2023).

Social Media Platforms**.** Due to the high diversity of languages and dialects used in Indonesian social media, we employed a more detailed method involving year-by-year sorting. Here, we identified common reports and questions in discussion forums, including requests for snake identification, inquiries about snake venom, reports of snake bites (self, friend, or family), justifications for killing snakes, encounters with snakes in houses or gardens, panic-induced snake killings, and other similar conflict-related captions.

Conflict Period / Time. The data spanned a period ranging from January 2015 to December 2023.

Conflict Categories / Limitations. We categorized conflicts into four main groups: Snakes entering human settlements, snakes being killed by humans, snake predation on humans, and snake bites.

Snake Identification. We identified snake species based on the information provided in the posts or news. We then revalidated and verified this information to address any potential misidentifications. This process involved using snake identification books (O'Shea 1996, de Lang & Vogel 2005, McKay 2006, Das 2010, de Lang 2011, de Lang 2017, Rusli 2020) and confirmed with voucher specimens in Museum Zoologicum Bogoriense, Indonesia (MZB), Directorate of Scientific Collection Management, National Research and Innovation Agency.

Data Analysis. Data analysis was conducted descriptively using RStudio (R Version: R.4.2.2) (R Core Team, 2021). We used MapChart (www.mapchart.net) to visualise the data.

Results

Overview of Human-snake conflicts in Indonesia. Our analysis revealed a total of 1872 conflicts across 38 administrative provinces between 2015 and 2023. We found 1264 (67.52%) cases of snakes entering houses, 374 (19.98%) cases of snakes killed by people, 227 snakebites (12.13%), and 7 (0.37%) cases of snakes predating on people (Figs. 1, 2; Tables 1, 2; Sup. Table 1). Our analysis revealed a marked spatial heterogeneity in the distribution of conflict events.

