

Systematic Review

Reported Prevalence of Acute Kidney Injury in Severe Malaria: A Systematic Review and Meta-Analysis

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Simple Summary

Severe malaria can damage several organs, including the kidneys. Sudden kidney damage is dangerous because it can worsen the course of the disease and increase the risk of death, but its frequency has been difficult to estimate because studies have used different definitions. We searched six scientific databases for studies published from January 2000 to March 2026 and combined data from 11 studies including 3113 patients with severe malaria. Sudden kidney damage was reported in about 40% of children and 33% of adults or mostly adult patient groups. Studies in children published more recently tended to report higher values, probably because newer definitions detect milder kidney damage that older definitions missed. These findings suggest that kidney assessment should be part of the care of patients with severe malaria whenever laboratory testing is available. Better and more consistent reporting in future studies may help hospitals identify kidney damage earlier and improve patient management.

Abstract

Severe malaria remains a global public health challenge, and acute kidney injury (AKI) is a frequent and potentially lethal complication. Variability in diagnostic criteria has limited estimation of the reported burden, particularly in pediatric populations and endemic settings. This study synthesized evidence on the reported prevalence of AKI in patients with severe malaria, stratified by age group, geographic region, *Plasmodium* species, and diagnostic definition. A systematic review and meta-analysis was conducted following PRISMA guidelines. Six electronic databases (PubMed/MEDLINE, Scopus, Web of Science, EMBASE, LILACS, and SciELO) were searched from 1 January 2000 to 30 March 2026, complemented by manual reference screening. Observational studies in patients with severe malaria that reported AKI prevalence according to defined criteria were included. A random-effects meta-analysis of proportions was performed with subgroup analyses and meta-regression. Eleven studies including 3113 patients were included. The pooled reported prevalence of AKI was 39.6% (95% CI: 29.9–49.6%) in children and 33.4% (95% CI: 13.3–57.0%) in adult or adult-classified cohorts, with substantial heterogeneity ($I^2 > 95\%$). Reported AKI prevalence increased across publication years in pediatric studies ($\rho = 0.880$, $p < 0.01$), a pattern likely reflecting greater diagnostic sensitivity and clinical awareness after adoption of Kidney Disease: Improving Global Outcomes (KDIGO) criteria rather than a proven biological increase. African studies reported higher prevalences (43.5%) than Asian studies (18.3%). AKI is frequently reported in severe malaria, but pooled estimates should be interpreted cautiously because heterogeneity was substantial and eligible studies



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were geographically concentrated. These findings support standardized renal assessment in severe malaria management and harmonized AKI definitions in future studies.

Keywords: malaria; acute kidney injury; prevalence; *Plasmodium falciparum*; systematic review; meta-analysis; KDIGO; child; Africa South of the Sahara

1. Introduction

Malaria remains one of the most pressing global public health challenges. According to the World Health Organization (WHO) World Malaria Report 2024, an estimated 263 million cases and 597,000 deaths occurred due to malaria in 2023, with most cases and deaths concentrated in the African region [1]. Severe malaria, defined as *Plasmodium* infection complicated by clinical or laboratory evidence of vital organ dysfunction, represents a medical emergency with high mortality when not promptly treated [2]. Among its most significant complications is acute kidney injury (AKI), which manifests as deterioration of renal function, frequently associated with oliguria, metabolic acidosis, and, in severe cases, requirement for renal replacement therapy [3].

Malaria-associated AKI is biologically plausible through several overlapping pathways. Sequestration of parasitized erythrocytes and endothelial activation may impair renal microcirculation, while intravascular hemolysis releases cell-free hemoglobin and heme, promoting oxidative stress, nitric oxide scavenging, tubular injury, and inflammatory amplification [3–6]. Lipid peroxidation products, including 4-hydroxynonenal (4-HNE), have been described in malaria and in experimental malaria-related renal injury; however, their specific contribution to human severe malaria-associated AKI remains insufficiently defined [7]. These mechanisms provide a biological rationale for why sensitive AKI definitions may detect clinically meaningful renal injury before the creatinine threshold used in traditional severe-malaria definitions is reached.

In recent years, there has been a significant increase in the recognition of AKI as a frequent and serious complication of severe malaria, particularly with the adoption of more sensitive diagnostic criteria established by the Kidney Disease: Improving Global Outcomes (KDIGO) group. Recent studies demonstrate that the prevalence of AKI in patients with severe malaria ranges between 24% and 59% when KDIGO criteria are applied, in contrast to the traditional WHO definition that establishes a creatinine threshold of >3 mg/dL, which significantly underestimates this complication, especially in pediatric populations [8,9]. For instance, in a Ugandan study, only 0.8% of children with severe malaria presented with creatinine > 3 mg/dL, while 35% met KDIGO criteria for AKI [8].

Considerable heterogeneity exists in the literature regarding the definition, diagnostic methodology, and reporting of AKI in severe malaria. Diagnostic criteria vary widely across studies, from non-standardized definitions to RIFLE, AKIN, or KDIGO criteria, which hampers direct comparisons and evidence synthesis [10,11]. Additionally, confusion persists in terminology across various studies, with inconsistent methodological approaches for measuring AKI burden [12]. Some research also reports differing rates according to *Plasmodium* species, with *P. falciparum* more frequently associated with severe AKI than *P. vivax* [13]. However, this distinction is not always adequately addressed in the literature.

