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Bio-sociological and clinical factors of chronic pain and pain interference in patients undergoing hemodialysis: a cross-sectional study

Fatima Z. Bouchachi[1*], Nadia AL Wachami[1], Younes Iderdar[1], Maryem Arraji[1], Abdeljalil Elgot[1] and Mohamed Chahboune[1]

Abstract

Background End-stage kidney disease is an irreversible and incurable alteration of kidney function, requiring renal replacement therapy such as hemodialysis. Hemodialysis patients are one of the most symptomatic of all chronic kidney disease groups, including chronic pain. Overlooked, underestimated, and undermanaged, pain is associated with altered health-related quality of life. Therefore, this study aims to explore the biological, clinical, and social variables associated with chronic pain and its interference with hemodialysis patients.

Methods A cross-sectional study was conducted on Moroccan hemodialysis patients. A total of 307 patients participated in the study. Data collection was based on a structured questionnaire with sociodemographic, clinical, and dialysis variables. The Numeric Rating Scale and Brief Pain Inventory were used to assess pain characteristics.

Results Almost half of the hemodialysis had chronic pain, the mean pain severity and pain interference scores were 3.73 ± 3.59, and 22.89 ± 22.74 respectively. Multiple regression analysis revealed that gender ($p = 0.022$), number of comorbidities ($p = 0.001$), dialysis vintage ($p < 0.001$), number of pain sites ($p < 0.001$), and PTH level ($p < 0.001$) were associated with pain severity score. Older patients ($p = 0.049$), gender ($p = 0.007$), subjects with a number of comorbidities ($p < 0.001$), dialysis vintage ($p < 0.001$), number of pain sites ($p < 0.001$), and level of PTH ($p < 0.001$) were significantly associated with pain interference score.

Conclusions The subgroups with increased pain severity were female hemodialysis, subjects living with multiple comorbid conditions, those with length dialysis vintage, a high number of painful sites, and increased PTH levels. Assessing and reducing pain intensity, pain interference, and its factors must be a priority for healthcare providers to manage pain and improve health-related quality of life.

Keywords Hemodialysis, Chronic pain, Moroccan, Interference, Daily activities

*Correspondence:
Fatima Z. Bouchachi
f.bouchachi@uhp.ac.ma
[1]Hassan First University of Settat, Higher Institute of Health Sciences, Laboratory of Sciences and Health Technologies, P.O. Box: 539, Settat 26000, Morocco

Background

End-stage kidney disease (ESKD) is an irreversible and incurable alteration of kidney function threatening the person's survival. In the world, 3 million of the population suffer from ESKD [1]. The prevalence steadily rises due to the epidemiological transition, strong demographic growth [2], and poor governance and vulnerability [2]. Treatment of ESKD is based on renal replacement therapies, hemodialysis is the most widespread. In Morocco, one study estimated the prevalence of chronic kidney disease at 5.1% of the Moroccan population, of which ESKD represents 7.2% [3]. Therefore, the prevalence of hemodialysis (HD) patients in 2015 was 571 per million inhabitants [4], increasing from 13,000 to 33,000 in 2013 and 2021 respectively, and reaching 50,000 patients in 2030 [5]. Patients undergoing HD are one of the most symptomatic of all chronic kidney disease groups, with symptom burden high in severity, frequency, and distress such as chronic pain (CP) [6].

The high prevalence of CP and the lack of effective management are causing widespread concern. In the recent systematic review and meta-analysis, 60.5% of hemodialysis patients reported CP (52.3- 68.3%), with 43.6% of this population describing their CP as moderate to severe (34.8–52.7%) [7]. This prevalence is similar to patients suffering from advanced cancer [8]. The pain is located in different parts of the body (lower and upper limbs; shoulders; hips; back, and abdomen), and can be multifocal [9] resulting in various types such as nociceptive, neuropathic, or mixed pain. The multiple pain conditions that complicate the experience of CP in this population are osteoarthritis, peripheral neuropathies, and osteoporosis as comorbidity [10]. Autosomal dominant polycystic kidney disease, urinary tract infections, and vasculitis are primary renal diseases [10]. Further, the complications related to end-stage renal disease include renal bone disease, and calcific uremic arteriolopathy [10], nevertheless, CP is considerably underestimated [11].

CP management is a real challenge in dialysis patients. Worries about the toxicity and side effects of analgesic drugs, inappropriate analgesic dosing, and pharmacokinetics alteration in this population are barriers to inadequate and under-managed CP [10]. In addition, access to non-pharmacological therapies is restricted because such interventions are costly, unavailable in the communities, or have side effects [12–14].

