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Pain in Hemodialysis Patients: Therapeutic and Longitudinal Aspects at the National Hemodialysis Center of Donka, Guinea

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Abstract

Background

Chronic pain is a frequent and often underestimated complication in patients with end-stage renal disease (ESRD) treated with hemodialysis. It significantly impairs quality of life and complicates therapeutic management. Despite its high prevalence, pain remains insufficiently assessed and treated in resource-limited settings, particularly in sub-Saharan Africa. This study aimed to describe the clinical, therapeutic, and longitudinal aspects of pain in hemodialysis patients at the National Hemodialysis Center of Donka (CNHD), Guinea.

Methods

We conducted an observational, longitudinal, prospective study with an analytical aim, from 1 August to 31 October 2025 at the CNHD. All chronic hemodialysis patients followed at the center during the study period were screened for the presence of pain; the 308 eligible patients were included, of whom 267 reported pain lasting more than 3 months and 41 reported no pain (comparison group). Patients with pain were assessed on three occasions during consecutive weekly visits (Week 1, Week 2, Week 3) using the Brief Pain Inventory (BPI) and the Visual Analog Scale (VAS, 0–10). Therapeutic changes (dose increase, drug substitution, stabilization) were recorded at each visit. Sociodemographic, clinical, biological, and dialysis-related variables were collected through a structured questionnaire and medical records. Normality of continuous variables was assessed with the Shapiro-Wilk test; comparisons used the Chi-square/Fisher's exact test, the Wilcoxon rank-sum test (independent groups), and Friedman's test (repeated measures over 3 weeks). Factors independently associated with pain were identified by multivariable logistic regression (significance threshold: $p < 0.05$).

Results

The prevalence of chronic pain was 86.7% (267/308). Pain was mainly intermittent (43.4%) or frequent (27.7%), predominantly of moderate intensity (VAS 3–5: 58.1%). It strongly affected daily life, particularly social activities (91.4%) and sleep (52.1%). Among patients with pain, 96.3% were receiving analgesic treatment, mostly paracetamol-based (73.9%). WHO step I analgesics predominated (73.5%). Despite treatment, only 11.2% of patients reported complete relief and 85.0% partial relief. In univariate analysis, female sex, vascular access type, and hemoglobin level were significantly associated with the presence of pain; after multivariable adjustment, only a low hemoglobin level remained independently associated with chronic pain (adjusted OR = 0.30 per 1 g/dl increase in hemoglobin; 95% CI 0.20–0.42; $p < 0.001$). Pain intensity differed significantly across the three weekly visits (Friedman's test, $p < 0.001$), with a net shift toward higher severity categories between Week 1 and Week 3 (51.5% of patients worsened vs. 21.4% improved); individual trajectories were heterogeneous and depended on baseline severity, a pattern partly consistent with regression to the mean.

Conclusions

Chronic pain affects the vast majority of hemodialysis patients at the CNHD and remains insufficiently controlled by current analgesic strategies. These findings highlight the urgent need for systematic, standardized pain assessment, therapeutic protocols adapted to the constraints of renal impairment, and a multidisciplinary approach to improve the quality of life of hemodialysis patients in resource-limited settings.

Background

Pain is a frequent and often underestimated symptom in patients with advanced-stage chronic kidney disease (CKD). Approximately 58% of them report experiencing pain, of whom nearly half describe it as moderate to severe in intensity, regardless of the renal replacement modality dialysis or conservative management [1]. The International Association for the Study of Pain (IASP) defines it as “an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage” [2]. Recognized by the World Health Organization (WHO) as a global public health priority, pain is one of the most frequently reported symptoms in hemodialysis patients, with a prevalence ranging from 33% to 82%, markedly higher than that observed in the general population [3].

Pain assessment is an essential prerequisite for any therapeutic approach [4]. Yet it remains poorly systematized in clinical practice, owing to the subjective nature of the symptom and reluctance to use standardized assessment tools. Pain management is a clinical obligation, all the more pressing because the lack of specific recommendations for this population complicates analgesic prescription, which requires mandatory dose adjustments and carries an increased risk of adverse effects [5, 6]. The therapeutic goal is not necessarily the complete eradication of pain, but its reduction to a threshold compatible with the maintenance of daily activities generally defined as a score less than or equal to 3 on a 0–10 numerical scale [7].

In practice, pain in dialysis patients is frequently relegated to secondary importance in favor of other medical concerns related to the complications of ESRD and dialysis treatment. In resource-limited countries such as Guinea, the management of pain in hemodialysis patients faces several obstacles:

- Limited access to appropriate analgesics;
- A risk of drug toxicity attributable to renal impairment;
- The absence of standardized protocols and sometimes insufficient training of care staff.