Therefore, the primary objective of this systematic review with meta-analysis was to synthesize the available evidence on the reported prevalence of AKI in patients with severe malaria, stratifying results by age group, geographic region, *Plasmodium* species, and diagnostic definition employed. Because diagnostic thresholds and baseline creatinine assumptions differ across studies, this synthesis was designed to characterize the

reported burden and sources of heterogeneity rather than to produce a definitive global prevalence estimate.

2. Materials and Methods

2.1. Study Design

A systematic review with meta-analysis followed the PRISMA 2020 guidelines [14] adapted for prevalence studies [15,16] (Supplementary Material S1). Given that the objective of this study was to estimate prevalence of AKI in a defined clinical condition, we followed the guidelines proposed for epidemiological systematic reviews focused on quantifiable outcomes.

The protocol of this systematic review was not prospectively registered in PROSPERO or another public registry; therefore, no registration number is available. The review was conducted and reported according to PRISMA 2020 guidance. The search strategy, eligibility criteria, study selection process, data extraction procedures, risk-of-bias assessment, statistical synthesis methods, Figure 1, and Supplementary Material S1 document the methodological process used to identify, categorize, analyze, and report aggregated evidence on acute kidney injury in severe malaria.

2.2. Search Strategy

The literature search was conducted in six electronic databases: PubMed/MEDLINE, Scopus, Web of Science, EMBASE, LILACS, and SciELO. The selection of the first four was based on methodological recommendations from the Cochrane handbook for systematic reviews [17], due to their broad thematic coverage and rigor in indexing international scientific literature. To complement this coverage and ensure adequate representation of regional scientific production, especially from Latin America and the Caribbean, LILACS and SciELO were also included as key sources to capture relevant studies published in local contexts or in languages other than English.

The search strategy combined controlled vocabulary and keywords related to malaria and acute kidney injury. Briefly, the core Boolean structure was: (malaria OR *Plasmodium* OR “falciparum malaria” OR “vivax malaria”) AND (“acute kidney injury” OR AKI OR “acute renal failure” OR “renal failure, acute” OR “injuria renal aguda” OR IRA), adapted to the syntax of each database. The search covered from 1 January 2000 to 30 March 2026, without language restriction. The complete database-specific strategy, with all terms and filters applied, is presented in Supplementary Material S1.

2.3. Selection Criteria

Observational studies, both cohort and cross-sectional, that reported prevalence data of acute kidney injury (AKI) in patients with severe malaria, according to clinical definitions of the World Health Organization (WHO) or their operational equivalents [18,19], were included. Studies in pediatric, adult, or mixed populations were accepted, provided they distinguished severe malaria cases. Studies needed to have a confirmed diagnosis of malaria by microscopy, rapid diagnostic test (RDT), or PCR [20–22], and define AKI using recognized criteria such as KDIGO, AKIN, RIFLE, pRIFLE, or absolute creatinine parameters [23–25]. Publications in any language with available full text and published between 1 January 2000 and 30 March 2026 were eligible.