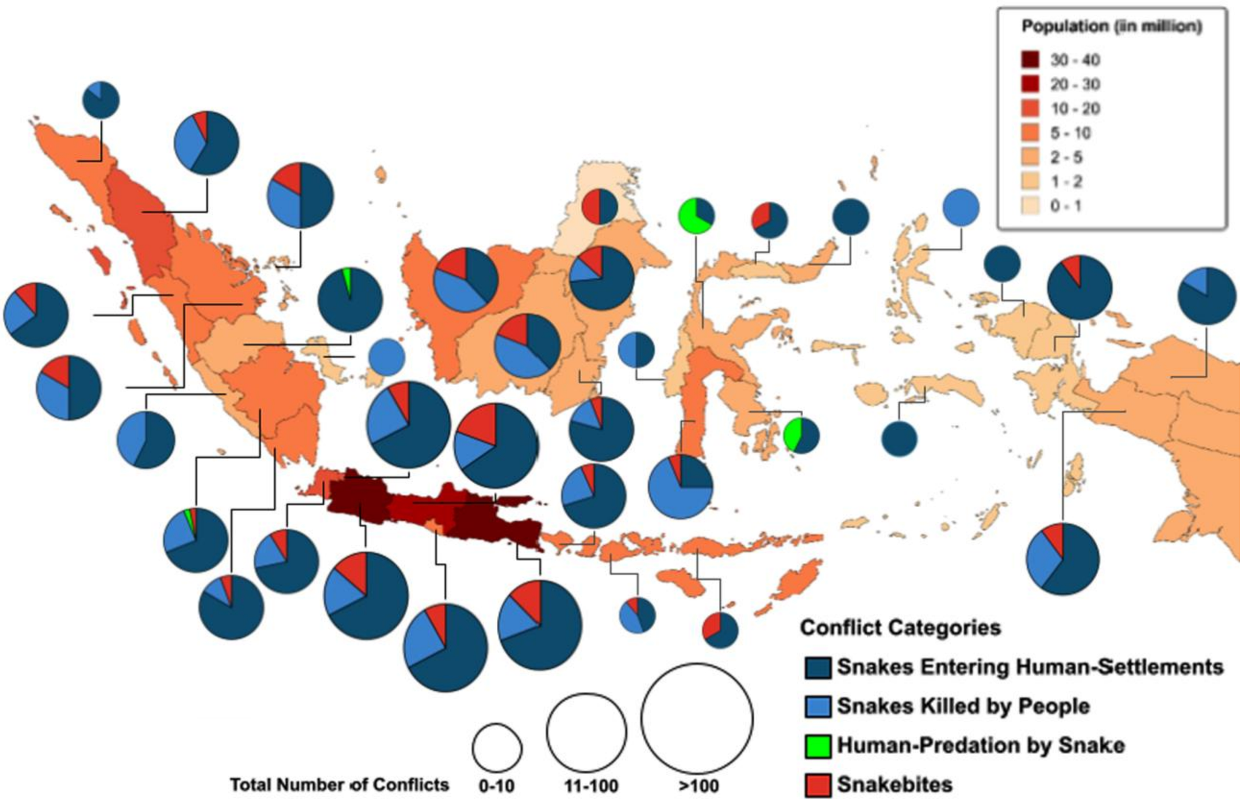

Figure 1. Map of Human-Snake conflict case in Indonesia (2015–2023)

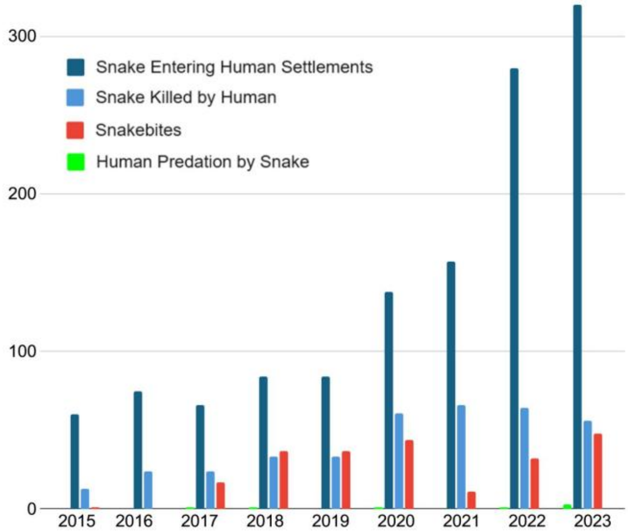

Figure 2. Annual trend of human-snake conflict in Indonesia (2015–2023)

Table 1. Distribution of human-snake conflicts by family; EHS = snake entering human settlements; SBK = snakes being killed by people; HPS = human predation by snakes; S = snakebites

Family	EHS	SBK	HPS	SB	Total
Colubridae	634	199		6	839
Elapidae	254	106		80	440
Pythonidae	161	20	7	4	192
Viperidae	53	15		110	178
Homalopsidae	54	13		2	69
Cylindrophiidae	30	5			35
Xenopeltidae	21	7			28
Pareidae	25	2			27
Typhlopidae	15	3			18
Boidae	6				6
Xenodermidae	2				2
Acrochordidae	1				1
Unidentified	8	4		25	37
Total	1264	374	7	227	1872

Table 2. The top four snakes for human-snake conflicts; EHS = entering human settlements, SBK = snakes being killed, HPS = human predation by snakes; SB = snakebites

Species	Conflict cases			
	EHS	SBK	HPS	SB
Naja sputatrix	138	37		33
Malayopython reticulatus	137	37	7	4
Coelognathus flavolineatus	133	35		0
Lycodon capucinus	91	26		0

West Java had the greatest number of conflict cases (n=537), constituting 28.69% of all snake conflict events. This was followed by Central Java (n=292, 15.60%), East Java (n=275, 14.69%), the Special Region of Yogyakarta (n=166, 8.87%), the Special Capital District of Jakarta (n=166, 8.87%), and Banten (n=70, 3.74%). Other than Java, North Sumatra had the highest conflict rate (n=41, 2.19%), followed by Riau (n=40, 2.14%), South Kalimantan (n=34, 1.82%), South Sumatra (n=32, 1.71%), East Kalimantan (n=30, 1.60%), Bali (n=30, 1.60%), Jambi (n=23, 1.23%), West Kalimantan (n=21, 1.12%), and Central Kalimantan (n=21, 1.12%). All other provinces had less than 20 cases, collectively representing 8.39% (n=157) of the total conflicts. Notably, no conflict incidents were documented in the southern part of Papua and the mountain regions in Papua. The apparent absence of human-snake conflict incidents in South Papua and Papua Mountains is likely due to underreporting rather than a true lack of such interactions. The remoteness and inaccessibility of these regions, coupled with cultural factors that may discourage reporting, can contribute to this underreporting bias.