Poor pain management can impair quality of life, reduce treatment adherence, and worsen patient prognosis [8]. The National Hemodialysis Center of Donka (CNHD) is the only public hemodialysis center in Guinea and the national reference center for the management of ESRD. To date, no study has specifically characterized the clinical profile, therapeutic management, or temporal course of pain in this

population. The present study therefore aimed to describe the therapeutic and longitudinal aspects of pain in hemodialysis patients at the CNHD.

Methods

Study setting

This study was conducted at the National Hemodialysis Center of Donka (CNHD), Conakry, Guinea the only national reference center for the management of patients with chronic kidney disease requiring hemodialysis.

Study design and duration

This was an observational, longitudinal, prospective study with an analytical aim, lasting three months, conducted from 1 August to 31 October 2025.

Study population

The target population comprised all patients managed with hemodialysis at the CNHD during the study period. All chronic hemodialysis patients followed at the center were systematically screened for the presence of pain, regardless of its location or intensity. Of the 308 eligible patients included, 267 reported pain lasting more than 3 months and entered the longitudinal follow-up (BPI/VAS assessment at three consecutive weekly visits and recording of therapeutic adjustments; 266 of them completed all three assessments), while the 41 patients reporting no pain constituted a comparison group used for the analysis of factors associated with pain (bivariate and multivariable analyses).

Eligibility criteria

Inclusion criteria: Any chronic hemodialysis patient followed at the CNHD during the study period who provided written consent to participate, regardless of the presence or absence of pain.

Non-inclusion criteria: Patients who did not provide informed consent, and patients with a history of recent trauma (a potential confounding cause of acute pain unrelated to chronic kidney disease).

Sampling

Exhaustive sampling was applied, including all eligible patients meeting the inclusion criteria during the study period.

Data collection and measured variables

Sociodemographic, clinical, anthropometric, paraclinical, therapeutic, and outcome data were collected using structured questionnaires and medical records.

Pain was characterized according to its temporal pattern: continuous (daily); frequent (every other day); intermittent (every third day); rare (once a week). Chronicity was defined as persistence beyond three months.

Pain was assessed using the Brief Pain Inventory (BPI), a tool that captures pain intensity (current, worst, least, and average pain) as well as its impact on activities of daily living (general activity, walking, work, sleep, mood, social relations, and enjoyment of life). Intensity was measured using the Visual Analog Scale (VAS, 0 to 10), rated as follows: absent (0); mild (1-2); moderate (3-5); severe (6-8); very severe (9-10).

Each participant was assessed during three consecutive weekly visits: Week 1 (W1), Week 2 (W2), and Week 3 (W3). At each visit, the following information was systematically collected: presence or absence of persistent pain; pain intensity (VAS); pain type; impact on daily activities; and changes to analgesic treatment (dose increase, drug substitution, or stabilization).

Analgesics were classified according to the WHO analgesic ladder: Step I paracetamol, ibuprofen, diclofenac; Step II codeine, tramadol, paracetamol + tramadol, paracetamol + codeine; Step III morphine. Data were collected using a structured questionnaire developed for this study (Additional file 1).

To identify clinically relevant factors associated with pain, the following variables were also collected for the entire cohort: hemoglobin level, C-reactive protein (CRP, inflammatory marker, classified as normal/elevated), vascular access type (arteriovenous fistula [AVF], permanent catheter, temporary catheter; no patient had a prosthetic graft), and etiology of the underlying chronic kidney disease (CKD).

Statistical analysis

Data were entered using KoboCollect and analyzed with RStudio (version 2026.05.0-218). Normality of continuous variables was assessed using the Shapiro-Wilk test; as all continuous variables studied (age, dialysis vintage, hemoglobin, VAS scores) were found to be non-normally distributed, they are presented as median [interquartile range, IQR] consistently throughout the manuscript.

Comparisons between the group of patients with pain and the group without pain were performed using the Wilcoxon rank-sum test (Mann-Whitney) for continuous variables, and the Chi-square test or Fisher's exact test (in case of low expected cell counts) for categorical variables.

For the longitudinal analysis of pain intensity across the three weekly visits (W1, W2, W3), a method appropriate for repeated measures was used: Friedman's test (non-parametric analysis of variance for

matched measures), complemented by an analysis of individual severity trajectories between the first and the last visit. Only patients with all three assessments (n = 266) were included in this analysis. Because Friedman's test indicates whether the distribution of scores differs across visits but not the direction of the change, the direction of change was described using the W1–W3 transition matrix. For this trajectory analysis, VAS scores were grouped into three categories (mild: 0-3; moderate: 4-6; severe: 7-10), the upper limit of the mild category corresponding to the usual therapeutic target (score ≤ 3); this grouping differs from the five-level classification used for the descriptive analysis of pain intensity (Table 4).

