

Deranged Level of Liver and Renal Function Tests in Snake Bite Patients

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Abstract: Background: Snake venoms typically contain hemotoxic, nephrotoxic, and hepatotoxic components, resulting in systemic symptoms such as coagulopathy, compromised liver function, and acute renal failure.

Objective: To determine the frequency of abnormal liver function tests, and renal function tests, and their impact on clinical outcomes among patients presenting with snake bite.

Materials and Methods: This prospective cohort study was conducted at the Department of Medicine, National Poisoning Control Centre, Jinnah Postgraduate Medical Centre, Karachi, from 15th December 2025 to 30th April 2026 (No.F.2-81/2025-GENL/784/JPMC, dated: 13th December 2025). Renal dysfunction was assessed using KDIGO criteria, while abnormal liver function tests were defined as ALT >40 U/L, AST >40 U/L, or total bilirubin >1.2 mg/dL. Envenomation severity and final outcomes were documented during hospital stay.

Results: Among 98 snakebite patients, the median age was 33.0 years (IQR=25.0–42.0), 63 (64.3%) were males. Venomous bite was identified in 68 (69.4%) patients. Acute kidney injury (AKI) was identified in 19 (19.4%), abnormal liver function tests in 33 (33.7%), and combined renal and abnormal liver function tests in 14 (14.3%) patients. abnormal liver function tests was significantly associated with longer presentation time ($p<0.001$), venomous bite ($p<0.001$), swelling ($p=0.001$), vomiting ($p<0.001$), bleeding manifestations ($p=0.001$), oliguria ($p<0.001$), renal dysfunction ($p<0.001$), greater envenomation severity ($p<0.001$), longer hospital stay ($p<0.001$), and poorer outcome ($p<0.001$). Renal dysfunction was associated with longer presentation time ($p<0.001$), venomous bite in 19 (100%) vs 49 (62.0%) patients ($p=0.001$), swelling ($p=0.017$), vomiting ($p<0.001$), bleeding manifestations ($p<0.001$), oliguria ($p<0.001$), hepatic dysfunction ($p<0.001$), greater envenomation severity ($p<0.001$), longer hospital stay ($p<0.001$), and poorer outcome ($p<0.001$).

Conclusion: Liver, and renal dysfunction are frequent in admitted snakebite patients and are closely linked with delayed presentation, venomous bite, severe envenomation, and adverse hospital outcomes.

Keywords: Liver, Oliguria, Renal, Snakebite, Venomous.

INTRODUCTION

Snakebite-related envenomation is significant health issue in numerous tropical and subtropical regions continuing to result in considerable incidence of severe illnesses and fatalities [1, 2]. World Health Organization (WHO) reported that snakebite is an overlooked tropical disease that mostly affects people who live in rural or agricultural areas. About 5.8 million people get it each year, and rate of amputations is about three times higher. Snake bite can induce paralysis, cardiovascular issues, and renal failure [3]. The emergence of envenomation symptoms is affected by variables including snake species, venom composition, and volume of venom administered into organism. Snake venoms typically contain hemotoxic, nephrotoxic, and hepatotoxic components,

resulting in systemic symptoms such as coagulopathy, compromised liver function, and acute renal failure [4, 5].

Acute Kidney Injury (AKI) is well-known problem, especially when viper bites someone. Its pathogenesis encompasses various mechanisms, including direct nephrotoxic injury, intravascular hemolysis due to venom-induced red blood cell lysis, rhabdomyolysis-related myoglobinuria, and disseminated intravascular coagulation, which leads to extensive microvascular thrombosis and depletion of clotting factors, thereby exacerbating renal perfusion impairment [6, 7]. Liver impairment, although less extensively researched, constitutes a significant and potentially grave consequence. It is frequently marked by increased liver enzymes, jaundice, and hepatocellular injury [8, 9]. Nevertheless, information regarding hepatic impairment in snakebite victims is still scarce.

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Assessing kidney and liver function using specific biochemical tests is crucial for monitoring the systemic effects of venom exposure. In cases of envenomation, common lab results show higher levels of blood urea-nitrogen (BUN) and serum creatinine, as well as higher levels of liver enzymes including alanine aminotransferase (ALT) and aspartate aminotransferase (AST) [10, 11]. It is very important to quickly notice these changes so that treatment may be guided, such as fluid resuscitation, renal replacement therapy, and giving antivenom [12].