Severe pain in HD was associated with an increasing risk of hospitalization, emergency department visits, shorter HD sessions [15], and mortality [16]. It can lead to a significant decrease in quality of life [17], cognitive decline [18], and impaired physical function [19].

In terms of its complexity, CP is overlooked in the treatment of HD patients, leading to silent suffering in these patients. This research will help to explain why some patients experience more CP while others consider it a simple problem. Understanding the many factors influencing and associating this experience is crucial in pain management. The assessment of the combination of different variables: biological (age, gender, laboratory parameters), physical (nociception, comorbidity, and dialysis), social (work, financial problems, social status), and outcomes is an adequate approach to identifying, understanding, and treating CP and reduce its impact.

To our knowledge, no prior study has investigated this model with CP in HD patients. Therefore, this study aims to explore the biological, physical, and social variables that might associate CP severity and CP interference with daily activities in patients undergoing HD.

Methods

Study design and setting

A multicenter, cross-sectional study, was conducted in patients with ESKD undergoing hemodialysis at four public hospitals in Morocco.

Study population and sampling technique

In the study area, 640 hemodialysis patients were cared for in various public hospitals and centers when this study was conducted. The Raosoft sample size calculator was used to determine a minimum sample size for this study, with a 95% confidence interval and 5% margin of error. The minimum sample size was set at 215. Convenience sampling.

was used to recruit and interview the patients. Subjects who satisfied each of the following criteria were progressively included in this study. Elderly patients with ESKD on hemodialysis ≥ 18 years of age, with HD duration ≥ 6 months at the time of the study, and who consented to participate in the research. The excluded criteria were mental disability, cancer, and hearing impairment. A total of 307 hemodialysis participated in the study. The research was conducted following the tenets of the Helsinki Declaration. Consent was acquired from every participant. All methods complied with all applicable guidelines and regulations, and all data was preserved confidentially.

Data collection instrument

Data collection was based on a structured questionnaire (Supplementary File 1) in three sections. Sociodemographic data included age, gender, residence, level of study, marital status, occupation, mode of transport, living conditions, health coverage, monthly income, and body mass index (BMI) categorized as follows: underweight (BMI of < 18.5 kg/m2), normal (BMI of 18.524.9 kg/m2), overweight (BMI of 25–29.9 kg/m2), and obese (BMI of ≥ 30 kg/m2). The lifestyle was

investigated by smoking status and respect for hygiene-dietary rules. The compliance with the diet was assessed using a question about adherence, according to previous studies [20]. Clinical and dialysis data set included the number of comorbidities (e.g. diabetes, hypertension, heart failure, ischemic heart disease, stroke, liver disease, and others), dialysis vintage in months, dialysis session duration, vascular access, and interdialytic weight gain in % (weight gain between two dialysis sessions in Kg/dry weight). The laboratory data were calcium (mg/L), hemoglobin (g/dL), PTH intact (1–84) (pg/mL), and phosphorus (mg/L).

Characteristics of chronic pain in the study

Pain and chronicity CP was defined as persistent or recurrent interdialytic pain lasting over 3 months [21]. The intradialytic pain and pain due to arteriovenous fistulas were excluded.

Severity Pain severity was assessed by the numeric rating scale (NRS). Pain screening tool enabling the patient to select the number representing pain perception between two extremities (0–10), the choice makes pain be categorized as absent for a score of 0, mild for a score from 1 to 3, moderate for a score of 4 to 6, and severe for a score of 7 to 10 [22].

Region and impact The Arabic version of the brief pain inventory (BPI) [23] was used to evaluate pain location and interference with activities in daily living. Fourteen sites were located by the instrument body map. Seven items were classified into two sub-dimensions, the affective sub-dimension (mood, relationship with others, and enjoyment of life) and the activity sub-dimension (walking, working, general activity, and sleep) measuring the CP interference. Each item was scored from 0 to 10, with 0 corresponding to "does not interfere" and 10 corresponding to "interferes completely". The total interference score was in the range (0–70).

Statistical analysis

The Statistical Package for Social Sciences (SPSS) program version 26 was utilized to analyze the data. Descriptive analysis was performed to describe the clinical, dialysis, and sociodemographic variables. Frequencies represented categorical variables. The quantitative data was represented by the mean ranks, medians, and interquartile (IQR: Q1, and Q3). The Kolmogorov-Smirnov test was used to evaluate the normality of the variables, and the internal consistency of BPI was evaluated using the Cronbach alpha test. The non-parametric tests assessed the association between the independent variables, pain severity, and interference scores using the Kruskal-Wallis H, and Mann-Whitney U tests. Spearman correlation was based on determining the relationship between the number of pain localization, laboratory variables (calcium, hemoglobin, PTH, and phosphorus), and the dependent variables. In addition, multiple linear regression analyses were applied to all significant variables. A p-value < 0.05 was the significance level. In case of missing data, the observation has been excluded.