Factors associated with chronic pain were first explored by univariate logistic regression for each of the following variables, chosen a priori on clinical grounds: age, sex, diabetes, dialysis vintage, weekly session frequency, vascular access type, CRP, and hemoglobin. All of these variables were then included simultaneously in a multivariable logistic regression model to identify factors independently associated with pain, adjusting for the other covariates. Results of both steps (univariate and multivariable) are presented as odds ratios (OR) with their 95% confidence interval. The absence of problematic collinearity between variables in the multivariable model was verified using the variance inflation factor (VIF). Continuous covariates were entered as continuous terms, and the corresponding ORs are expressed per one-unit increase (e.g., per 1 g/dl of hemoglobin). The regression analyses were performed on complete cases (n = 301). Given the small number of patients without pain (n = 41) relative to the nine model parameters (approximately 4.6 events per parameter, below the conventional threshold of 10), the multivariable model was considered exploratory, and estimates for very sparse categories (e.g., three weekly sessions, n = 2) were regarded as unstable and not interpreted.

A p-value < 0.05 was considered statistically significant for all analyses.

Ethical considerations

This study was approved by the Ethics Committee of the National Hemodialysis Center of Donka, Donka National Hospital, Conakry, Guinea. Written informed consent was obtained from each participant before inclusion. Data were collected anonymously, and confidentiality was maintained throughout the study. The study was conducted in accordance with the Declaration of Helsinki.

Results

Sociodemographic characteristics

A total of 308 patients were included. Men were in the majority (58.4%, n = 180). The median age was 45 years (IQR: 32–57; range: 10–76 years). Nearly half of the patients had no formal education (46.1%). The main socio-occupational categories were traders (20.5%), employees (20.5%), and the unemployed (22.1%) (Table 1).

Table 1
Sociodemographic characteristics of hemodialysis patients at the CNHD (August-October 2025; N = 308).

Variable	Category	n	%
Sex			
	Female	128	41.6
	Male	180	58.4
Age (years)	Median (IQR)	45 (32–57)	—
Age group	10–20 years	21	6.8
	21–30 years	49	15.9
	31–40 years	55	17.9
	41–50 years	63	20.5
	51–60 years	62	20.1
	≥ 61 years	58	18.8
Educational level	No formal schooling	142	46.1
	Primary	19	6.2
	Secondary	55	17.9
	Higher	92	29.9
Occupation	Health worker	19	6.2
	Trader	63	20.5
	Employee	63	20.5
	Pupil/Student	28	9.1
	Homemaker	62	20.1
	Unemployed	71	22.1

IQR, interquartile range.

Comorbidities, dialysis characteristics, and factors associated with pain

Arterial hypertension was present in 304 patients (98.7%). Diabetes mellitus was the second most frequent comorbidity (18.5%). Median dialysis vintage was 14 months (IQR 6–34). The vast majority of patients (99.4%) received two hemodialysis sessions per week.

Sex was significantly associated with pain status, women being proportionally more represented in the pain group (44.6% vs. 22.0% in the no-pain group; p = 0.006). Age, dialysis vintage, weekly session frequency, and history of diabetes, arterial hypertension, heart disease, and stroke did not differ significantly between the two groups (p > 0.05 for all these comparisons).

Hemoglobin level was significantly lower in patients with pain (median 9.0 g/dl [IQR 8.1–10.0]) compared with patients without pain (13.0 g/dl [IQR 10.7–14.0]; p < 0.001). Vascular access type also differed significantly between the two groups (p < 0.001): temporary catheters were proportionally more frequent among patients without pain, while permanent catheters and arteriovenous fistulas (AVF) predominated in the pain group. A targeted comparison between patients with an AVF and patients with a permanent catheter showed no significant difference in the frequency of chronic pain between these two access modalities (p = 0.838).

The etiology of CKD was dominated by vascular nephropathy (71.4% of the cohort) and did not differ significantly according to pain status (p = 0.126). Diabetic nephropathy accounted for 16 cases (5.2%); these patients are exposed to an additional risk of painful diabetic peripheral neuropathy, which may constitute a cause of chronic pain distinct from that related to dialysis itself. CRP level did not differ significantly according to pain status (p > 0.999) (Table 2).

Table 2
Comparison of clinical and biological characteristics according to pain status (N = 308). Wilcoxon rank-sum test for continuous variables; Fisher's exact test for categorical variables.

