



Clinic-based prevalence and husbandry-associated factors of radiographically confirmed urolithiasis among pet tortoises in Jakarta

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ABSTRACT: Bladder stone is one of the most frequently encountered urological disorders in land tortoises kept as pets, closely related to husbandry practices. This retrospective clinic-based study estimated the prevalence of radiographically confirmed bladder stones and explored associated husbandry factors in pet tortoises examined at an exotic animal clinic in Jakarta. Medical records of 42 land tortoises examined between October 4 and December 1, 2025, were reviewed. The extracted data included species, diet, water access, housing system, clinical findings, and radiographic results. Seven tortoises were diagnosed with bladder stones, giving a clinic-based prevalence of 16.7% (7/42). All affected tortoises were *Centrochelys sulcata*. In univariable exact analyses, species was associated with bladder stone occurrence, whereas diet, water access, and housing showed uncertain associations because of small subgroup sizes and missing data. These findings suggest that *C. sulcata* presented to exotic animal clinics may warrant routine radiographic screening, but larger multicenter studies are needed to clarify the role of husbandry factors.

Keywords:

urolithiasis, pet tortoises, clinic-based prevalence, husbandry management, *Centrochelys sulcata*

■ INTRODUCTION

Urolithiasis is a disorder that affects tortoises, especially captive terrestrial species. In chelonians, stones are associated with urate and mineral precipitation (Takami *et al.* 2021). As uricotelic animals, tortoises excrete waste mainly as poorly soluble uric acid, which can precipitate when the urinary concentration increases (Mori *et al.* 2023). Hydration is central because reduced water intake and renal water conservation concentrate urinary solutes; inadequate water provision, soaking, and dietary imbalance may increase the risk of urolithiasis (Zapf *et al.* 2023).

Although urolithiasis has been documented in tortoises, epidemiological data are limited and hospital-based. In Japan, a survey reported 4–5% of tortoises (Takami *et al.* 2021). Prevalence may vary with species and husbandry. African spurred tortoises are kept in captive environments that differ from their ecological requirements (Keller *et al.* 2015). Confinement, sunlight restriction, limited water, and an inappropriate diet may increase the risk of urolithiasis in pet tortoises (Flanagan 2015).

In Indonesia, data on bladder stones in tortoises are scarce, limiting recommendations because species and husbandry vary by region. Cases have documented stones in sulcata tortoises (Sari 2020). No study has documented the prevalence and risk factors in land tortoises examined at veterinary clinics in Indonesia, hindering guidelines because husbandry practices and species composition may differ from

referenced countries. This study estimated urolithiasis prevalence and explored species- and husbandry-associated factors among tortoises from a Jakarta clinic.

■ MATERIALS AND METHODS

This retrospective cross-sectional study was based on the medical records of pet land-tortoises examined at the Aves Animal Clinic, Jakarta. A total of 42 tortoises of various species were included in this study. Medical records of 42 land tortoises examined between October 4 and December 1, 2025, were reviewed. The extracted data included species, diet, water access, housing system, clinical findings, and radiographic results. The diagnosis of bladder stones was established based on a combination of clinical findings and radiographically confirmed bladder stone-like mineral opacity. Data were analyzed using Fisher's exact test with a one-sided calculation of odds ratio (OR) and prevalence ratio (PR) to determine the prevalence and identify factors associated with bladder stone occurrence. The Haldane–Anscombe correction was applied when zero cells were encountered.

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Table 1 Statistical analysis of risk factors associated with bladder stone in land tortoises (n=42) at Aves Jakarta Veterinary Clinic

Factor	Exposed Group	Unexposed Group	OR / PR	p-value
Species (Sulcata vs Non-Sulcata)	7/26 (26.9%)	0/16 (0.0%)	PR = 8.9 ^a	0.024*
Diet (NA/NACF vs CF)	7/35 (20.0%)	0/2 (0.0%)	OR = 1.3 ^a	0.653
Water access (Limited vs Adequate)	5/9 (55.6%)	2/10 (20.0%)	OR = 5.00	0.130
Housing (Indoors vs Outdoors/Both)	5/9 (55.6%)	2/16 (12.5%)	OR = 8.75	0.034*

Note: NA= Natural/Whole Food; CF= Commercial Formula; NACF= Mixed Diet (NA+CF); In= Indoors; Out= Outdoors; OR= Odds Ratio; PR= Prevalence Ratio; ^aHaldane–Anscombe correction applied (zero cell present); *p<0.05 significant.

■ RESULTS AND DISCUSSION

The prevalence of bladder stones in land tortoises examined at the Aves Jakarta Veterinary Clinic during the study period was 16.6% (7/42) (Table 1). All seven positive cases were identified in *Centrochelys sulcata*, while no positive cases were detected in any non-sulcata species (*Geochelone pardalis*, *Aldabrachelys gigantea*, *Testudo graeca*, *Chelonoidis carbonaria*, *Testudo hermanni*). All seven positive cases came from tortoises maintained on high-protein or fruit-based diets (NA or NACF). Most positive cases occurred in tortoises with limited water access (drinking water bowl only or no access) and housed exclusively indoors; however, positive cases were also recorded in tortoises categorized as having adequate water access and outdoor/both housing. No positive cases were found among tortoises receiving a commercial formula diet only (CF), those with soaking pool access (PW or DWPW), or those housed partially or fully outdoors.

Statistical analysis revealed that sulcata had a significantly higher risk of bladder stones (PR = 8.9; p = 0.024), consistent with reports that *C. sulcata* carries a greater predisposition to urolithiasis due to physiological traits, native dry habitat, and frequent mismatches between captive husbandry and ecological requirements (Djazuli *et al.* 2023, Moeller *et al.* 2025). Indoor housing was also significantly associated with bladder stone occurrence (OR = 8.75; p = 0.034), as reduced sun exposure, lower ambient temperatures, and restricted mobility decrease overall water intake and elevate urinary uric acid concentration (Ardjima *et al.* 2020, Hernandez *et al.* 2020). Limited water access (OR = 5.00; p = 0.130) and diet (OR = 1.3; p = 0.653) did not reach statistical significance, likely due to small subgroup sizes and limited reference group numbers, respectively. Sex was excluded due to high proportions of unknown data.

Mechanistically, when fluid intake is insufficient, the urinary bladder reabsorbs water from urine, concentrating uric acid toward supersaturation and promoting crystal precipitation and mineral aggregation (Mori *et al.* 2023, Zapf

et al. 2023). This links all three identified risk factors — high-protein or fruit-based diet, limited water access, and indoor housing — to stone formation, with their concurrent presence in every positive case suggesting a compounding effect.

■ CONCLUSION

Bladder stones were identified in 16.7% of the tortoises, with all positive cases in *Centrochelys sulcata*. This species was associated with stone occurrence, whereas links with indoor housing, water access, and diet remained uncertain because of limited data and confounding. Findings support radiographic screening in at-risk *C. sulcata* and multicenter studies to clarify husbandry-related risk factors.

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