Regional and global studies indicate that acute kidney damage (AKI) occurs in 13–32% of snakebite patients, predominantly as a result of viper envenomation [13]. Conversely, hepatic dysfunction is not studied by the researcher when determining AKI in this population [14]. In contrast, some researchers have report no statistically significant variations in the signs of respiratory failure and coagulation problems [15].

Pakistan has a big problem with snake bites, but we still don't know enough about how the venom affects liver and kidney biochemistry. The majority of local research concentrate on hematological and neurological effects, whereas hepatic and renal damage frequently remains unacknowledged until severe organ failure occurs. The study specifically aims to assess abnormalities in renal and liver function tests in snakebite patients and to connect these laboratory findings with the severity of envenomation, length of hospital stay, and clinical outcomes. This study may be helpful in furnishing evidence-based insights that could facilitate timely diagnosis, appropriate care, and improved prognostic assessment of snakebite patients in Pakistan. This study was aimed to determine frequency of abnormal LFTs and RFTs, and their impact on clinical outcomes among patients presenting with snake bite at a tertiary care facility of Karachi, Pakistan.

MATERIALS AND METHODS

This prospective cohort study was conducted at the Department of Medicine Unit 1, Ward 5, National Poisoning Control Centre, Jinnah Postgraduate Medical Centre, Karachi, during 15th December 2025 to 30th April 2026, following approval from Institutional Ethical Committee (No.F.2-81/2025-GENL/784/JPMC, dated: 13th December 2025). A sample size of 98 was calculated using the WHO sample size calculator by taking the frequency of acute renal failure as 14.6% [16], with 95% confidence level, and 7% margin of error. Sample size calculation also performed considering the frequency

of hepatic dysfunction (3.84%) [17], at 95% confidence interval and 4% margin of error which came out to be 89. So, a higher sample size of 98 studied. Patients aged 15-60 years, and admitted with a history of snakebite were included. Patients were enrolled with their written informed consent. Patients with history of liver or kidney disease including chronic kidney disease, hepatitis, or cirrhosis (as per history or available medical records) were excluded. Patients or caregivers refusing to be part of this research were excluded. Patients with clinically identified non-venomous snakebites and those already receiving known nephrotoxic or hepatotoxic drugs were not enrolled.

At enrollment, demographic and clinical details including age, gender, time from snakebite to hospital presentation, relevant comorbidities, and presenting features were documented. Snakebite was categorized clinically as either dry bite or venomous bite. A dry bite was defined as a snakebite in which no venom entered the body and no clinical effects were observed beyond the local bite mark. The term “venomous snakebite” referred to an identifiable snakebite that was clinically proven envenomation with local tissue injury (e.g., swelling, blister formation, or necrosis), and/or systemic manifestations such as bleeding, problems in the blood-clotting processes, neurotoxicity, hypotension or shock, and the other recognized signs of snake poisoning. Also, the species of snake involved in the bite was considered where known. However, hepatic and renal function problems were excluded from the definition of envenomation and assessed as separate outcomes. Venous blood samples were obtained at admission for renal and liver function testing. Renal dysfunction was considered as incidence of AKI. The KDIGO criteria were used to evaluate AKI based on serum creatinine and urine output. AKI was defined by an increase in serum creatinine of ≥ 0.3 mg/dL within a 48-hour period and/or urine output of < 0.5 mL/kg/hour for six hours or longer. The serum creatinine value upon admission to the hospital was considered the baseline value, as the serum creatinine measurements of patients prior to admission were not reliably available for the seven days preceding the hospitalization. Patients were monitored for 24-72 hours, during which their serum creatinine and urine output values were gathered periodically for review [18]. Abnormal liver function tests were defined as either ALT > 40 U/L, or AST > 40 U/L, or total bilirubin > 1.2 mg/dL [19]. Liver and renal function tests were repeated after 48 hours to assess progression or improvement in organ dysfunction. Patients

remained under close clinical observation for 24 to 72 hours, and any worsening in hepatic or renal parameters during admission was documented. The severity of envenomation was classified on clinical and laboratory grounds. Mild envenomation was considered when the patient had only local pain and swelling without systemic signs. Moderate envenomation was defined as the presence of systemic manifestations such as vomiting or bleeding, without life-threatening complications. Severe envenomation was defined by the presence of life-threatening complications, including shock, respiratory failure, severe bleeding other clinical complications requiring intensive support management. Patients were followed throughout their hospital stay, and duration of hospitalization was recorded in days from admission until discharge or death. Patients were labeled as recovered when clinical signs resolved and liver and renal function showed improvements. Those with incidence of any major clinical adverse event during hospitalization such as death, bleeding ICU admission, need of mechanical ventilation or dialysis were classified as having a complicated outcome.