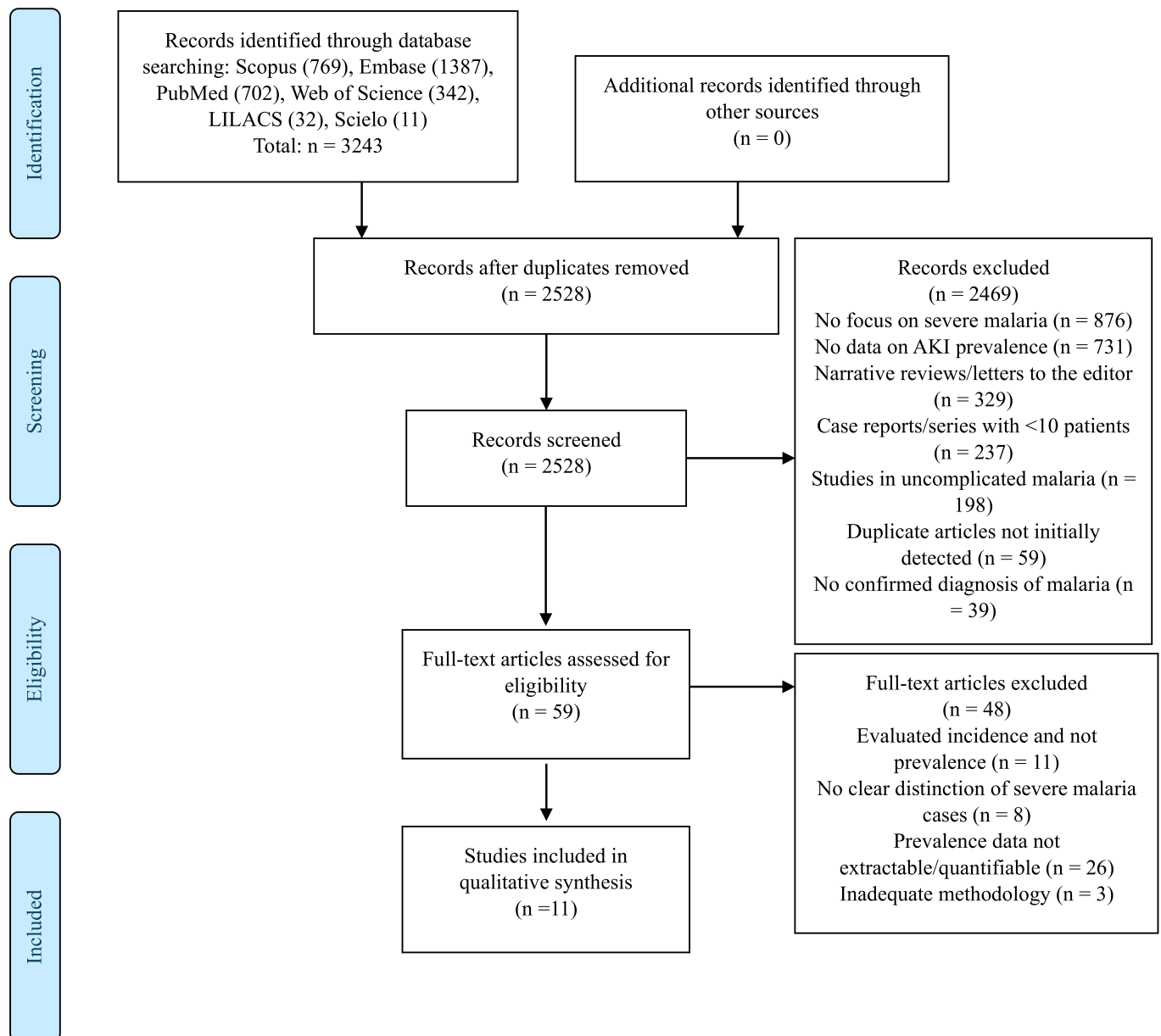


Figure 1. Flowchart of Study Selection.

Studies that did not specify or did not allow distinction of severe malaria cases, those that included only outpatients or patients with uncomplicated malaria, and studies without an explicit definition of AKI or without quantifiable prevalence data were excluded. Letters to the editor, comments, single case studies, case series with fewer than 10 patients, previous systematic reviews, and studies with an exclusively bibliometric or methodological focus were also excluded.

2.4. Study Selection Process

Search results were imported into the Rayyan platform for reference management and automatic duplicate removal. Subsequently, four independent reviewers blindly examined the titles and abstracts of all identified records. Studies that met the inclusion criteria underwent full-text evaluation to confirm their eligibility. Discrepancies between reviewers were resolved through discussion, and in case of persistent disagreement, a third evaluator was consulted.

During the process, the reasons for exclusion for each study in the full-text phase were carefully documented to ensure transparency and reproducibility. A PRISMA flow diagram was constructed to illustrate the selection process, including the number of records identified, selected, excluded, and finally included in the analysis.

2.5. Data Extraction

Data from selected studies were independently extracted by four researchers using a standardized template designed in Microsoft Excel 2023. The information collected included: first author, year of publication, country or geographic region, study design, sample size, population characteristics (age, sex, inclusion criteria), malaria diagnostic method, AKI definition method (KDIGO, RIFLE, etc.), and reported values of AKI prevalence, including their respective confidence intervals when available.

A third reviewer verified each extraction, and in case of discrepancies, the original text was accessed again for validation. Additional relevant data for subgroup analyses were also extracted, such as *Plasmodium* species, geographic region, hospital type (urban/rural), and timing of renal function assessment (at admission or during hospitalization).

2.6. Risk of Bias Assessment

The risk of bias assessment was performed independently by four reviewers for all studies included in this review. The tool proposed by Munn et al. [15] for prevalence studies was used due to its relevance in evaluating the methodological quality of this type of research and its wide recognition in the field of systematic reviews.

This instrument considers ten essential criteria in conducting prevalence studies, such as the representativeness of the sample in relation to the target population, the quality of the sampling frame, the method of participant selection (random or not), the minimization of biases related to non-response, obtaining information directly from subjects, clear and acceptable case definition, reliability and validity of the instrument used, consistency in data collection, suitability of the considered prevalence period, and adequacy of the denominator used.

Each of the ten items was scored as 1 when the criterion was adequately fulfilled and 0 when it was not fulfilled or insufficiently reported. Total scores therefore ranged from 0 to 10. Studies were classified as high quality/low risk of bias when they scored 8–10 points, moderate–high quality with 7 points, moderate quality with 5–6 points, and low quality/high risk of bias with ≤ 4 points. No study was excluded on the basis of quality score; the assessment was used to inform interpretation of the pooled estimates and heterogeneity.

2.7. Statistical Analysis

To estimate the pooled prevalence of acute kidney injury, we performed meta-analyses of proportions using the meta package in R version 4.3.0. We applied the Freeman–Tukey double arcsine transformation to stabilize the variance of proportions, especially important when prevalences approach extreme values (0 or 1). Individual confidence intervals were calculated using the Wilson Score method, which provides better coverage than standard asymptotic methods for proportions. Given the high level of heterogeneity anticipated between studies, we used random-effects models exclusively with the DerSimonian–Laird (DL) between-study variance estimator. Heterogeneity was assessed using Higgins' I^2 statistic, which represents the percentage of total variability attributable to differences between studies rather than chance, and Cochran's Q statistic with its corresponding p -value.