The annual trend of human-snake conflict in Indonesia from 2015 to 2023 reveals a concerning pattern. While incidents of snakes entering human settlements remain prominent, the number of snakebites has shown a significant upward trend throughout the period. Additionally, there is a slight increase in cases of snakes killed by humans, suggesting a growing level of human-snake interaction. Predation by snakes on humans, however, remains relatively rare. It is important to note that the data may be influenced by increased reporting through social media in recent years.

Colubridae emerged as the snake family most frequently associated with human-snake conflict, accounting for 839 cases (44.82%) of the total reported incidents. Elapidae followed with 439 cases (23.45%), highlighting potential public health concerns due to envenomation risks. Pythonidae were involved in 192 cases (10.26%), while Viperidae were implicated in 179 cases (9.56%). Snake families such as Homalopsidae, Cylindrophiidae, Xenopeltidae, Pareidae, and Typhlopidae were involved in a considerably lower percentage of conflicts, ranging from 0.05% to 3.69% each. Notably, 37 cases (1.98%) were unidentified.

At the species level, *Naja sputatrix* had the highest conflict rate (n=212, 11.32%), followed by *Malayopython reticulatus* (*n*=165, 8.81%), *Coelognathus flavolineatus* (*n*=127, 6.78%), *Lycodon capucinus* (*n*=122, 6.52%), *Ptyas korros* (*n*=71, 3.79%), *Bungarus candidus* (*n*=69, 3.69%), *Calloselasma rhodostoma* (*n*=57, 3.04%), *Dendrelaphis pictus* (*n*=48, 2.56%), *Calliophis intestinalis* and *Trimeresurus albolabris* (Both with *n*=48, 2.56%), *Naja sumatrana* (*n*=45, 2.40%), *Trimeresurus insularis* (*n*=44, 2.35%), *Fowlea melanzosta* (*n*=39, 2.08%), *Ptyas mucosa* (*n*=36, 1.92%), *Rhabdophis subminiatus* (*n*=31, 2.35%), *Cylindrophis ruffus* (*n*=35, 1.87%).

Discussion

***Case 1: Snakes entering human settlements*.** All provinces with the highest rates of snake visitation are in Java, which is likely due to two factors. First, Java is the most populous island in Indonesia (Batubara *et al*. 2023). Some species of snakes are well adapted to human habitation, such as *Naja sputatrix*, *Malayopython reticulatus*, *Lycodon capucinus*, and are well adapted to houses that provide a variety of prey (e.g., house geckos such as *Hemidactylus frenatus*, *H. platyurus*, *Gehyra mutilata*). This brings house geckos, further increasing the risk of snake encounters. Secondly, people in these areas are actively involved in online groups and other forums, and many news outlets focus their reports on these provinces. More people might also be aware of snake presence due to local groups and media focusing on the issue. This leads to a higher number of sighting reports compared to areas with less active reporting channels.

We suspect that urbanisation has benefited some species of snakes that exhibit a high degree of ecological flexibility, which have higher populations in these urban areas. Overall, a combination of habitat changes, prey availability in human habitations, and increased awareness through local reporting networks likely contributes to the higher number of reported snake sightings in Java. The findings presented in the Tables emphasize the significance of accurate snake identification during human-snake conflict events. Differential risk assessments and appropriate management strategies can be implemented based on the snake family and species involved (Underkoffler & Adams 2021). Additionally, improved public education initiatives regarding snake identification can foster safer interactions and reduce unnecessary fear (Learmonth 2020).