STATISTICAL ANALYSIS

Data analysis was performed using IBM-SPSS Statistics version 26. Quantitative variables including age, time from snakebite to presentation, serum creatinine, blood urea, ALT, AST, total bilirubin, and duration of hospital stay were summarized as mean and standard deviation (SD), or median with interquartile range (IQR). Qualitative variables including gender, type of bite, presence of acute kidney injury, hepatic dysfunction, severity of envenomation, and clinical outcome were presented as frequencies and percentages. For inferential analysis, the independent sample t-test was applied for comparison of normally distributed quantitative variables, while the Mann-Whitney U test was used where the distribution was not normal. Associations between categorical variables were assessed using the chi-square or fisher's exact

test. A p-value < 0.05 was taken as statistically significant.

RESULTS

In a total of 98 patients, the median age was 33.0 years (IQR=25.0-42.0), and 63 (64.3%) patients were male. The median time from snakebite to hospital presentation was 5.0 hours (3.0-8.0), while 61 (62.2%) patients presented within 6 hours of the bite. Venomous bite was identified in 68 (69.4%) patients, whereas 30 (30.6%) patients had dry bite. The lower limb was the most frequent site of bite, involving 64 (65.3%) patients. Local pain, and swelling were the most common presenting features, noted in 86 (87.8%), and 71 (72.4%) patients, respectively, followed by vomiting in 28 (28.6%), bleeding manifestations in 17 (17.3%), and oliguria in 14 (14.3%) patients. At admission, the median serum creatinine was 1.0 mg/dL (0.8-1.4), median blood urea was 35.0 mg/dL (26.0-48.0), median alanine transaminase was 43.0 U/L (28.0-71.0), median aspartate transaminase was 49.0 U/L (31.0-84.0), and median total bilirubin was 1.0 mg/dL (0.8-1.4). Overall, AKI was documented in 19 (19.4%) patients, abnormal liver function in 33 (33.7%), and both acute kidney injury and abnormal liver function in 14 (14.3%) patients.

The median time to presentation was significantly longer in patients with abnormal liver function ($p<0.001$). Venomous bite was significantly more frequent among patients with abnormal liver function (93.9% vs. 56.9%, $p<0.001$). Swelling ($p=0.001$), vomiting ($p<0.001$), bleeding manifestations ($p=0.001$), and oliguria ($p<0.001$) were significantly more frequent in patients with abnormal liver function. Renal dysfunction was present in 14 (42.4%) patients with hepatic dysfunction, compared with 5 (7.7%) patients without abnormal liver function ($p<0.001$). Abnormal liver function was associated with higher severity of envenomation ($p<0.001$), longer hospital stay ($p<0.001$), and poorer final outcome ($p<0.001$), and the details are given in Table 1.

Table 1. Comparison of Demographic, Clinical, and Outcome Characteristics according Abnormal Liver Function Test Status.

Variables	Abnormal Liver Function Present (n=33)	Abnormal Liver Function Absent (n=65)	P-value
Age (years), median (IQR)	35.0 (27.0-44.0)	31.0 (24.0-40.0)	0.109
Male gender, n(%)	22 (66.7%)	41 (63.1%)	0.732
Time from bite to presentation (hours), median (IQR)	7.0 (5.0-9.0)	4.0 (2.0-6.0)	* <0.001