Variable	Overall N = 308	No pain n = 41	Pain n = 267	p-value
Sex				0.006
Male	180 (58%)	32 (78%)	148 (55%)	
Female	128 (42%)	9 (22%)	119 (45%)	
Diabetes				0.831
No	251 (81%)	33 (80%)	218 (82%)	
Yes	57 (19%)	8 (20%)	49 (18%)	
Arterial hypertension				> 0.999
No	4 (1.3%)	0 (0%)	4 (1.5%)	
Yes	304 (99%)	41 (100%)	263 (99%)	
Heart disease				0.379
No	296 (96%)	41 (100%)	255 (96%)	
Yes	12 (3.9%)	0 (0%)	12 (4.5%)	
Stroke				> 0.999
No	307 (100%)	41 (100%)	266 (100%)	
Yes	1 (0.3%)	0 (0%)	1 (0.4%)	
Dialysis vintage (months), median [IQR]	14 [6–34]	23 [7–41]	14 [5–34]	0.361
Weekly session frequency				0.249
2 sessions	306 (99%)	40 (98%)	266 (100%)	
3 sessions	2 (0.6%)	1 (2.4%)	1 (0.4%)	
Hemoglobin (g/dl), median [IQR]	9.20 [8.30–10.20]	13.00 [10.70–14.00]	9.00 [8.10–10.00]	< 0.001
Vascular access type				< 0.001
AVF	56 (18%)	5 (13%)	51 (19%)	
Permanent catheter	187 (61%)	13 (33%)	174 (65%)	

Variable	Overall N = 308	No pain n = 41	Pain n = 267	p-value
Temporary catheter	63 (21%)	21 (54%)	42 (16%)	
Etiology of CKD				0.126
Chronic glomerulonephritis	29 (9.4%)	3 (7.5%)	26 (9.7%)	
HIV-associated nephropathy (HIVAN)	6 (2.0%)	0 (0%)	6 (2.2%)	
Diabetic nephropathy	16 (5.2%)	5 (13%)	11 (4.1%)	
Tubulo-interstitial nephropathy	30 (9.8%)	2 (5.0%)	28 (10%)	
Vascular nephropathy	220 (72%)	28 (70%)	192 (72%)	
HIV-associated vascular nephropathy	4 (1.3%)	1 (2.5%)	3 (1.1%)	
Polycystic kidney disease	2 (0.7%)	1 (2.5%)	1 (0.4%)	
CRP				> 0.999
Normal	164 (53%)	22 (54%)	142 (53%)	
Elevated	144 (47%)	19 (46%)	125 (47%)	

IQR, interquartile range; AVF, arteriovenous fistula; HIV, human immunodeficiency virus; CRP, C-reactive protein. Missing values: hemoglobin (n = 6), vascular access type (n = 2), etiology of CKD (n = 1).

Dialysis parameters

The median dry weight was 59 kg (IQR: 52–69). Pre-dialysis weight was 62 kg (IQR: 54–69) and post-dialysis weight was 59 kg (IQR: 51–67) (Table 3). These weight data alone do not allow the adequacy of fluid management or of dialysis to be assessed, as interdialytic weight gain and dialysis dose (Kt/V) were not analyzed.

Table 3
Dialysis parameters of hemodialysis patients at the CNHD (N = 308).

Variable	Median (Q1, Q3)
Dry weight (kg)	59 (52–69)
Pre-dialysis weight (kg)	62 (54–69)
Post-dialysis weight (kg)	59 (51–67)

Prevalence, characteristics, impact, and management of pain

Chronic pain was reported by 267 of 308 patients (86.7%). Pain was predominantly intermittent (43.4%) or frequent (27.7%). Moderate intensity (VAS 3–5) was the most represented category (58.1%), followed by severe pain (VAS 6–8) in 22.5% of patients. Pain had a considerable impact on daily activities, particularly social activities (91.4%) and sleep (52.1%).

Among patients with pain, 96.3% (n = 257) were receiving analgesic treatment. Paracetamol was the most frequently prescribed analgesic (73.9%), followed by the paracetamol-tramadol combination (15.6%). Non-steroidal anti-inflammatory drugs (NSAIDs) were used as self-medication by 16.0% of patients. WHO step I analgesics predominated (73.5%). Complete relief was reported by only 11.2% of patients, whereas 85.0% reported partial relief (Table 4).

Table 4
Prevalence, characteristics, impact of pain, and response to analgesic treatment (N = 308).

