



Venomous spiders of Albania –does an increase of temperature influence the toxicity of spider venom?☆

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ABSTRACT

Black widow spiders (*Latrodectus* sp.) are distributed worldwide, and in Albania the *L. tredecimguttatus* Rossi, 1790 has been the dominant spider. Other medically important spiders in Albania include the brown recluse with symptoms known as loxoscelism, the false black widow and the egg sac spiders; the last two inducing similar symptoms to a wasp sting. Methods: The data analyzed is from a decade-long study of 125 patients hospitalized in the regional hospital of Fier County, in the Western Lowland of Albania from May 2009 and to October 2018. Objective: Although the venom is rarely fatal, the recent spider bites raise questions about the influence of higher air temperatures on their possibly increased toxicity. Results: Significantly the severity of the α -latrotoxin rises during the summer, when human–spider contact frequency is higher and when the black widow spiders have an increased motivation to protect their egg sacs. Conclusion: This study revealed an increased severity of the black widow bites with respect to patient health, shown via all the severe systemic symptoms, during those months with higher temperatures.

1. Introduction

Venomous spiders are distributed worldwide in warmer regions and represent a risk, particularly for rural populations. Some spiders are of medical importance, and in the Balkans and especially in Albania these include the black widow and brown recluse. Black widow spiders (*Latrodectus* Walckenaer, 1805) from the family Theridiidae Sundevall, 1833 include 34 species. Recluse spiders (*Loxosceles* Heineken and Lowe, 1832) from the family Sicariidae Keyserling, 1880 include 142 species. Both genera occur worldwide (WSC, 2021).

Like most spiders they have venom glands that produce venom and inject it into the victim via their bites, serving to immobilize prey but also for self-defense against possible danger. These bites may cause mild effects and rarely result in fatalities in humans, the most dangerous being perhaps the *Latrodectus* species. The venom of the black widow spider is primarily neurotoxic and has higher toxicity in mammals, with increased mortality in children. The venom consists of some of the most important biologic toxins, which cause the destabilization of cell membranes and the granulation of nerve terminals resulting in the release of neurotransmitters, such as acetylcholine and norepinephrine which lead to so-called latrodectism. Typical systemic symptoms here

are severe pain from muscle cramps, neurotoxic effects, and severe allergic reactions. The severity of the spider venom is related to several factors such as the quantity of the injected venom, bite location and time, spider size and motivation, season, and the general health of the patient (Ericsson et al., 2006; Farzad et al., 2014; Nicholson and Graudins, 2002; Reeves et al., 1996).

Venomous spiders encountered in Albania include the Mediterranean brown recluse *Loxosceles rufescens* (Dufour, 1820), and the black widow *Latrodectus tredecimguttatus* Rossi, 1790. A hundred and twenty five patients with spider bites were admitted to hospital over the decade 2009–2018 as a result of the severity of their symptoms. Although the venom was rarely fatal, these bites were medically significant and an interesting question is whether higher air temperatures during the summer months influence their toxicity. This forms the basis of the present study. *L. tredecimguttatus* is known to cause neurotoxic arachnidism, which has significant toxic effects, and for severe symptoms, antivenom is the only effective treatment. The *L. rufescens* bites vary from mild to necrotic arachnidism. Therefore, this retrospective study will highlight the importance of the spiders' venom severity and raise awareness to prevent morbidity.

☆ Abbreviated title: The severity of spider venom in higher temperatures.

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2. Material and methods

2.1. Venomous spiders in Albania

A description of 125 patients during a decade from May 2009 to October 2018, from the villages of Fier County, in the Western Lowland of Albania hospitalized in the regional hospital is presented. Patients identified the spiders either as black widows or simply as a spider bite. Medical staff had no clear evidence of the spider for accurate identification, but based on the symptoms latrodectism or loxoscelism could be identified from *L. tredecimguttatus* and *L. rufescens* respectively. Both species have significant variations in sexual dimorphism, where the females are massive. *L. tredecimguttatus* females have black legs and round black body, with the characteristic 13 red to orange spots in the dorsal part of the abdomen. Females of *L. rufescens* have a reddish to yellow prosoma and gray to the reddish-brown opisthosoma (Farzad et al., 2014; Nentwig et al., 2013; WSC, 2021). The period of the spider bites was during the seasonal fieldwork, from April until November, and is related to female maturity (sub-adults and adults). Only females are venomous and, as they feed mainly on insects, they are not naturally aggressive towards humans (D'amour et al., 1936). Other less known venomous spiders found in Albania, and reported more generally in Europe, include the false black widow *Steatoda paykulliana*, the yellow sac spider from the family Cheiracanthiidae, *Cheiracanthum puncturium*, followed by rare cases of spider bites by *Argyroneta aquatica*, *Atypus affinis*, *Dysdera crocata*, *Eresus kollari*, *Nuctenea umbratica*, *Segestria senoculata*, *Zoropsis spinimana*, and some agelenids, araneids, and gnaphosids (Nentwig et al., 2013).