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Venomous bite, n(%)		31 (93.9%)	37 (56.9%)	*<0.001
Bite on lower limb, n(%)		23 (69.7%)	41 (63.1%)	0.528
Local pain, n(%)		31 (93.9%)	55 (84.6%)	0.301
Swelling, n(%)		31 (93.9%)	40 (61.5%)	*0.001
Vomiting, n(%)		18 (54.5%)	10 (15.4%)	*<0.001
Bleeding manifestations, n(%)		12 (36.4%)	5 (7.7%)	*0.001
Oliguria, n(%)		12 (36.4%)	2 (3.1%)	*<0.001
Renal dysfunction, n(%)		14 (42.4%)	5 (7.7%)	*<0.001
Envenomation severity, n(%)	Mild	4 (12.1%)	35 (53.8%)	*<0.001
	Moderate	14 (42.4%)	23 (35.4%)	
	Severe	15 (45.5%)	7 (10.8%)	
Hospital stay (days), median (IQR)		5.0 (3.0–7.0)	2.0 (2.0–4.0)	*<0.001
Final outcome, n(%)	Recovered	16 (48.5%)	58 (89.2%)	*<0.001
	Complicated	12 (36.4%)	6 (9.2%)	
	Expired	5 (15.2%)	1 (1.5%)	

*Significant at $p<0.05$.

The median time from snakebite to hospital presentation was significantly longer among patients with renal dysfunction ($p<0.001$). Venomous bite was noted in all 19 (100%) patients with renal dysfunction compared with 49 (62.0%) patients without renal dysfunction ($p=0.001$). Swelling ($p=0.017$), vomiting ($p<0.001$), bleeding manifestations ($p<0.001$), and oliguria ($p<0.001$) were signifi-

cantly more frequent in the renal dysfunction patients. Abnormal liver function was also considerably more common among patients with renal dysfunction (73.7% vs. 24.1%, $p<0.001$). Renal dysfunction was found to have significant association with severe envenomation ($p<0.001$), prolonged hospital stay ($p<0.001$), and worse final outcome at discharge ($p<0.001$) (Table 2).

Table 2. Comparison of Demographic, Clinical, and Outcome Characteristics According to Renal Dysfunction.

Variables		Renal Dysfunction Present (n=19)	Renal Dysfunction Absent (n=79)	P-value
Age (years), median (IQR)		36.0 (28.0–45.0)	32.0 (24.0–41.0)	0.188
Male gender, n(%)		13 (68.4%)	50 (63.3%)	0.676
Time from bite to presentation (hours), median (IQR)		8.0 (6.0–11.0)	4.0 (3.0–7.0)	*<0.001
Venomous bite, n(%)		19 (100%)	49 (62.0%)	*0.001
Bite on lower limb, n(%)		14 (73.7%)	50 (63.3%)	0.394
Local pain, n(%)		18 (94.7%)	68 (86.1%)	0.442
Swelling, n(%)		18 (94.7%)	53 (67.1%)	*0.017
Vomiting, n(%)		12 (63.2%)	16 (20.3%)	*<0.001
Bleeding manifestations, n(%)		10 (52.6%)	7 (8.9%)	*<0.001
Oliguria, n(%)		14 (73.7%)	-	*<0.001
Abnormal liver function, n(%)		14 (73.7%)	19 (24.1%)	*<0.001
Envenomation severity, n(%)	Mild	-	39 (49.4%)	*<0.001
	Moderate	4 (21.1%)	33 (41.8%)	
	Severe	15 (78.9%)	7 (8.9%)	
Hospital stay (days), median (IQR)		6.0 (5.0–8.0)	3.0 (2.0–4.0)	*<0.001
Final outcome, n(%)	Recovered	5 (26.3%)	69 (87.3%)	*<0.001
	Complicated	10 (52.6%)	8 (10.1%)	
	Expired	4 (21.1%)	2 (2.5%)	

*Significant at $p<0.05$.

The median time to presentation was significantly longer among the combined renal and abnormal liver function patients ($p<0.001$). All 14 (100%) patients with combined abnormal liver function and renal dysfunction had venomous bites compared with 54 (64.3%) of those without combined dysfunction ($p=0.006$). Combined abnormal

liver function and renal dysfunction was significantly more frequent among patients presenting with swelling ($p=0.014$), vomiting ($p<0.001$), bleeding manifestations ($p<0.001$), oliguria ($p<0.001$), severe envenomation ($p<0.001$), prolonged hospitalization ($p<0.001$), and poorer final outcome ($p<0.001$) (Table 3).