Variable	n	%
Pain present	267	86,7
No pain	41	13,3
Type of pain (n = 267)		
Continuous (daily)	65	24,3
Frequent (every other day)	74	27,7
Intermittent (every third day)	116	43,4
Rare (once a week)	12	4,5
Intensity (VAS)		
Mild (1–2)	41	15,4
Moderate (3–5)	155	58,1
Severe (6–8)	60	22,5
Very severe (9–10)	11	4,1
Impact on daily life (n = 267)		
Disturbed sleep	139	52,1
Anxiety	41	15,4
Difficulty walking	127	47,6
Reduced social activities	244	91,4
Depression	10	3,7
Analgesic treatment received (n = 267)	257	96,3
Prescribed analgesics (INN)		
Paracetamol	190	73,9
Paracetamol + tramadol	40	15,6
Self-medication (NSAIDs)		
Ibuprofen or diclofenac	41	16,0
WHO step		
Step I	189	73,5

Variable	n	%
Step II	57	22,2
Therapeutic response		
No relief	10	3,7
Complete relief	30	11,2
Partial relief	227	85,0

VAS, Visual Analog Scale; NSAIDs, non-steroidal anti-inflammatory drugs; INN, international non-proprietary name.

Factors independently associated with chronic pain: univariate and multivariable logistic regression

Among the 301 patients with complete data for all covariates of interest, univariate analysis found a significant association between female sex and the presence of chronic pain (OR = 2.61; 95% CI 1.19–6.37; p = 0.023), between temporary catheter use (versus AVF) and a lower frequency of pain (OR = 0.16; 95% CI 0.04–0.45; p = 0.002), and between a higher hemoglobin level and a reduced risk of chronic pain (OR = 0.27; 95% CI 0.18–0.38; p < 0.001). Age, diabetes, dialysis vintage, weekly session frequency, permanent catheter use, and CRP level were not significantly associated with pain status in univariate analysis.

After multivariable adjustment for all these covariates, only hemoglobin level remained independently associated with chronic pain (adjusted OR = 0.30; 95% CI 0.20–0.42; p < 0.001), each 1 g/dl increase in hemoglobin being associated with an approximately 70% reduction in the odds of reporting chronic pain; because pain was highly prevalent (86.7%), this odds ratio should not be interpreted as a 70% reduction in risk, and the magnitude of the association is probably overstated given the small comparison group. Female sex (adjusted OR = 2.69; 95% CI 0.83-10.0; p = 0.114) and temporary catheter use (adjusted OR = 0.26; 95% CI 0.04–1.49; p = 0.152), significant in univariate analysis, did not retain statistical significance after adjustment, suggesting that their crude associations with pain might be partly explained by confounding (for female sex, notably by the lower hemoglobin levels generally observed in women); the wide confidence intervals also indicate limited statistical power, so that an association cannot be excluded (Table 5).

Table 5
Factors associated with chronic pain (> 3 months) in hemodialysis patients — univariate and multivariable analyses (n = 301 patients with complete data).

Characteristic	N	Univariate OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)	301	1.02	0.99–1.04	0.144	1.02	0.99–1.07	0.216
Sex	301						
Male		—	—		—	—	
Female		2.61	1.19–6.37	0.023	2.69	0.83-10.0	0.114
Diabetes	301						
No		—	—		—	—	
Yes		0.87	0.37–2.26	0.752	0.87	0.20–4.08	0.853
Dialysis vintage (months)	301	1.00	0.99–1.01	0.476	1.01	0.99–1.02	0.513
Weekly session frequency	301						
2 sessions		—	—		—	—	
3 sessions		0.12	0.00-3.19	0.143	0.05	0.00-15.8	0.524
Vascular access type	301						
AVF		—	—		—	—	
Permanent catheter		1.52	0.40–4.87	0.503	0.83	0.12–4.50	0.836
Temporary catheter		0.16	0.04–0.45	0.002	0.26	0.04–1.49	0.152
CRP	301						
Normal		—	—		—	—	
Elevated		0.99	0.48–2.04	0.979	0.58	0.17–1.84	0.360
Hemoglobin (g/dl)	301	0.27	0.18–0.38	< 0.001	0.30	0.20–0.42	< 0.001

OR, odds ratio; CI, confidence interval. ORs for continuous variables are expressed per one-unit increase (year, month, or g/dl). Estimates for three weekly sessions are based on two patients only and are unstable.

Evolution of pain intensity over the three weeks of follow-up

Pain intensity (VAS score) differed significantly across the three weekly visits (Friedman's test, χ^2 = 15.58; df = 2; p = 0.0004; n = 266), indicating an overall group-level change in the distribution of scores. As Friedman's test does not indicate the direction of this change, the direction is described by the individual trajectories below.

Analysis of individual severity trajectories (mild: VAS 0–3; moderate: VAS 4–6; severe: VAS 7–10) between Week 1 and Week 3, among the 266 patients with pain who completed all three assessments, revealed a heterogeneous pattern: a worsening of severity category was observed in 137 patients (51.5%), stability in 72 patients (27.1%), and improvement in 57 patients (21.4%). This evolution differed markedly according to baseline severity: among the 50 patients initially classified as severe, 88% moved to a less severe category by W3, whereas among the 170 patients initially classified as mild, 75% moved to a more severe category (Table 6).