Results

Population characteristics

330 chronic HD patients were enrolled, 16 participants were excluded due to non-eligibility for inclusion criteria (five under the age of 18 years, one pregnant woman, and 10 unable to participate), and seven subjects did not complete the questionnaire. The study comprised 307 patients (Fig. 1).

In total, 148 males (48.2%) and 159 females (51.8%) were included in the study, F/M ratio was 1.07. The mean age was 54.69 ± 15.02 years, age category (> 49 years) covered 66.8%. Most patients were rural provenance (50, 2%), illiterate (70.7%), and married (63.5%). The majority of subjects were unemployed (82.41%), living with family (96.7%), used a means of transport to get to the center (90.9%), had coverage economically diminished (99.0%), and had a monthly income of less than $297 (96.7%).

Regarding clinical and dialysis characteristics, 78.9% of HD had at least one comorbidity, and more than half of the participants had an unknown etiology for their ESKD. However, diabetic nephropathy and hypertensive nephropathy were the origins of 15.6% and 10.1% of cases respectively. 36.1% had at least two painful sites, 55% of cases have been on dialysis for more than 4 years (mean duration 5.68 ± 4.66 years), and 49.8% had interdialytic weight gain > 4%. Table 1 displays hemodialysis patients' sociodemographic, clinical, and dialysis characteristics. (see supplementary file 3). The means of laboratory parameters for calcium, hemoglobin, PTH, and phosphorus were 88.14 ± 10.39 mg/l, 9.13 ± 1.51 g/l, 320.36 ± 233.80 pg/ml, and 50.06 ± 19.13 mg/l, respectively.

The Cronbach α of the interference items was 0.98. Almost half of the HD patients had CP, the mean pain severity score was 3.73 ± 3.59, and the pain interference score was 22.89 ± 22.74. Their median and IQR were 4 (0–7) and 17(0–44) respectively, while the medians and IQR of pain interference items scores were 3(0–7) for general activity and working ability, walking ability 3(0–8), mood 2(0–6), sleep 1(0–7) relationships with others 2(0–6), and enjoyment of life 1(0–5). CP was presented in 49.18% of lower limbs, 23.45% of the back, 20.52% of hips, 14.65 of the shoulders, and 8.1% of the upper limbs. The mean pain duration in the CP group was 63.29 ± 55.39 months.

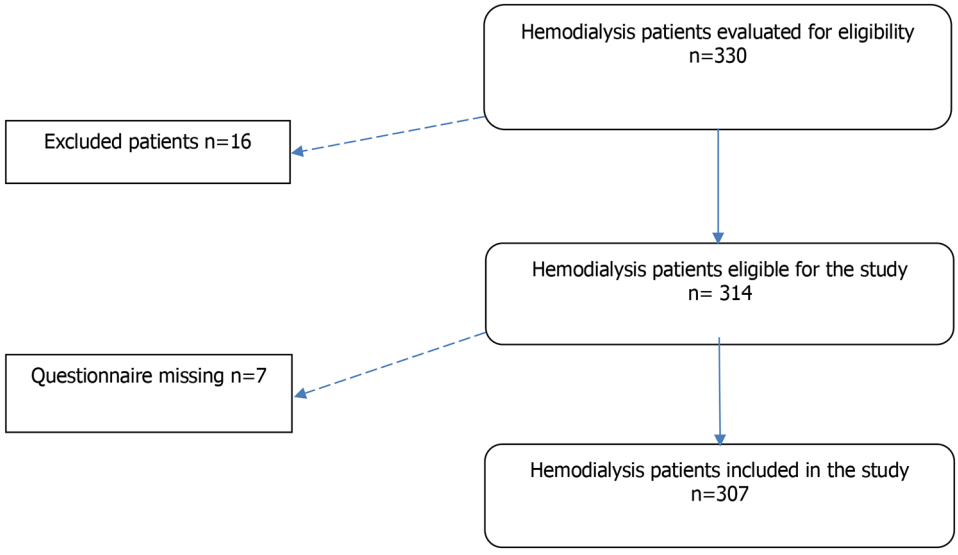

Fig. 1 Study recruitment flowchart

Socio-demographic, clinical, and dialysis factors of pain severity score

The results of the variables' association with the pain severity score are displayed in Table 2. Age ($p = 0.001$), gender ($p < 0.001$), residence ($p = 0.041$), level of study ($p < 0.001$), marital status ($p = 0.03$), number of comorbidities ($p < 0.001$), and dialysis vintage ($p < 0.001$) revealed a statistically significant association with the pain severity score. The remaining variables examined were not significantly associated with this score. The Spearman correlation coefficient value for the pain severity score with the number of pain sites was 0.876 with $p < 0.001$. (See Table 4 in the supplementary file 2).