Detailed data on the localities, age, gender, bite location, symptoms, supportive treatment, bite date, and hospitalized time were analyzed.

2.2. The Western Lowland climate

Fier County is located in the Western Lowland near the western coastal area and has a typical Mediterranean climate with humid, warm winters and hot, dry summers with temperatures higher than 35°. The Western Lowland has a daily maximum temperature in summer up to the new record 43.9 °C (July 2020) with a recent trend of the air temperature +4.3 °C compared with the normal values, and in winter up to 23 °C; whereas daily minimum temperatures in summer are down to 9 °C and in winter down to -6 °C. The higher rainfall values during winter with +262% (January 2021) causes flooding in many agricultural areas of the Western Lowland, whereas, in summer, there are only a few days with rainfall which can be up to 124%, but mostly there is no rainfall, which characterizes the dry summer. These values are taken from the monthly climatograms in the measured points of the Western Lowland (IGEO, 2021).

2.3. Distribution of *Latrodectus tredecimguttatus* and *Loxosceles rufescens*

Latrodectus has a wide distribution, mainly in tropical and temperate areas of the world. The black widow *L. tredecimguttatus* is distributed throughout the Mediterranean region, and from Ukraine, the Caucasus, Russia (Europe to South Siberia), to Kazakhstan, Iran, Central Asia and China. *L. rufescens* is a native European spider, distributed from southern Europe and northern Africa to Iran and Afghanistan and introduced into several other countries (Nentwig et al., 2021). *L. tredecimguttatus* is the only species of the genus *Latrodectus* found in Albania. Its preferred natural habitat includes dry areas around buildings, within agricultural machinery, in stockpiles, in low vegetation and bushes, dunes and sandy beaches. Females typically build nests in dry places under stones, soil crevices, dead trunks, tunnels and shelters. By contrast, recluse spiders prefer mainly dry habitats, stones, and soil crevices, as well as retreats in the walls inside and around buildings. Bites usually occur when humans put on clothes or shoes in which the spider was hiding. In Europe, the

black widow is often present in agricultural environments and crop fields, and under leaves or fruits. This is reflected in the profession of the hospitalized patients who are mainly farmers (Forster, 1995; Isbister and White, 2004).

The morbidity of the spider venom in Albania raises awareness to consider the distribution map of the venomous spiders and detailed data on their venom severity on the residents of agricultural areas. *L. tredecimguttatus* bites have been reported since 1999 in the Western Lowland of Albania, with the worst year being 2001. The black widow is widely distributed in the plains and hilly areas of the Adriatic coast, from southern to northern Albania, including Konispol, Kolonjë, Tepelenë, Vlorë, Fier, Lushnje, Berat, Elbasan, Kavajë, Durrës, Tiranë, Shkodër. By comparison *L. rufescens* bites occurred in the Western Lowland including Sarandë, Fier, Lushnje, Berat, Tiranë (Fig. 1) (Hoxha, 2006; Kürka et al., 2020; Laho and Puca, 2014; Marko et al., 2017; Naumova and Deltshv, 2021). Data on their distribution were also reported by S. Pavouk, pers. comm, and B. Vrenozi, pers. comm.

2.4. Statistical methods

The data explorations and statistical analysis were performed in SPSS 28.0. The Chi-square test for independence was used to test the relationships between several selected nominal variables. The Chi-square goodness-of-fit test was used to determine whether the distribution of cases in a single categorical variable was equal across categories. The results were considered significant for a significance level smaller than 0.05.