Table 6
Transition of pain severity category between Week 1 and Week 3 (n = 266 patients with complete data across all three weeks).

Severity at W1	Mild at W3	Moderate at W3	Severe at W3
Mild (0–3)	42	100	28
Moderate (4–6)	13	24	9
Severe (7–10)	12	32	6

Longitudinal course of therapeutic adjustments

Dose increases were rare at Week 1 (3.0%), slightly more frequent at Week 2 (4.9%), and absent at Week 3 (0%). Drug substitutions affected 10.1% of patients at W1, decreasing to 5.2% at W3, reflecting progressive stabilization of treatment. These trends could reflect treatment adjustments prompted by the structured pain assessment at the start of follow-up, followed by stabilization (Fig. 1).

Discussion

This prospective, longitudinal study conducted at the CNHD reveals a high prevalence of chronic pain (86.7%) in hemodialysis patients, markedly higher than that reported in several comparable African and North African studies. El Harraqui et al. in Morocco reported a prevalence of 70.9% [6], while Bouattar et al. and Noto-Kadou-Kaza et al. found 50.7% and 51%, respectively [9, 10]. These differences may partly reflect differences in case definition and assessment methods (systematic screening for pain of any location lasting more than 3 months), the burden of hypertension, the limited frequency of dialysis

sessions (two per week in 99.4% of patients), and the absence of systematic pain management protocols at the CNHD. However, as almost all patients received two sessions per week, the role of session frequency could not be tested in our data, and these explanations remain hypothetical.

The demographic profile in our study—a male predominance (58.4%) and a median age of 45 years (IQR: 32–57)—is consistent with the typically young profile of ESRD patients in sub-Saharan Africa [11, 12]. Hypertension was present in 98.7% of patients, reflecting its dual role as a major etiological factor and a consequence of ESRD [12].

Pain was predominantly intermittent (43.4%) and of moderate intensity (58.1%), findings consistent with those of Mrabet et al. in Tunisia (2025), who reported intermittent pain in 52.6% of participants [13]. However, our study showed a higher proportion of severe pain (22.5%), which might be related to the inadequacy of current analgesic treatments; the contribution of the reduced number of weekly sessions could not be assessed in our study. The major impact on social activities (79.2%) and sleep (45.1%) is congruent with the data of El Harraqui et al., who observed a limitation of general activity in 65.1% of patients [6].

The challenges of analgesic management in patients with renal impairment are well established, given the narrow therapeutic margin between pain relief and toxicity [14]. In our study, paracetamol dominated analgesic prescription (73.9%), with WHO step I analgesics accounting for 73.5% of prescriptions—a profile suggestive of undertreatment of moderate to severe pain. Despite near-universal therapeutic coverage, complete relief was achieved in only 11.2% of patients, and 85.0% reported only partial relief, findings similar to those of Kitala-Tańska et al. [15]. The limited use of step II analgesics (22.2%) and the absence of step III agents reflect both prescribing caution justified by renal impairment and the limited accessibility of opioids in Guinea.

A concerning finding is self-medication with NSAIDs in 16.0% of patients. NSAIDs are associated with documented nephrotoxicity and can accelerate the decline of residual renal function; their use is generally contraindicated in ESRD [14]. This finding underscores the critical importance of patient therapeutic education and structured pharmaceutical counseling within hemodialysis programs.

In univariate analysis, female sex was significantly associated with the presence of pain (OR = 2.61; 95% CI 1.19–6.37; p = 0.023), consistent with the general pain literature, which highlights gender differences in pain perception and expression [16]. However, this association did not retain statistical significance after multivariable adjustment (OR = 2.69; 95% CI 0.83-10.0; p = 0.114), suggesting it may be partly explained by other factors, notably hemoglobin level. No significant association, univariate or multivariable, was found with age, diabetes, dialysis vintage, or session frequency, although the latter could not be meaningfully evaluated because only two patients received three sessions per week.