Subsequently, we performed meta-regression analyses using the metafor package to explore the sources of heterogeneity between studies. The variables explored included

year of publication (continuous), age group (adults vs. children as reference), sample size (continuous, per 100 patients), AKI diagnostic criteria (standard, either KDIGO/AKIN, vs. non-standard as reference), and geographic region (Africa and Asia vs. Europe as reference). We initially evaluated each variable in univariate mixed-effects models, followed by a multivariate model that included the most promising variables ($p < 0.20$ in univariate analysis). The amount of between-study variance explained by each model was calculated as $R^2 = (\tau^2_{\text{null}} - \tau^2_{\text{model}}) / \tau^2_{\text{null}} \times 100\%$. We used the restricted maximum likelihood (REML) estimation method for all meta-regression models.

Finally, we evaluated temporal trends using Spearman correlations between the year of publication and the prevalence of AKI, calculated for the complete set of studies and stratified by age group. Complementarily, we performed univariate meta-regression with year of publication as a continuous variable to quantify the temporal change on the logit scale. We generated scatter plots with separate trend lines by age group to visualize the temporal patterns, using simple linear regression with 95% confidence intervals. The size of the points in the visualizations reflects each study's sample size to facilitate interpretation of the relative weight of each contribution. All analyses were performed in R version 4.3.0, and statistical significance was considered with $p < 0.05$, reporting marginal p -values (0.05–0.10) when clinically relevant.

3. Results

3.1. Article Selection Process

In this systematic review on acute kidney injury in patients with severe malaria, 3243 records were identified through six databases (Scopus, Embase, PubMed, Web of Science, LILACS, and SciELO). After removing 715 duplicates, 2528 records were screened, excluding 2469. Of the 59 articles evaluated in full text, 48 were excluded due to their focus on incidence rather than prevalence ($n = 11$), unclear distinction between severe malaria cases ($n = 8$), non-extractable data ($n = 26$), or inadequate methodology ($n = 3$). Finally, 11 studies met all the inclusion criteria and were incorporated into both the qualitative synthesis and the meta-analysis [4,8–10,13,26–31] (see Figure 1).

3.2. Characteristics of Selected Studies

The systematic search identified 11 studies that met the inclusion criteria for evaluating the reported prevalence of AKI in severe malaria, encompassing a total of 3113 patients (see Supplementary Material S2). Although the search covered literature through 30 March 2026, the eligible studies were published between 2014 and 2023; therefore, all publication-year analyses refer to the 2014–2023 range of included studies. Geographic representation was concentrated in sub-Saharan Africa ($n = 5$) [8,9,26–28], followed by Asia ($n = 4$) [4,13,29,30] and Europe ($n = 2$) [10,31]. Most studies were prospective observational studies ($n = 8$) [4,8,9,26,27,29–31], followed by retrospective cohort studies ($n = 2$) [10,13] and one prospective cross-sectional study ($n = 1$) [28].

The main characteristics of the included studies are summarized in Table 1.

The included populations consisted of six pediatric studies (2 months to 14 years) [8,9,26–29] and five adult or adult-classified cohorts [4,10,13,30,31]. Most studies focused on *P. falciparum* infections [8–10,26,27,29–31]; one included *P. vivax*, *P. falciparum*, and mixed infections [13], one exclusively evaluated patients with *P. knowlesi* malaria [4], and one did not specify the parasitic species [28]. Malaria confirmation was performed mainly by microscopy ($n = 9$) [4,8,9,13,26–30], with additional use of HRP2/pLDH rapid diagnostic tests ($n = 4$) [8,10,27,29], QBC ($n = 2$) [10,31], PfHRP2 quantification by ELISA ($n = 1$) [30], or PCR in selected studies.

Table 1. Summary characteristics of included studies.

Study (Country)	Population/Age Range	<i>Plasmodium</i> Species	AKI Definition	AKI Cases/Total (%)	Quality Score
Saravu 2014 (India) [13]	Adults (≥ 18 years)	<i>P. vivax</i> , <i>P. falciparum</i> , mixed infection	KDIGO	147/824 (17.8)	5
Koopmans 2015 (Netherlands) [10]	Adult-classified imported-malaria cohort; ages reported up to 78 years	<i>P. falciparum</i>	KDIGO	23/61 (37.7)	5
Prasad 2016 (India) [29]	Children 2–14 years	<i>P. falciparum</i>	pRIFLE	31/156 (19.9)	7
van Wolfswinkel 2016 (Netherlands) [31]	Adult imported-malaria cohort; median ages 43–46 years	<i>P. falciparum</i>	KDIGO	6/39 (15.4)	5
Barber 2018 (Malaysia) [4]	Hospitalized patients ≥ 12 years; severe cases median 55 years	<i>P. knowlesi</i>	KDIGO	42/48 (87.5)	8
Sriboonvorakul 2018 (Bangladesh) [30]	Adults with severe malaria	<i>P. falciparum</i>	KDIGO	13/90 (14.4)	5
Conroy 2019 (Uganda) [8]	Children 18 months–12 years	<i>P. falciparum</i>	Absolute creatinine threshold	229/652 (35.1)	8
Hickson 2019 (Uganda) [26]	Children 1.5–12 years	<i>P. falciparum</i>	Absolute creatinine threshold	146/440 (33.2)	8
Oshomah-Bello 2019 (Nigeria) [9]	Children 0.5–12 years	<i>P. falciparum</i>	KDIGO	96/244 (39.3)	7
Tembo 2022 (Zambia/Malawi) [27]	Children 2–11 years with CNS malaria	<i>P. falciparum</i>	KDIGO	134/209 (64.1)	8
Kwambele 2023 (Uganda) [28]	Children 2 months–12 years	Not specified	AKIN	167/350 (47.7)	7