3. Results and discussion

3.1. Spider bite localities

Black widow bites are especially related to rural areas. Patients in this study were mostly farmers from agricultural fields in the Western Lowland, bitten during harvest time in the spiders' preferred habitats e. g. the watermelon and cornfields (wheat, straw), as mentioned in other studies (Dzelalija and Medic, 2003; Maretić, 1983; Murat et al., 2018). Working in the agricultural fields in a bent position makes some human body parts closer to the ground and thus more exposed to potential spider bites. These bites were usually in the lower and upper limbs such as the leg (20.8%), hand (28.8%), arm (7.2%), forearm (4%), one case was in the face (0.8%), although sometimes in the neck and shoulder too (B. Vrenozi, pers. comm.) (Graph 1, Fig. 2). Lower limb bites were previously identified as the most common bite sites, and the head and neck as the rarest (Clark et al., 1992). In contrast to this, here, the upper limbs were significantly the most bitten sites ($\chi^2(1) = 7.579$; $p = 0.006$). Bites could occur while resting in the shade in these areas inside and outside of vehicles, or when pitting on clothes or shoes which the spiders happened to be using as shelters (Timms and Gibbons, 1986).

The bite itself is usually initially mild such that the patients often did not feel the bite straight away during their work in the fields; hence they often did not know the bite location (NA, 38.4%), and only went to hospital when the symptoms of envenomation appeared (Maretić, 1983).

3.2. Venom toxicity versus the size of the patients

Venom severity is related to patient size, such that severe complications of black widow venom are usually reported in children of less than 15 kg of body weight and in patients with weaker body musculature requiring the use of antivenom. In young children, the Latrodectism syndrome can continue for more days than in adults, and the black widow spider bite is extremely painful due to the neurotoxic effect of the typical *Latrodectus* neurotoxin, α -latrotoxin. In this retrospective study, the age groups of 15–59 years old, were predominantly bitten by the spiders ($\chi^2(1) = 52.488$; $p < 0.001$). In addition, there were reports of

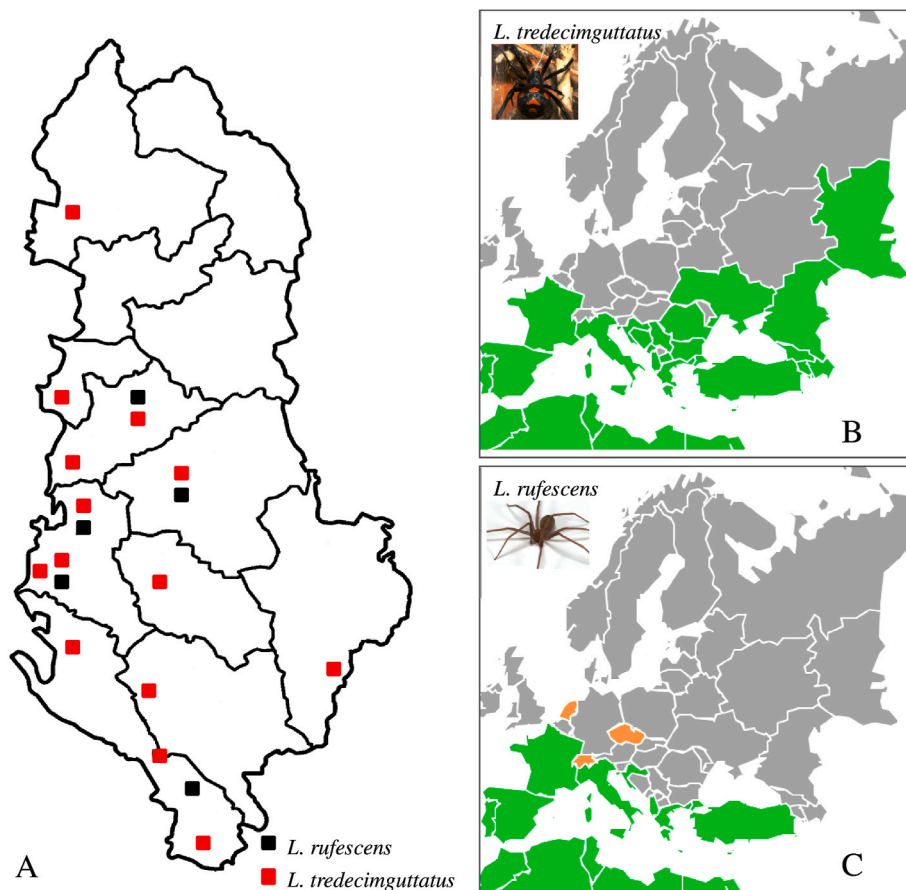


Fig. 1. Distribution maps of *L. tredecimguttatus* and *L. rufescens* in: A – Albania (respectively red and black squares), B and C – Globally at www.araneae.nmbe.ch (green - presence, yellow – not established, gray – no data).