Table 3. Comparison of Demographic, Clinical, and Outcome Characteristics according to Combined Renal Dysfunction and Abnormal Liver Function.

Variables		Both Renal Dysfunction and Abnormal Liver Function Present (n=14)	Both Renal Dysfunction and Abnormal Liver Function Absent (n=84)	p-value
Age (years), median (IQR)		37.0 (29.0–46.0)	32.0 (24.0–41.0)	0.175
Male gender, n(%)		10 (71.4%)	53 (63.1%)	0.548
Time from bite to presentation (hours), median (IQR)		8.5 (6.0–11.0)	4.0 (3.0–7.0)	* <0.001
Venomous bite, n(%)		14 (100%)	54 (64.3%)	*0.006
Bite on lower limb, n(%)		10 (71.4%)	54 (64.3%)	0.602
Local pain, n(%)		14 (100%)	72 (85.7%)	0.206
Swelling, n(%)		14 (100%)	57 (67.9%)	0.014
Vomiting, n(%)		10 (71.4%)	18 (21.4%)	* <0.001
Bleeding manifestations, n(%)		10 (71.4%)	7 (8.3%)	* <0.001
Oliguria, n(%)		12 (85.7%)	2 (2.4%)	* <0.001
Severe envenomation, n(%)		12 (85.7%)	10 (11.9%)	* <0.001
Hospital stay (days), median (IQR)		7.0 (5.0–8.0)	3.0 (2.0–4.0)	* <0.001
Final outcome, n(%)	Recovered	-	74 (88.1%)	* <0.001
	Complicated	10 (71.4%)	8 (9.5%)	
	Expired	4 (28.6%)	2 (2.4%)	

*Significant at $p<0.05$.

Increase in the severity of envenomation was significantly associated with Among 39 patients with mild envenomation, none had renal dysfunction, 4 (10.3%) had hepatic dysfunction, and none had combined renal and abnormal liver function. In 37 patients with moderate envenomation, renal dysfunction was observed in 4 (10.8%), abnormal liver function in 14 (37.8%), and combined dysfunction in 2 (5.4%). Among 22 patients with severe envenomation, 15 (68.2%) had renal dysfunction, 15 (68.2%) had abnormal liver function, and 12 (54.5%) had both renal dysfunction and abnormal liver function ($p<0.001$ for all). Clinical outcome also worsened with increasing severity. Recovery was noted in 38 (97.4%) patients with mild envenomation, 30 (81.1%) with moderate envenomation, and 6 (27.3%) with severe envenomation, whereas mortality occurred only in severe envenomation, affecting 6 (27.3%) patients.

DISCUSSION

This study showed that derangement of liver, and renal function was common among hospitalized snakebite patients and clustered around markers of severe envenomation. Nearly one fifth of patients developed acute kidney injury, one third abnormal liver function tests, and a smaller but clinically important subgroup developed both. These findings seem important because snakebite remains a major neglected tropical emergency worldwide with 1.8 to 2.7 million envenomings each year, and venomous bites can lead to bleeding disorders, irreversible kidney failure, and other preventable severe outcomes when timely treatment is delayed.

The frequency of AKI in the present study was 19.4% which falls within the range reported in recent literature and is lower than cohorts selected specifically for nephrotoxic or hemotoxic presentations. A study by Push-

palatha and colleagues found acute kidney injury in 20 of 68 snakebite patients, giving a rate of 29.4% [14]. A recent review on poisoning and envenomation induced acute kidney injury also stated that kidney injury after snakebite is not uncommon, with reported prevalence up to 32% [20]. The lower rate in the present study may be explained by inclusion of all admitted snakebite patients rather than only venomous or kidney focused cases, along with the presence of 30.6% dry bites in the cohort. In contrast, an Indian study reported 44.5% had Stage 1 AKI and 30.3% had Stage 3 AKI [21].

Abnormal liver function tests were documented in 33.7% of patients in the present study. In a Nigerian study, Longwap and colleagues showed significant rises in AST, ALT, and GGT among *Echis ocellatus* bitten individuals compared with non-venomous bites supporting the view that hepatic biomarker derangement is a genuine systemic effect of venom exposure rather than a coincidental laboratory finding [22]. These observations emphasize the clinically meaningful hepatic involvement in snake bite patients.