Among all species of snakes, *Naja sputatrix*, *Malayopython reticulatus*, and *Coelognathus flavolineatus* were the most commonly encountered. These species are commonly found in human settlements (urban or suburban; Eprilurahman *et al*. 2009, Riyanto 2010, Arief 2014, Firdaus *et al*. 2016, Yudha *et al*. 2016), and are thought to have benefited from anthropogenic activities such as rice farming and palm oil production (Shine *et al*. 1988, Natusch *et al*. 2019).

***Case 2: Snakes being killed by humans*.** Human-snake conflicts often result in snake fatalities, either intentional or accidental. We recorded 374 cases of snake killing across 27 provinces in Indonesia. Non-venomous snakes were most common (*n*=218, 53.29%, including pythons (*n*=2, 5.35%), followed by venomous snakes, *Rhabdophis subminiatus* (*n*=11, 2.94%), elapids (*n*=105, 28.07%), viperids (*n*=16, 4.28%), and unidentified snakes (*n*=4, 1.07%). The four provinces with the highest conflict rate in this category are West Java (*n*=101, 27.01%), East Java (*n*=47, 12.83%), Central Java (*n*=44, 11.76%), and Special District of Yogyakarta (*n*=40, 10.70%). Most snakes killed in these four provinces are non-venomous snakes, often considered harmless to humans. Most people would intentionally kill snakes if they entered their house, garden, or any other private property, not to mention other sources of conflicts such as road-kill (Rosen & Lowe 1994, Karunarathna *et al*. 2013). Another study also reported that people tend to have an adverse reaction/attitude when confronted with snakes; interestingly, this is learned in childhood (Yorek 2014).

Java Island has an area of 129,438.28 km^2 and comprises six provinces: the Special Capital District of Jakarta, Banten, West Java, Central Java, East Java, and the Special Region of Yogyakarta. The total human population of Java Island in 2020 was 151.6 million people, or equivalent to 56.1% of the country's total human population (sulut.bps.go.id). The dense population on the island of Java is the most significant driving factor for land cover changes, possibly contributing to high wildlife conflict rates. The Special Capital District of Jakarta is a city with a high level of development and numerous land cover changes from green areas to buildings (Tursilowati *et al*. 2012), followed by the other rapidly developing provinces. There are eleven administrative provinces with zero conflicts in this category. Further study and deeper analysis are required to determine whether this can be attributed to local wisdom, culture, or any other factors such as wildlife knowledge, ethnobiology social media usage.

Naja sputatrix and *Malayopython reticulatus* have the highest rate of occurrence in this type of conflict (both *n*=37, 9.89%), followed by *Coelognathus flavolineatus* (*n*=35, 9.36%), *Lycodon capucinus* (*n*=26, 6.95%). These snakes can be categorized as snakes that adapt to disturbed habitats, so that they conflict with humans who encounter them. In general, snakes are feared or considered disgusting and dangerous in Indonesia. Poor public perception of snakes can cause fear and dislike, making people tend to harm or kill snakes (Uyeda *et al*. 2022), regardless of whether the snake is venomous. Cobras (*Naja sputatrix* and *Naja sumatrana*) are easily recognized by their large stature and habit of rearing and spreading their hood when they feel threatened (Young 2010), so that people can immediately recognize them as dangerous venomous snakes and try to kill them. Meanwhile, some non-venomous snakes can also curve their anterior bodies into an "S" shape and inflate the front of their bodies when they feel cornered, giving the impression of aggression (*Coelognathus flavolineatus*, *Ptyas korros*, and *Coelognathus radiatus*). This defensive behaviour is often misinterpreted as aggressive behaviour or even "chasing behaviour", so people panic and try to kill them. In general, most people think that snakes with striped patterns or striking colours are venomous (Wüster *et al*. 2004), so any snake with this kind of colour pattern (e.g., non-venomous *Cylindrophis ruffus* and juvenile *Coelognathus flavolineatus*) is at risk of being killed when they encounter humans. *Lycodon capucinus* is a natural predator of house geckos, often enters human settlements, and has conflicts with humans. This species sometimes falls from walls or house tiles, moves actively to escape, and can bite multiple times if held (Mirza *et al*. 2011), so it is mistakenly considered a dangerous type of snake. Giant snakes such as *Malayopython reticulatus* can come into conflict with humans and be killed when they threaten or are perceived as threatening pets (cats and dogs), or livestock (chickens, ducks, and goats).