bitten children too (<14 years old, 5.6%). These younger patients were considered as possible fatalities, based on the other studies where victims under 14 years of age and the ones with smaller body size, who thus received a higher dose of venom per kilogram body weight. Here, there were only two severe cases involving younger victims (16 and 19-year-old), and a higher number of males showed severe systemic symptoms (6♂: 3♀) (Table 1). This pattern was also reported by other studies showing a higher incidence of male victims (Clark et al., 1992; O'Malley et al., 1999; Peterson, 2006).

The study revealed an almost equal gender ratio of the field workers (66♂: 59♀), which is related to the recent trend of an increasing numbers women working in the agricultural greenhouses in the Western Lowland in Albania, although other studies revealed a different gender distribution with the higher number of males (Clark et al., 1992). This ratio is almost equal for the age of the females ranging from 12 to 72 years (median 41) and of males from 11 to 75 years (median 40).

Screening the literature revealed that the first two fatalities in Albania were recorded in July 2006. Both were young patients from the Western Lowland (17 and 29 years old, respectively ♂ and ♀), followed by another case of a deceased 15 year old boy in July 2011. Added to this are the 10 and 17-year-old girls in July 2014 and 2016 respectively who suffered myocarditis due to the black widow spider (Hoxha, 2006; Laho and Puca, 2014; Marko et al., 2017; Sulaj et al., 2015). Recently, in July 2021, I was in contact with my colleagues (Dr. EnkelejdaVelo), and with the high sensitization of EUVEN experts (European Venom Network, CA, 19144), we followed up the critical hospitalized case of a 16 year old boy at the University Hospital “Mother Theresa” in Tirana. He survived only by taking two shots intravenously (2.5 mL each) of the antidote to *Latrodectus mactans* (Fabricius, 1775), provided by the Poison Control Centre and National Toxicology Information Centre - Toxicology Unit,

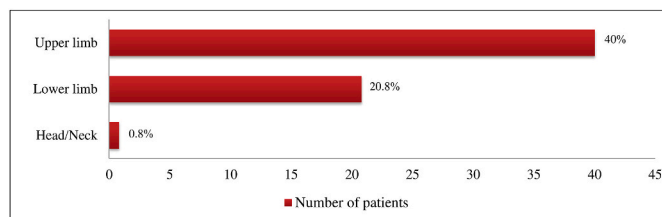
Pavia, Italy (Dr. Davide Lonati). The above-mentioned reported spider bites were all in healthy young patients without previous health issues.

3.3. Seasonality of the spider bites and features of the venom severity

Fieldwork seasonality defined spider bite times, which occur mainly in summer. Considering the number of patients reporting to hospital, bites started in late April (0.8%) and May (10.4%), followed by increasing cases during June (17.6%), July (20.8%), and August (30.4%); and ended in September (12.8%), till early October (4%) and even November (3.2%). August had the highest percentage of bites and proved to be significant ($\chi^2(7) = 71.544$; $p < 0.001$). Higher numbers of black widow bites in July and August have been reported in other studies in Europe, such as in Turkey (Cesaretti and Ozkan, 2011), Croatia (Dzelalija and Medic, 2003) and Italy (Mammola et al., 2020). Venom severity thus appears to be higher during the summer season when females lay eggs ($\chi^2(2) = 71.728$; $p < 0.001$), compared to spring and early autumn. Patients usually recover within 24 h, and in our retrospective study, these typical symptoms of latrodectism mainly took up to 48 h ($\chi^2(1) = 45.000$; $p < 0.001$), with the highest number of spider bites in August ($n = 21$), but some patients recovered over 3–7 days (20%, median 3.5), up to 12 days in other studies (Timms and Gibbons, 1986). The extended hospitalizations of more than three days during the hot summer (June – four; July-four, six; August – four, seven), and early autumn (September – four, six; October - five) of the decade in this study (Graph 2), suggests that higher temperatures may increase the toxicity of the black widow α -latrotoxin. Other factors may be the higher dosage of injected venom either from being pressed by human limbs and/or from the increased bite motivation of black widows during the reproductive period. Early life stages are often more sensitive to extreme



Fig. 2. A- *L. tredecimguttatus*, B- *L. rufescens*, C- Redness of the bite location (arm), D- Swelling of the bite location (leg), E- Swelling of the face soon after the bite (leg), F- Necrosis wound of the bite (abdomen).