The definition of AKI varied across studies. Seven studies used KDIGO criteria [4,9,10,13,27,30,31], two used absolute creatinine thresholds $> 265 \mu\text{mol/L}$ [8,26], one used AKIN [28], and one used pRIFLE [29]. Baseline renal function was estimated using heterogeneous approaches, including assumed normal glomerular filtration rates, MDRD or Pottel equations, the lowest creatinine value during hospitalization, or pediatric-specific equations [32].

All studies used WHO criteria to define severe malaria, although with temporal variations and local adaptations. The most frequently reported criteria included coma or altered consciousness ($n = 9$) [8–10,13,26–28,30], severe anemia ($n = 6$) [8,9,13,26–28], convulsions ($n = 3$) [9,27,28], respiratory distress ($n = 5$) [4,9], and hyperparasitemia ($n = 2$) [4,13]. Some studies used modified WHO criteria [30] or pediatric-specific combinations [8,26,29].

Finally, none of the 11 studies explicitly reported probability sampling, which was a common methodological limitation. After applying the scoring system uniformly, four studies were rated as high quality/low risk of bias (score 8), four as moderate–high quality

(score 7), and three as moderate quality (scores 5–6). No study was classified as low quality/high risk of bias.

3.3. Meta-Analysis of AKI Prevalence in Children and Adults

The meta-analysis of 6 pediatric studies ($n = 2051$ patients) showed a pooled prevalence of AKI of 39.6% (95% CI: 29.9–49.6%) [8,9,26–29]. High heterogeneity was observed ($I^2 = 95\%$, $\tau^2 = 0.0150$, $p < 0.01$), with individual prevalences ranging from 19.9% [29] to 64.1% [27]. The most recent studies [27,28] consistently reported prevalences above 40%, while earlier studies such as Prasad 2016 reported lower prevalences (see Figure 2).

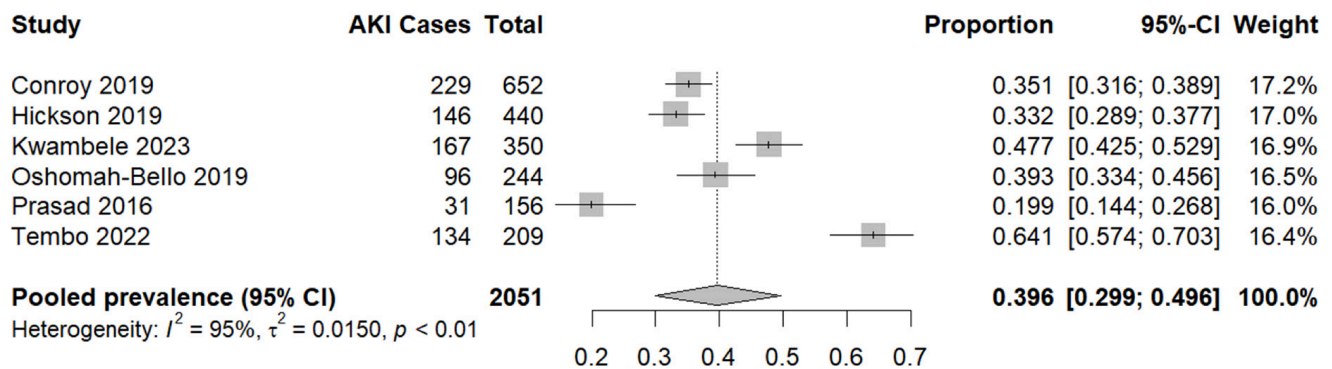


Figure 2. Meta-analysis of reported acute kidney injury prevalence in children with severe malaria. Pediatric studies included participants from 2 months to 14 years of age. Source studies represented in the figure are Conroy 2019 [8], Hickson 2019 [26], Kwambele 2023 [28], Oshomah-Bello 2019 [9], Prasad 2016 [29], and Tembo 2022 [27].

The meta-analysis of 5 studies in adults ($n = 1062$ patients) revealed a pooled prevalence of AKI of 33.4% (95% CI: 13.3–57.0%) [4,10,13,30,31], slightly lower than in children but with greater uncertainty. Heterogeneity was extreme ($I^2 = 97\%$, $\tau^2 = 0.0692$, $p < 0.01$), reflected in the wide confidence interval and marked variability between individual studies, from 14.4% [30] to 87.5% [4] (see Figure 3).