A major finding of the present study was the strong association between delayed presentation and both abnormal liver function tests, and renal dysfunction. Wang and colleagues noted that presentation beyond 6 hours after the bite emerged as a risk factor in patients with more severe systemic involvement [15]. These findings also fit current WHO guidance that early access to effective antivenom is central to preventing serious morbidity and mortality [23]. Delay in presentation may closely be tied to progression from local signs to multi organ toxicity, and settings such as Karachi where transport delays, first contact outside hospital care, and uncertainty about the species are common, rapid triage and early serial laboratory monitoring can change the course before organ injury becomes established.

The relationship between venomous bite and organ dysfunction was also very strong in this study. WHO notes that venomous snakebites can cause fatal haemorrhage, irreversible kidney failure, and severe tissue injury while current clinical guidance emphasizes ongoing observation because some patients who initially appear stable may later progress to systemic toxicity [23,24]. The distinction between venomous and dry bites is not merely descriptive as it may identify a subgroup of patients in whom laboratory deterioration is much more likely and in whom observation should be more intensive [25, 26].

LIMITATIONS

Several limitations should be considered. This was a single study from a tertiary referral poison centre so the results may over represent more symptomatic patients and may not fully reflect the spectrum of community managed or early discharged snakebites. The study did not record snake species and antivenom treatment details such as its administration and timings which could have impact of renal and liver function. Regression analysis was not performed because of limited number of events resulting in overfitting of the model and unreliable findings. The sample size might have been adequate for the primary descriptive objective but modest for more detailed subgroup modelling.

CONCLUSION

Liver, and renal dysfunction are frequent in admitted snakebite patients and are closely linked with delayed presentation, venomous bite, severe envenomation, and adverse hospital outcomes. The subgroup with combined abnormal liver function and renal dysfunction carried the greatest clinical burden. These findings support early referral, prompt antivenom based management where indicated, and routine serial liver and renal assessment in patients with suspected systemic envenomation.

ABBREVIATIONS

AKI: Acute kidney injury.

ALT: Alanine aminotransferase.

AST: Aspartate aminotransferase.

BUN: Blood urea-nitrogen.

KDIGO: Kidney Disease: Improving Global Outcomes.

LFT: Liver function test.

RFT: Renal function test.

WHO: World Health Organization.

AUTHORS' CONTRIBUTION

Kumari Hina: Conceptualization, study design, methodology, data analysis and interpretation, drafting the manuscript, final approval of the version to be published, and accountability for the work.

Muhammad Inam Khan: Study design, critical review and revision of the manuscript, final approval of the version to be published, and accountability for the work.

Muhammad Omer Sultan, Muhammad Ghufuran, Anjili Tara, and Mahnoor Jamal: Methodology, data analysis and interpretation, drafting the manuscript, final approval of the version to be published, and accountability for the work.

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Declared none.

ETHICAL DECLARATIONS

Data Availability

The data supporting the findings of this study are included in the article. Further inquiries regarding the data may be directed to the corresponding author, subject to applicable ethical, privacy, and institutional requirements.

Ethical Approval

This prospective cohort study was conducted at the Department of Medicine Unit 1, Ward 5, National Poisoning Control Centre, Jinnah Postgraduate Medical Centre, Karachi, Pakistan, from 15 December 2025 to 30 April 2026. The study was conducted in accordance with applicable ethical standards and following approval from the Institutional Ethical Committee (No. F.2-81/2025-GENL/784/JPMC, dated: 13th December 2025).

Consent to Participate

Written informed consent was obtained from all participants before their enrollment in the study.

Consent for Publication

Written informed consent for publication was obtained from participants whose individual information or other potentially identifiable material is included in this article, where applicable.

Declaration of Competing Interest

The authors declare that they have no financial or non-financial competing interests that could have influenced the work reported in this study.

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Use of AI-Assisted Technology

For the limited purpose of improving the language, gram-

mar, readability, and formatting of the manuscript, the authors used Google Gemini, an AI-assisted language tool. The authors reviewed, edited, and approved all AI-assisted output and take full responsibility for the accuracy, integrity, originality, and final content of the manuscript. AI was not used for data collection, data analysis, interpretation of the results, or formulation of the scientific conclusions.

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