Graph 1. Locations of spider bites envenomation.

environmental conditions, such as low humidity and higher summer temperatures, influencing the spider behavior, increasing their aggressiveness and motivation to protect their egg sacs and/or hatched spiderlings (D’amour et al., 1936; Duran et al., 2021). Evidence suggests that the venom toxicity is lowest in spring, and increased toxicity is related to higher environmental temperatures during the late summer to autumn, causing lethal cases (Cesaretli and Ozkan, 2011; Ennik, 1980; Keegan et al., 1960; Peterson, 2006). This period may change from year to year depending on the temperatures, and recently the global climate change has replaced July with August as the hottest month in Albania. This is reflected in the higher number of hospitalized patients due to spider bites in this month (IGEO, 2021).

Table 1
Clinical features of the most severe systemic cases of latrodectism.

Case	Age (years)	Sex	Time of the bite	Location of the bite	Systemic symptoms	Treatment	Hospitalization (days)
1	16	♂	June	NA	Body pain, tachicardi	Glucose solution, Apetol, Piroxicam, Dexamethasone, Tramadol	2
2	19	♀	August	Arm	Fading, headache, redness and limb itching	Ca gluconate, Ringer solution, Vitamins B1, B6, B12, Diazepam	2
3	42	♂	August	Arm	Limb pain, numbness, difficulties in breathing	Glucose solution, Piroxicam, Prednisolone	2
4	55	♂	July	NA	Abdominal and chest pain	Ringer solution, Glucose solution, Metamizole, Diazepam, Tramadol	2
5	63	♀	July	Arm	Numbness and limb swelling, difficulties in breathing	Calcium gluconate, Vitamins B1, B6 B12, KCl, Prednisolone, Tramadol	2
6	64	♀	July	NA	Breathing difficulties, chest pain	Dexamethasone, Prednisolone, O2 therapy, Tramadol	2
7	70	♂	August	NA	Body pain, difficulties in breathing	Glucose solution, Magnesium sulphate, Piroxicam, Diazepam, Tramadol	2
8	48	♂	June	Leg	Limb, abdominal and chest pain, numbness	Calcium gluconate, HCl, Prednisolone, Diazepam, Metamizole, Tramadol	3
9	58	♂	July	NA	Strong pain in the body, head and chest	Glucose solution, Diazepam, Metamizole, Prednisolone	4

Higher temperature during summer is related to higher venom severity based on different features of the black widows and the brown recluses. The severity of the spider bites is counted for the black widow venom and is shown with the higher number of patients bitten and hospitalized during this period, resulting from the increase of human-spider contacts during summer. Patients reported that they immediately felt the spider bite being stronger than a bee sting, followed by increasing pain within the first hour (Cesaretti and Ozkan, 2011; Isbister and Gray, 2003). The bite is not based on the spider's aggression, as black widows are not known for such behavior; instead, it is an extreme act of defense when the spiders feel threatened in their habitats from the pressure of human limbs.

In addition, the toxicity of the venom is related also to the injected venom quantity, which is closely related to the pressing time and frequency of human contact towards the spiders, the time of the day, time of the year, spider size and the motivation of the spider to inject a higher dosage. The last characteristics relate to sexual maturity, where only females are venomous. Females are about 20 times larger than males, and mate during summer. Adult female black widows are more protective during the period of egg-laying in summer; consequently, there are a higher number of bites with critical health issues, including fatalities, precisely in this period when the spiders are more motivated for a higher venom injection dosage. Moreover, the toxicity of the venom is higher and causes severe symptoms by the first bite, which means that these patients are mainly bitten before noon when the spider has just started its feeding activity and had not used its venom yet (D'amour et al., 1936; Keegan et al., 1960; Peterson, 2006).