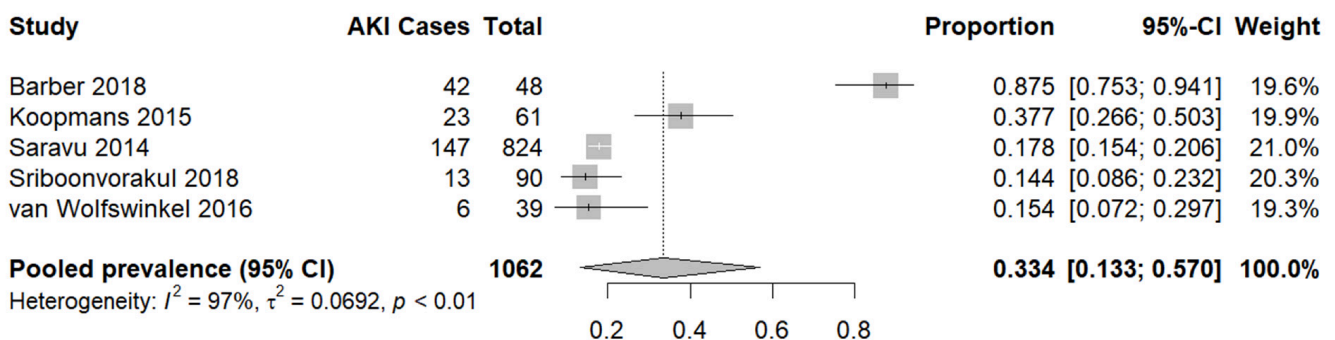


Figure 3. Meta-analysis of reported acute kidney injury prevalence in adult or adult-classified cohorts with severe malaria. Eligibility lower limits were ≥ 12 or ≥ 18 years where specified, and reported ages extended to older adulthood. Source studies represented in the figure are Barber 2018 [4], Koopmans 2015 [10], Saravu 2014 [13], Sriboonvorakul 2018 [30], and van Wolfswinkel 2016 [31].

3.4. Meta-Regression and Temporal Trend Analysis

The meta-regression analysis revealed that none of the explored variables adequately explained the substantial heterogeneity observed across studies ($I^2 > 97\%$ in all models). Publication year showed a marginal association with reported AKI prevalence ($p = 0.076$), standard diagnostic criteria (KDIGO/AKIN) tended to detect higher prevalence than non-standard criteria ($p = 0.167$), and age group, sample size, and geographic region showed

no significant associations. The multivariable model including age group and diagnostic criteria explained only 7.4% of between-study variance, indicating that unmeasured clinical and methodological factors likely accounted for most heterogeneity (see Table 2).

Table 2. Meta-regression analysis of reported AKI prevalence in severe malaria.

Variable	Studies (n)	Coefficient (95% CI)	p-Value	τ^2	I ² (%)	R ² (%)
Univariate models						
Publication year (per year)	11	0.0429 (−0.0045, 0.0902)	0.076	0.0435	97.6	19.5
Age group (adults vs. children) ^a	11	−0.0627 (−0.3572, 0.2318)	0.677	0.0592	98.2	0.0
Sample size (per 100 patients)	11	−0.0170 (−0.0814, 0.0373)	0.473	0.0570	98.2	0.0
Diagnostic criteria (standard vs. non-standard) ^b	11	0.1959 (−0.0819, 0.4736)	0.167	0.0493	97.9	8.7
Geographic region (overall test)	11	—	0.651	0.0614	98.4	0.0
Multivariable model						
Age group (adults vs. children) ^a	11	−0.1342 (−0.4196, 0.1512)	0.357	0.0500	97.7	7.4
Diagnostic criteria (standard vs. non-standard) ^b		0.2382 (−0.0555, 0.5318)	0.112			

τ^2 = between-study variance; I² = percentage of total variation due to heterogeneity; R² = percentage of between-study variance explained by covariates. All coefficients are reported on the logit scale. ^a Reference category: children. ^b Standard diagnostic criteria were KDIGO/AKIN; non-standard criteria included absolute creatinine thresholds or pRIFLE. WHO = World Health Organization; KDIGO = Kidney Disease: Improving Global Outcomes; AKIN = Acute Kidney Injury Network; pRIFLE = pediatric Risk, Injury, Failure, Loss, End-stage kidney disease.

Publication-year patterns differed by age group. In children, a strong positive correlation was observed between publication year and reported AKI prevalence ($\rho = 0.880$, $p < 0.01$), with studies published in 2019–2023 reporting higher prevalences than the earlier pediatric study. In contrast, adult or adult-classified studies were concentrated in 2014–2018 and showed no publication-year pattern ($\rho = -0.103$, $p = 0.87$). Because the literature search extended to 30 March 2026 but no eligible studies after 2023 were identified, Table 3 and Figure 4 summarize the publication-year range of the included studies rather than the full search period.

Table 3. Publication-year patterns and study distribution by age group.