The strong, independent association between low hemoglobin level and the presence of chronic pain, found in both univariate and multivariable analysis (adjusted OR = 0.30; 95% CI 0.20–0.42; p < 0.001), is consistent with several previously documented pathophysiological pathways. A Japanese study notably

showed that iron deficiency, independent of hemoglobin level, was significantly associated with increased pain during vascular-access puncture as well as intradialytic cramps, suggesting that iron status, and not only hemoglobin concentration, may be involved in pain-related symptoms, with tissue hypoxia and systemic inflammation proposed as possible mechanisms [21]; iron parameters were not measured in our study, so this hypothesis could not be tested. A cross-sectional study conducted in Palestine further showed a significant correlation between CRP level and both pain severity and its functional impact, as well as a significant association between gender and pain severity [22], reinforcing the hypothesis that chronic inflammation—of which anemia is a frequent indirect marker in patients with renal failure—might constitute a common determinant of pain and of the severity of the underlying nephropathy, rather than an isolated causal factor. In our cohort, however, CRP did not differ according to pain status and was not associated with pain in multivariable analysis, which does not support a major role of systemic inflammation, at least as captured by a dichotomous CRP measurement. These findings should nevertheless be interpreted with caution given the cross-sectional nature of the association analysis (pain status and hemoglobin assessed at inclusion), which does not allow a causal link between anemia and pain to be established; a prospective study evaluating the effect of anemia correction on the course of chronic pain would help clarify this relationship further. In addition, the magnitude of the association should be interpreted cautiously: the comparison group was small (n = 41), the number of events per model parameter was low, and the relatively high hemoglobin levels of patients without pain (median 13.0 g/dl) may reflect unmeasured differences (e.g., residual kidney function, access to erythropoiesis-stimulating agents or iron, dialysis adequacy) rather than an effect of anemia itself. Reverse causation (e.g., pain-related reduced activity, poor appetite, or inflammation contributing to lower hemoglobin) also cannot be excluded.

The longitudinal analysis of therapeutic adjustments revealed more frequent treatment adjustments during Weeks 1 and 2, followed by stabilization at Week 3. As most patients had been on dialysis for more than one year (median vintage 14 months), this pattern is more likely to reflect treatment adjustments prompted by the structured pain assessment at the start of follow-up than the pharmacokinetic changes described at dialysis initiation (changes in the volume of distribution and in residual renal clearance) [17, 18]; pharmacokinetic parameters were not measured, and this interpretation remains hypothetical. The progressive decrease in drug substitutions, from 10.1% at W1 to 5.2% at W3, occurred while pain intensity tended to worsen at the group level. This stabilization of treatment should therefore not be interpreted as adequate pain control; it may rather reflect therapeutic inertia or the limited availability of alternative analgesics, in a context where drug-dosing adjustments in CKD are frequently suboptimal [19].

While Friedman’s test confirms a significant overall change in pain intensity across the three weeks of follow-up ($p = 0.0004$), the analysis of individual trajectories reveals a more complex dynamic than a simple worsening trend: among patients initially classified as severe, 88% moved to a less severe category by W3, whereas among patients initially classified as mild, 75% moved to a more severe category. This pattern is consistent, at least in part, with regression to the mean, a well-documented statistical phenomenon that occurs when a variable subject to substantial within-subject fluctuation as

is the case for self-reported pain intensity is measured at one time point and then re-measured later: extreme values recorded at the first measurement statistically tend to move closer to the group mean at the subsequent measurement, independent of any real therapeutic effect. Regression to the mean alone, however, cannot account for the net shift toward higher severity categories (51.5% of patients worsened vs. 21.4% improved), which may reflect a genuine worsening of pain over the follow-up period or a change in reporting with repeated assessment. Given the short follow-up and the absence of repeated baseline measurements, neither the group-level change nor the individual transitions should be interpreted as evidence of a treatment effect or of true disease progression.

Study limitations

This study has several limitations. The three-week follow-up period is insufficient to capture the full course of chronic pain, and does not allow a causal link to be established between the identified factors (notably hemoglobin) and pain; only a longer-duration prospective study would allow this question to be settled. Although multivariable logistic regression was used to identify factors independently associated with pain, it relies on a limited number of available covariates and a restricted comparison-group size (41 patients without pain), resulting in a low number of events per parameter (approximately 4.6), with a risk of overfitting and imprecise estimates; residual confounding cannot be excluded. In addition, the association analysis was cross-sectional, so the temporal sequence between anemia and pain cannot be determined. Several clinically relevant determinants of pain could not be evaluated in this study, notably dialysis adequacy (Kt/V), markers of CKD-mineral bone disorder (serum calcium, phosphate, parathyroid hormone), residual kidney function, and the precise etiology of pain (mechanical, neuropathic, inflammatory, vascular-access-related, etc.); their absence limits the complete characterization of potential confounders and should be addressed in future studies. Data collected on analgesic management did not include detailed information on exact dosage, treatment duration, adherence, or the occurrence of adverse effects, which limits the fine-grained interpretation of therapeutic outcomes; this point deserves particular attention given the reported NSAID self-medication. The absence of systematic screening for neuropathic pain limits the etiological characterization of pain. The single-center design restricts the generalizability of the results: although the CNHD is the only public hemodialysis center in Guinea, patients treated in private facilities may differ in their characteristics and access to analgesics. Finally, difficulties in cooperation and the deterioration of some patients' health status occasionally compromised complete data collection, and the absence of a quality-of-life instrument (e.g., the KDQOL-SF) limits the quantification of the overall impact of pain.