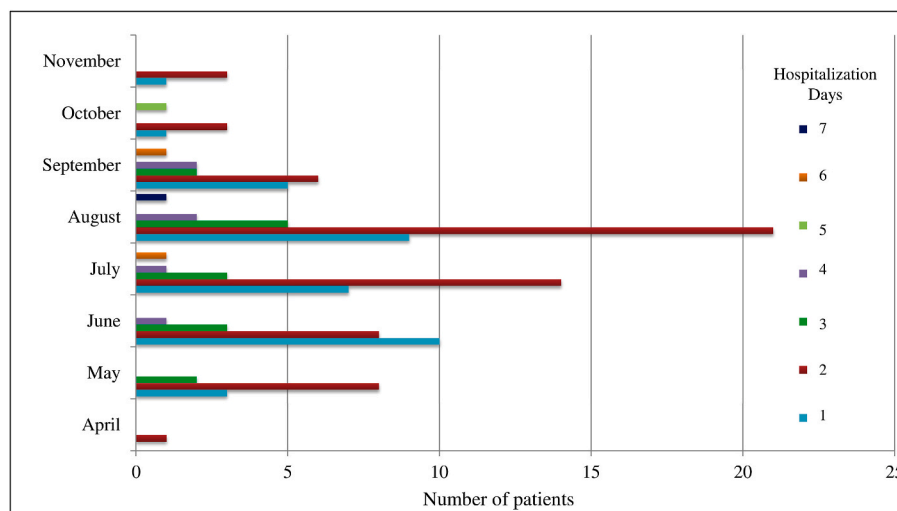
3.4. The symptoms of the spider bites

Symptoms usually begin within the first hour to 8 h after the bite. In contrast to all other spider bites, the brown recluse bite does not cause pain, but mainly moderate local itchiness and redness along with the necrotic lesions, which can heal within a short time, but sometimes take several weeks or months (Hunt, 1981). Such symptoms were seen in only two patients in this study (1.6%). In Loxoscelism, the bite appears as a central blister with mottling and a blanched halo with surrounding erythema (Wilson and King, 1990). Most of the patients claimed to have pain at the bite location ($\chi^2(1) = 10.124$; $p < 0.001$), although sometimes this pain is a psychological shock known as anxiety and fear of death from the spider bite. Pain is the main symptom of latrodectism, caused by the α -latrotoxin acting in the cerebrospinal and autonomic systems. The local symptoms (33.6%) include redness, itching, and swelling of the bite location or the face and eyelids. The neuromuscular

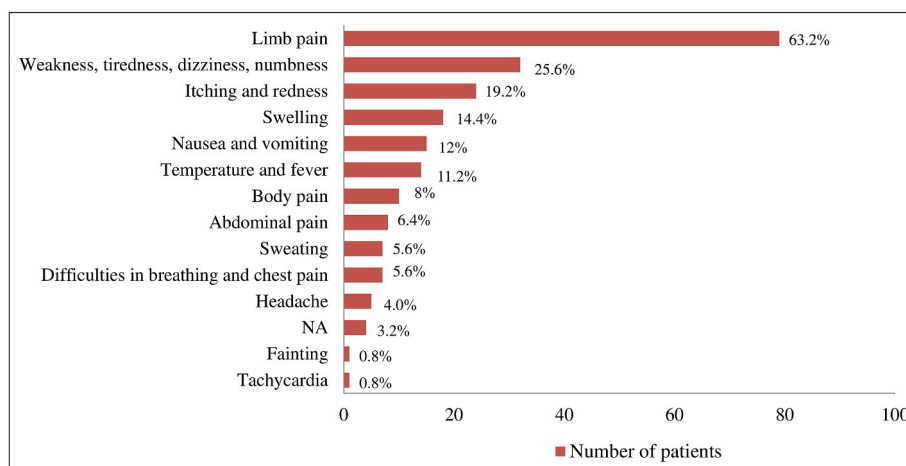
effects may rapidly worsen, with severe and long-lasting pain up to four days which mainly increases within the first hour and mostly radiates from the limbs into the abdomen and body (14.4%). Moderate systemic symptoms occur within a few hours after the bite, such as profuse sweating (5.6%), raised temperature, and fever (11.2%). Usually, patients are referred to the hospital with clinical signs of anaphylactic shock with nausea and vomiting (12%), causing dizziness, weakness, tiredness; through to severe systemic symptoms (7.2%) such as breathing difficulties and chest pain, fainting, hypertension, tachycardia followed by bradycardia, all of which have occurred in the summer period in this study (Graph 3, see Table 1). Systemic symptoms depend on the size of the spider and its motivation, time of year, size and age of the patients, location of the bite, and any underlying health problems. Sometimes anxiety and psychosis may occur, and the patients may have disturbances in speaking and other psychological disorders (Isbister and White, 2004; Maretić, 1983; Murat et al., 2018; Peterson, 2006; Timms and Gibbons, 1986)..