Age Group (Range)	Studies (n)	Time Range	Spearman ρ	p-Value	Studies by Period	Prevalence Range (%)	Weighted Mean (%)
Children (2 mo–14 y)	6	2016–2023	0.880	<0.01	2016–2018: 1 2019–2023: 5	19.9–64.1	42.8
Adults/adult-classified ($\geq 12/\geq 18$ y)	5	2014–2018	−0.103	0.87	2014–2018: 5 2019–2023: 0	14.4–87.5	34.6
Combined (2 mo–adult)	11	2014–2023	0.566	0.055	—	14.4–87.5	39.7

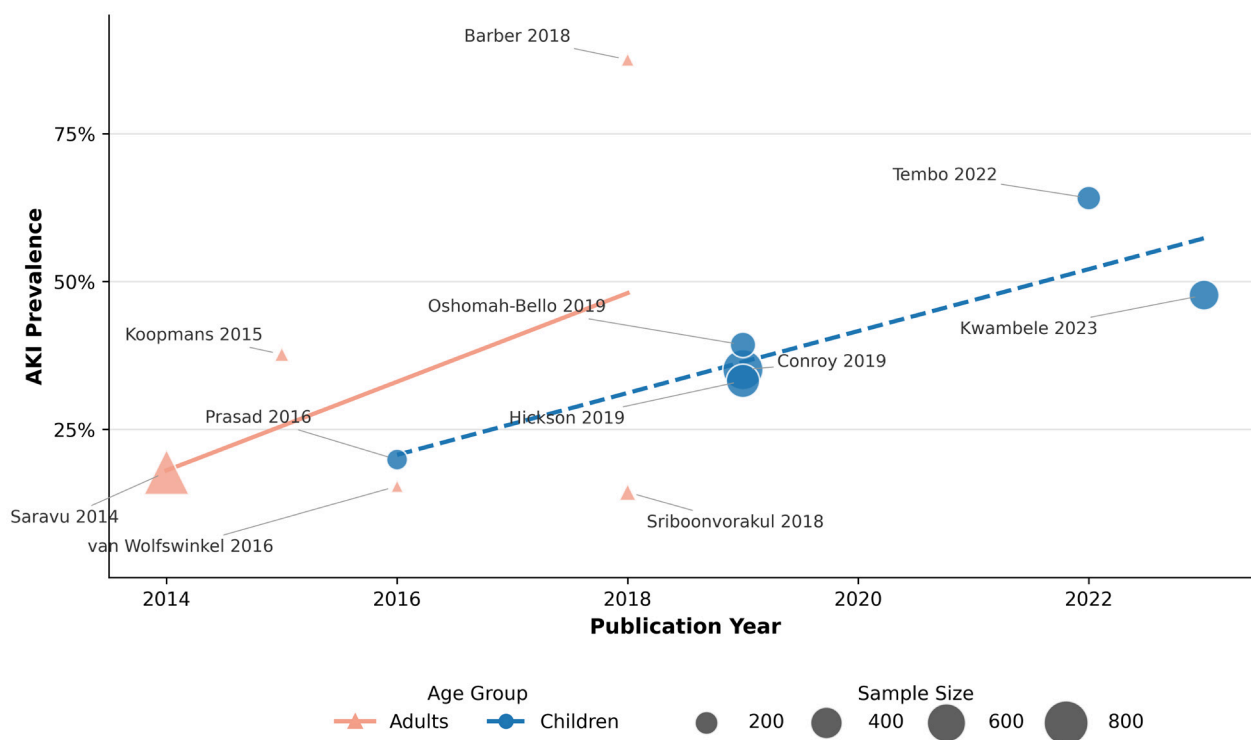


Figure 4. Reported prevalence of acute kidney injury by publication year and age group in severe malaria among included studies published between 2014 and 2023. Trend lines describe changes in reported prevalence and should not be interpreted as evidence of a true biological increase in AKI occurrence; differences over time may reflect evolving diagnostic definitions, particularly KDIGO/AKIN-based criteria, greater clinical awareness, and changes in reporting practices. Source studies represented in the figure are cited in Table 1 and include the studies used in the meta-analysis [4,8–10,13,26–31].

Spearman correlation coefficients (ρ) were calculated between publication year and AKI prevalence. Weighted means were calculated using sample sizes as weights. Age ranges summarize eligibility criteria and reported ages in included studies; the table describes the included publication years, not the complete search period.

Figure 4 visualizes reported AKI prevalence by publication year and should not be interpreted as evidence of a true biological increase in AKI occurrence. The pediatric line rises from 2016 to 2023, but this pattern may reflect progressive adoption of KDIGO/AKIN-based definitions, greater clinical awareness, and changes in reporting practices. Adult or adult-classified data were limited to studies published up to 2018, precluding inference about recent publication-year patterns in this group (see Figure 4).

4. Discussion

4.1. Summary of Evidence and Heterogeneity

This systematic review and meta-analysis found that AKI was frequently reported among hospitalized patients with severe malaria, with pooled reported prevalences of 39.6% in children and 33.4% in adult or adult-classified cohorts. These estimates should be interpreted as approximate summaries rather than definitive global prevalences, because heterogeneity was substantial ($I^2 > 95\%$) and the evidence base consisted of 11 studies with uneven geographic representation [4,8–10,13,26–31].