Conclusions

This study shows that chronic pain affects the vast majority of hemodialysis patients at the CNHD (86.7%) and remains insufficiently controlled by current analgesic strategies. More than eight out of ten patients reported persistent pain, predominantly of moderate to severe intensity, with profound functional and psychosocial consequences. In multivariable analysis, a low hemoglobin level was the only factor independently associated with chronic pain; given the cross-sectional nature of this

association and the small comparison group, anemia should be regarded as a hypothesis-generating potential target that warrants confirmation through prospective studies. Analgesic treatment was dominated by paracetamol and step I agents, with complete relief obtained in only a minority of patients. Self-medication with NSAIDs represents a significant safety risk in this population.

These findings call for: (1) systematic, standardized pain assessment using validated tools (BPI, VAS) at every hemodialysis session; (2) the development and implementation of analgesic protocols adapted to the constraints of renal impairment; (3) the strengthening of therapeutic education to prevent self-medication with NSAIDs; and (4) multidisciplinary management integrating nephrologists, pharmacists, and mental health professionals. Improving pain management in hemodialysis patients is essential to durably enhance their quality of life and treatment adherence in resource-limited settings.

Declarations

Ethics approval and consent to participate

Free and informed written consent was obtained from each participant. The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was granted by the institutional ethics committee of the CNHD, Conakry, Guinea.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

OA conceived and designed the manuscript and performed the data analysis. DF corrected and revised the article. DM contributed to the study conception and reviewed the manuscript. TA and MML collected the data. SH and CS collected the data and monitored patient follow-up. TMS acted as the general study

coordinator and oversaw the preparation of the manuscript. All authors read and approved the final version of the manuscript.

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Figures

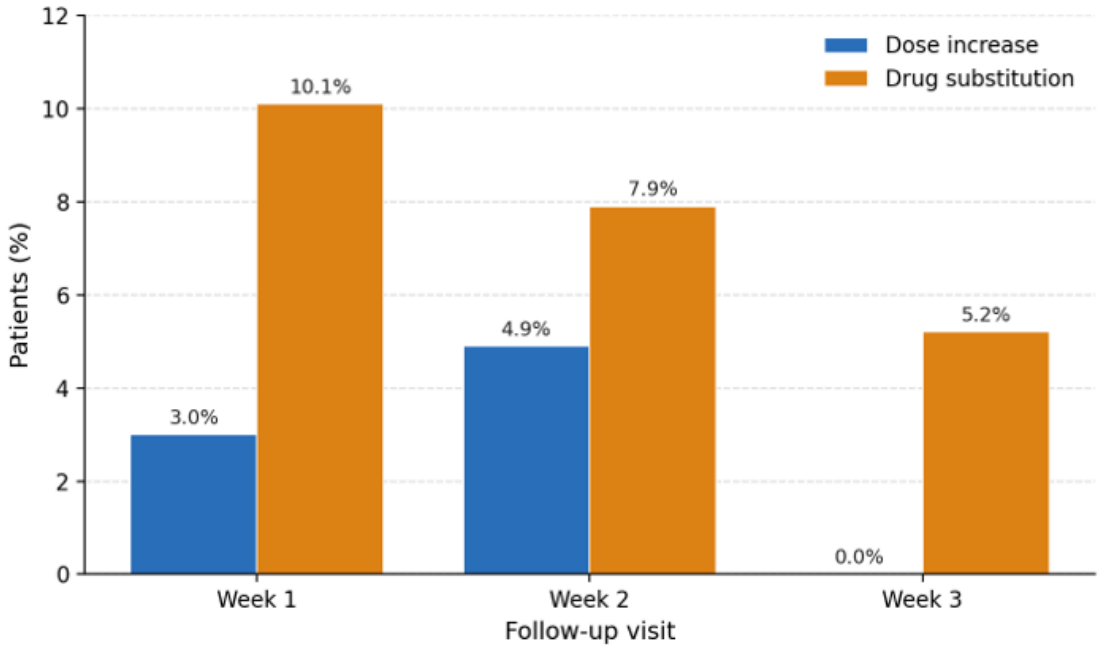


Figure 1

Longitudinal course of therapeutic adjustments (dose increase and drug substitution) over the three weeks of follow-up in hemodialysis patients at the CNHD, Donka (N = 267).

Supplementary Files

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