3.5. Treatment of the spider bites

Treatment of the spider bite involves several medications. Calcium therapy was applied to most patients with calcium gluconate intravenously ($\chi^2(1) = 13.893$; $p < 0.001$), and 5.6% received Ringer solution, which also contains calcium chloride. Calcithery is the first-choice treatment for latrodectism, acting too quickly to suppress the pain, muscles contraction, and cramps (Key, 1981). Spider bites cause anxiety and fear of death, and therefore it is used diazepam that acts as an anxiolytic in addition to its muscle relaxants properties ($\chi^2(1) = 15.281$; $p < 0.001$). In addition to the muscles contractions, it was proved as effective the intravenous use of the myorelaxants such as dantrolene sodium, every 4 h for two days (Rollard et al., 2015; Ryan et al., 2017). Some patients required narcotic analgesics for relieving pain (tramadol, 22.4%), although pain relief was recorded as being most effective from the combination of the intravenous analgesic opioids (morphine) and muscle relaxants (benzodiazepines) (Ryan et al., 2017). The spider bite may become infected, like any other bite, and in addition, antibiotics were sometimes used (20%). As an anti-inflammatory drug, the corticosteroids such as prednisolone ($\chi^2(1) = 19.843$; $p < 0.001$) were used to treat also itching, redness, swelling, and the allergic reactions. Rehydration using serotherapy, e.g. intravenous Ringer solution, Glucose solution, and Vitamins B1, B6, and B12, was applied in all patients, as mandatory for the toxin elimination since the binding of latrotoxin on cells can last several days. The combination of both calcithery and serotherapy is the most effective and rapid therapy



Graph 2. Monthly variation of the hospitalization days of the patients suffering from the spider bite.



Graph 3. Symptoms of the spider bites in the hospitalized patients.

(Rollard et al., 2015). None of the patients with severe symptoms required antivenom treatment, except oxygen therapy applied to only one patient, as a necessity concerning breathing difficulties. In adults and older children without cardiovascular disease, an instant improvement can occur, and the use of antivenom is rarely necessary. Antivenom is the only effective treatment for severe cases of latrodectism, and is recommended for those younger than 16 or older than 60 years of age, and for patients with underlying cardiovascular diseases, which commonly had hypertension and tachycardia after the spider bite (O'Malley et al., 1999). These target groups include rarely reported cases of death from spider bites (Clark et al., 1992; Maretić, 1983; Peterson, 2006; Timms and Gibbons, 1986). In Europe, fatal bites of *Latrodectus tredecimguttatus* are rare, although there have been reported deaths in Croatia (Dzelalija and Medic, 2003), Greece (Pneumatikos et al., 2003), Spain (Gómez and Vázquez, 2001), and Turkey (Cesaretli and Ozkan, 2011). Fortunately, the black widow spider bite is survivable if treated immediately, and the patients can fully recover. Nevertheless, it might happen a rapid loss of weight due to the psychic troubles of the patient (Rollard et al., 2015). By comparison, the *Loxosceles rufescens* bite causes milder symptoms. In severe Loxoscelism, skin necrosis requires skin grafts, and thrombocytopenia can cause hemorrhages. The treatment requires decreasing thrombosis using an aspirin a day, minimizing itching using antihistamines, and using corticosteroids and antibiotics to treat itching and infection of the bite location. In severe forms, a viscera cutaneous syndrome characterized by fever, hemolytic jaundice, and nephropathy requires considering the cardiac and renal parameters (Rollard et al., 2015; Sams et al., 2001).