Case 3: Snake predation on humans. We documented seven cases of snake predation on humans by *Malayopython reticulatus*, three cases occurred in Southeast Sulawesi, two in Central Sulawesi, one in Jambi, and one in South Sumatra. These cases occurred in remote rural areas with abundant high levels of vegetation cover. In all cases, the victims were attacked whilst walking alone at dusk or during the night in plantations. Cases of reticulated pythons preying on humans in Indonesia were first recorded in 1853 in Tondano, North Sulawesi (Buddingh 1860). Since then, recorded cases occurred on three large islands in Indonesia (Sumatra, Borneo, and Sulawesi) as well as on several smaller islands (Banggai, Halmahera, and Salebabu) (Lang 2010). Among giant constricting snakes, reticulated pythons are the only snakes confirmed to have successfully preyed on humans (Natusch *et al*. 2021, Burger 2022).

The snakes involved in these cases were all adults with an estimated length of more than 4 metres. Adult reticulated pythons of this size generally have a more terrestrial than arboreal lifestyle (O'Shea *et al*. 2004) and hunt warm-blooded prey (mammals and large birds) by ambushing prey from dense vegetation, bodies of water, or other places of concealment (Corlett 2011). Pythons over four metres long shift their prey preferences from rodents to larger mammals such as pigs, goats, deer, and primates (Shine *et al*. 1998, Natusch *et al*. 2019), so these snakes have the potential to see passing humans as prey.

Case 4: Snakebites. The 227 cases of recorded snakebite consist of 194 (85.46%) confirmed to have been administered by venomous snakes, eight (3.52%) confirmed by non-venomous snakes, four (1.76%) by pythons and four by other non-venomous snakes (1.76%), and twenty-five (11.01%) by unidentified species. Non-venomous snake bites are not always harmless: a python bite could cause serious injury (bleeding) given their potentially enormous size, body, and teeth, and stronger jaws than any other snake; therefore, we have separately reported the bite rate from pythons. In venomous bite cases, we have separated the other families, genera, and species due to the lack of available information on the possession of medically significant venom. Although sea snakes are notable for their highly potent venom toxicity (Tan *et al*. 2017), there were no reported cases of bites from sea snakes in our data.

Of 194 snakebite reports confirmed by venomous snakes, four cases are by *Rhabdophis subminiatus*, 110 are by viperids, and 80 are by elapids. West Java has the highest number of snakebites by venomous snakes (*n*=63; 32.47%), followed by Central Java (*n*=50, 25.77%), East

Java (*n*=29, 14.95%), the Special District of Yogyakarta (*n*=12, 6.19%), and Banten (*n*=6, 3.09%). We believe the actual number of snakebite cases is greater than our data suggests; we assume that the reports from these three provinces are influenced not only by the number of residents but also by the presence of several local groups among these communities that provide identification/reporting platforms compared to other provinces.

Among the 25 cases of unidentified snakes, 8 (32%) resulted in envenomation and 13 (52%) were unconfirmed. The lack of confirmation is due to missing information about symptoms, snakes, and the limited samples. Thus, we believe the actual unidentified snakebite cases are greater than what is reported here. Where envenomation has not been stated, this might be due to the snake not being venomous or due to dry bites (Alves-Nunes *et al*. 2024) by venomous snakes (Pucca *et al*. 2020). This data also illustrates that snake identification remains challenging in most cases of snakebite, which lack confirmation of the species involved. It also supports that snake identification played an essential and fundamental role in pre- and post-hospitalisation as part of first aid for snakebite envenoming treatment. It also supports the argument that polyvalent antivenom products are still needed, given the emergence of unidentified venomous bites without detailed information about the suspect. Even though administering monospecific antivenin is recommended by WHO for effective treatment (Hurt & Maday 2016, Hurt & Maday 2018), monospecific antivenin therapy is not always available to snakebite victims because of its high cost, frequent lack of availability, lack of technology and the snake identification challenges (Chippaux *et al*. 2015).