The main sources of variability were probably methodological rather than purely biological. Included studies differed in AKI definition, baseline creatinine estimation, timing of renal assessment, use of urine-output criteria, and local severe-malaria case definitions.

Different assumptions about baseline creatinine can substantially alter AKI classification, particularly in pediatric and low-resource settings where premorbid creatinine values are rarely available [33–36]. Consequently, pooled estimates are useful for quantifying the reported burden, but clinical and epidemiological interpretation should prioritize the range of study-specific prevalences and the diagnostic methods used.

4.2. Pathophysiological and Age-Specific Interpretation

The observed burden is biologically plausible. Severe malaria can promote renal injury through microvascular sequestration, endothelial activation, intravascular hemolysis, heme-mediated oxidative stress, inflammation, and tubular injury [3–6]. Experimental evidence also supports a potential role for lipid peroxidation products such as 4-HNE in malaria-related tubular damage, although direct evidence in human severe malaria-associated AKI remains limited [7]. This mechanistic background supports the clinical relevance of detecting mild or early AKI stages rather than relying only on traditional absolute creatinine thresholds.

Differences between pediatric and adult estimates must also be interpreted cautiously. Children may be more susceptible to AKI during severe malaria because of developmental renal physiology, dehydration risk, severe anemia, inflammatory activation, and challenges in estimating baseline kidney function. However, the apparent age difference is also shaped by diagnostic criteria and study distribution. Pediatric studies included more recent KDIGO/AKIN-based assessments, whereas adult or adult-classified studies were fewer and concentrated before 2019. Pediatric AKI is clinically important because it has been associated with mortality, persistent kidney disease, and post-discharge morbidity, supporting follow-up beyond the acute admission when feasible [5,8,26,37,38].

4.3. Diagnostic Criteria, Publication-Year Patterns, and Geographic Context

The apparent increase in pediatric AKI prevalence by publication year should be read as a pattern in reported prevalence, not as evidence that biological susceptibility has increased over time. The adoption of KDIGO and AKIN criteria, greater awareness of AKI as a severe-malaria complication, and more systematic creatinine monitoring can increase detection compared with older WHO creatinine thresholds [23,24]. The absence of eligible adult studies after 2018 and the absence of eligible studies after 2023, despite a search through 30 March 2026, further limit any inference about recent temporal trends.

Geographic patterns also require caution. African studies reported higher prevalences than Asian studies, but regional comparisons were constrained by small numbers of studies, differing malaria transmission settings, population characteristics, referral patterns, and laboratory capacity [1,9,10,39,40]. The absence of eligible studies from several endemic regions, including the Americas, is the main reason the title and interpretation were revised from a global-prevalence framing to a reported-prevalence framing.

4.4. Clinical and Public Health Implications

The prognostic relevance of AKI extends beyond malaria and has also been documented in other severe systemic infections, including COVID-19 [41]. The findings support systematic renal assessment in severe malaria whenever laboratory capacity allows. Serial creatinine measurement, standardized AKI staging, careful fluid management, and explicit referral thresholds may improve risk stratification, especially in settings where renal replacement therapy is limited. However, recommendations should be adapted to local resources: the present estimates justify strengthening renal monitoring but do not by themselves define a single universal protocol for all endemic settings [5,23,38,42].

4.5. Strengths and Limitations

The main strengths of this review were the broad database search, absence of language restrictions, duplicate screening and extraction, use of prevalence-oriented quality assessment, and exploration of heterogeneity through subgroup analysis and meta-regression. The limitations are equally important: only 11 studies were eligible, heterogeneity remained largely unexplained, AKI definitions and baseline creatinine methods varied, adult data were sparse after 2018, and geographic coverage was incomplete. These limitations motivated the more cautious wording used throughout the revised manuscript.

5. Conclusions

AKI was frequently reported among hospitalized patients with severe malaria, with pooled estimates of 39.6% in children and 33.4% in adult or adult-classified cohorts; however, these values should be interpreted as approximate reported prevalences rather than definitive global estimates because heterogeneity was substantial and only 11 studies were included. The higher reported prevalence in recent pediatric studies probably reflects greater diagnostic sensitivity and clinical awareness after adoption of KDIGO/AKIN-based definitions, rather than a proven increase in biological occurrence. Future studies should use standardized AKI definitions, transparent baseline creatinine estimation, and comparable reporting across regions, while clinical protocols for severe malaria should incorporate renal assessment whenever laboratory capacity allows.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/zoonoticdis6030032/s1>. Supplementary Material S1: Search strategy by database (PubMed, Scopus, Web of Science, EMBASE, LILACS, SciELO); Supplementary Material S2: Characteristics of studies included in the meta-analysis on acute kidney injury prevalence in severe malaria.

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Abbreviations

AKI, acute kidney injury; AKIN, Acute Kidney Injury Network; CI, confidence interval; KDIGO, Kidney Disease: Improving Global Outcomes; PCR, polymerase chain reaction; pRIFLE, pediatric Risk, Injury, Failure, Loss, End-stage kidney disease; PRISMA, Preferred Reporting Items

for Systematic Reviews and Meta-Analyses; RDT, rapid diagnostic test; RIFLE, Risk, Injury, Failure, Loss, End-stage kidney disease; WHO, World Health Organization.

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