The increased cases of the severe spider bites during summer due to high temperatures in Albania raise awareness and consider several precautions for the immediate treatment of the black widow venom. Precautions toward the human-spider contact at homes and agricultural fields include limiting the amount of cover available for spiders. Stored items should be closed, and clothes should be kept away from the contact with the floor. Since spiders are not aggressive and retreat from humans, turning on lights and making noise is helpful. Insecticides are beneficial, as they help concerning insects, which serve as spider prey, but not directly toward the spiders, which tend to hide where sprays do not reach. Clothes and shoes should be shaken out before being worn or manipulated. Gloves and long sleeves should be worn when working in the agricultural fields where the spider occurs (Sams et al., 2001; Wilson and King, 1990). After the bite of a venomous animal, including the black widow spider, before going directly to the hospital, the affected limb should usually be immobilized, disinfected, using ice cubes and elevation to minimize venom spread and inflammation, but not tied, cut, or sucked (Sams et al., 2001; Schaper et al., 2019; Wilson and King, 1990). The old myths of tying the limb above the bitten location, cutting

the bite location, and sucking the blood, are not helpful, as α -latrotoxin is highly neurotoxic and acts immediately after the first few minutes of the black spider bite.

3.6. Other spider bites of medical importance in Albania

The symptoms of latrodectism are mainly observed in the hospitalized case studies, but there are other spiders of medical importance present and identified in Albania, although there is no clear evidence of their significance from emergency medical doctors and patients. Considering the rare hospitalized cases in Albania from the brown recluse bites, which are painless and not severe ($n = 2$, 1.6%), they are mainly treated at home with the support of specialists and/or pharmacists. For example, I have been contacted by several patients or their families and have advised them to follow some instructions for home treatment (Fig. 1. F). There are few reported hospitalizations from the cytotoxic spider bites of *L. rufescens*, with atypical skin lesions through to necrosis usually on the limbs but also on the abdomen (Sulaj et al., 2015). Generally, hospitalized spider bite patients are being treated for latrodectism, and in only a few cases for loxoscelism. The other medically important spiders found in Albania, and also reported in Europe, include *S. paykulliana*, *Ch. punctorium*, *S. senoculata*, *E. kollari*, *D. crocata*, *N. umbratica*, *A. affinis*, *A. aquatica*, *Z. spinimana*, some agelenids, araneids, and gnaphosids, with bites similar to the instant pain like the wasp sting, and similar milder symptoms compared to black widow and the brown recluse bite (Cesaretli and Ozkan, 2011; Nentwig et al., 2013). In addition, from the discussion with the local community of the agricultural areas where bites have occurred, there are probably a higher number of spider bites, considering those cases which are treated at home, and as a result some cases, including even fatal ones, may not be reported in hospitals.

4. Conclusions

This retrospective study of 125 cases of spider bites in the Western Lowland in Albania revealed a higher venom severity at higher temperatures during the summer period. The longer recovery times, i.e. more than three days, from the black widow bites are probably related to the quantity and toxicity of the spider venom α -latrotoxin, and take into account different factors, such as the time of the year, time of the bite, bite location, bite number, the spider's motivation, the size of the spider, the size and age of the patient, and underlying health issues. Higher environmental temperatures caused by global warming may thus lead to higher black widow venom toxicity during the hot summer months until early autumn. In this study, the highest number of spider bites was in August, and summer generally witnessed the occurrence of all severe

systemic symptoms.

Credit author statement

The credits to this research work goes entirely to the only author, Blerina Vrenozi, who ensures that she has written by herself the entirely original work, from visualization, investigation, methodology, writing the draft and the whole manuscript, preparing the table, graphs and figures, literature review, and other data analyzes of these case studies from the spider bite envenomation.

Availability of data and materials

All data generated during this study will be available upon request.

Ethical statement

The study doesn't include experimentations with animal or humans. The data are collected anonymously for each patient, from the registers of the hospital during a decade between May 2009 and October 2018. This research work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki), Privacy and Confidentiality, where is protected the privacy of each patient and the data doesn't involve their identity or other personal information.

The data are original and not previously published in another journal. The authorship is given for each of the original Figures presented in the manuscript. These data are presented in the EUVEN2021 congress, and therefore the author has submitted this manuscript for publication in a dedicated Special Issue of *Toxicol: X* "EUVEN 2021: Venoms in Europe and beyond", with a full waiver of the article processing charges, regardless of the publication date.

An official request is made to the director of the hospital, Nevila Shuke, to have permission to these data. Author acknowledges her for permitting to study these data from the registers, and her master student Armela Shaba, who assisted during this process.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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