Among the 194 snakebite cases, bites from vipers (*n*=110, 56.7%) occurred at the highest rate compared to the other families, followed by the elapids (*n*=80, 41.24%) and *Rhabdophis subminiatus* (*n*=4, 2.06%). The vipers' significantly high bite rate is possibly related to their behaviour of ambushing their prey. Therefore, they are rarely recognised or seen because of this behavioural trait, which is different from the many members of the elapids that are sensitive to disturbance and exhibit a particular threat display, such as cobras with their loud hissing sounds and rearing upwards while spreading out their ribs to form a hood. However, the *Bungarus candidus* and *Bungarus fasciatus* also have a high rate of reported bites (*n*=18, 9.28%), despite their nocturnal behaviour and hiding their head below their body when threatened, and their intimidating stripe, and they are often reported during the rainy season. It is because they are commonly found to inhabit human settlements (Category 1 in Indonesia) (World Health Organization, 2016). For the colubrid snakebite, the *Rhabdophis subminiatus*, presumably, most bites are due to overlapping habitat with human settlements, especially agricultural areas, even though they are generally known as non-aggressive (Anita *et al*. 2022).

The white-lipped pit viper (*Trimeresurus albolabris*; *n*=44) has the highest bite rate, followed by the Malayan pit viper (*Calloselasma rhodostoma*; *n*=36), followed by the Javanese spitting cobra (*Naja sputatrix*; *n*=33), and the Island white-lipped pit viper (*Trimeresurus insularis*; *n*=21). Even though *N. sputatrix* and *Calloselasma rhodostoma* are covered by the currently available polyvalent antivenom product BioSAVE1 (produced by Biofarma), *Bungarus candidus*, *Trimeresurus albolabris*, and *Trimeresurus insularis* do not match the current domestic product. In the Eastern part of Indonesia, despite the low numbers of reported snakebites, *Acanthophis laevis* and *Micropechis ikaheka*, are recorded as being involved in the case of snakebite. Especially, *Acanthophis laevis*, which is listed in Category 1 (World Health Organization 2016). Specific antivenoms for each snake species are ideal yet not always practical, especially when accurate species identification is challenging, as with *Trimeresurus albolabris* and *Trimeresurus insularis*. In such cases, a broader-spectrum antivenom could be more efficient and effective (Rojnuckarin 2015). This is also possible due to the evolutionary relatedness of snake venoms, which often share protein families. This phenomenon, known as paraspecificity (Archundia *et al*. 2011), allows a single antivenom to neutralize venoms from multiple snake species. Other reports suggest cross-neutralization among *Trimeresurus* species (Yee *et al*. 2020, Thakur *et al*. 2022) is likely to be potent. This would require investment in research, production, and distribution of these antivenoms (Potet *et al*. 2021).

Our data undoubtedly underestimate the true extent of human-snake conflict in Indonesia. Nevertheless, it provides important insights into what we suspect are general trends across the archipelago. Four species of snakes, *Malayopython reticulatus*, *Naja sputatrix*, *Calloselasma rhodostoma*, and *Trimeresurus insularis*, have the highest number of conflicts with humans in Indonesia. Exploring the biology of these four species should be prioritised as an initial step in eradicating the conflict, allowing for more accurately targeted recommendations for managing human-snake conflicts. We recommend the implementation of community-based education programs to raise awareness among local communities about the importance of snakes in the ecosystem, as well as providing information on how to safely coexist with these reptiles. Empowering people with knowledge about snake behaviour, identification, and proper snake handling techniques, communities can reduce and dispel common myths and misconceptions surrounding snakes, fostering a better understanding and appreciation of these animals. Research has shown that such initiatives can lead to a decrease in snakebite incidents and promote conservation efforts for threatened snake species (Uyeda *et al*. 2022, Yulyanita & Albakri 2023, Underkoffler & Adams 2021). We would also recommend prioritizing extensive production of antivenoms for *Trimeresurus insularis*, *Trimeresurus albolabris*, and *Bungarus candidus*.

Author contributions

All the authors contributed equally.

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