Socio-demographic, clinical, and dialysis factors of pain interference score

The variables' association findings in univariate with the pain interference score are shown in Table 3. Age ($p < 0.001$), gender ($p < 0.001$), residence ($p = 0.03$), level of study ($p < 0.001$), marital status ($p = 0.013$), occupation ($p = 0.041$), monthly income ($p = 0.029$), number of comorbidities ($p < 0.001$), dialysis vintage ($p < 0.001$), and dialysis session duration ($p = 0.015$) showed a statistical association with a score of pain interference. No significant association was found between this score and the remaining analyzed variables. Furthermore, the correlation coefficient of pain interference with the number of pain sites was 0.886 with $p < 0.001$. (See Table 4 in the supplementary file 2).

Laboratory factors of pain severity and pain interference scores

The bivariate analysis was conducted to identify the possible laboratory factors correlated with pain severity and pain interference scores. The results revealed that the PTH level was significantly correlated with both scores, the correlation coefficients were 0.452 for the pain severity score, and 0.445 for the pain interference score ($p < 0.001$). However, it was not significant for the other laboratory parameters (calcium, hemoglobin, and phosphorus). (View Table 4 in the supplementary file 2).

Multiple linear regression analysis

The regression analysis indicates that gender ($p = 0.022$), HD with a number of comorbidities ($p = 0.001$), dialysis vintage ($p < 0.001$), the number of pain sites ($p < 0.001$), and the level of PTH ($p < 0.001$) were associated with a pain severity score. The multiple linear regression model's correlation results with the pain severity score are summarized in Table 5.

Using pain interference as a dependent variable in the multiple regression, the correlation indicated that older patients ($p = 0.049$), gender ($p = 0.007$), subjects with a number of comorbidities ($p < 0.001$), dialysis vintage ($p < 0.001$), the number of pain sites ($p < 0.001$), and the PTH level ($p < 0.001$) were significantly associated with pain interference score. Table 6 summarizes the multiple linear regression model with pain interference.

Discussion

The present study found that biological, clinical, and social variables associate with CP severity and CP interference with daily activities in patients undergoing HD.

More than half of HD patients had a CP, the mean pain severity and pain interference scores were 3.73 ± 3.59 and $22.89 \pm 23,745$,respectively. In a study conducted in Palestine, the results showed lower scores for both pain

Table 2 Chronic pain severity score according to socio-demographic, clinical, and dialysis characteristics

Variable	Mean rank	Median (Q1-Q3)	*P* value
Age			
18-49years	128,39	0(0–6)	**0.001***
50-65years	163,06	5(0–7)	
> 65years	172,99	5(0–7)	
Gender			
Male	135,09	0(0–6)	**< 0.001****
Female	171,60	5(0–8)	
Residence			
Urban	163,93	0(5–7)	**0.041****
Rural	144,13	0(3–7)	
Level of study			
Illiterate	170,67	5(0–7)	**< 0.001***
Primary	115,15	0(0–5)	
College	108,55	0(0-4.5)	
High school	126,92	0(0-7.25)	
Marital status			
Single	129,16	0(5.5)	**0.03***
Married	154,93	4(0–7)	
Divorced	148,81	0(0-7.5)	
Widowed	180,14	5.5(2.25-8)	
Occupation			
Unemployed	155,07	4(0–7)	0.57**
Employed	136,45	4(0–7)	
Mode of transport			
Car	155,95	4(0–7)	0.2**
Foot	134,61	0(0–5,75)	
Living conditions			
With family	154,00	4(0–7)	NS**
Alone	154,00	4,5(0–6,25)	
Health coverage			
Coverage of economically diminished	153,23	4(0–7)	0.11**
Employee coverage	231,83	6(7-NA)	
Monthly income			
< 297 $	155,72	4(0–7)	0.053**
> 297 $	102,95	0(0–4,25)	
Smoking status			
Current smoker	110,00	0(0–6)	0.16**
Non-smoker	155,03	4(0–7)	
Number of comorbidities			
No comorbidity	124,52	0(0–5)	**< 0.001***
1 to 2 comorbidities	146,47	3(0–6)	
> or equal 3 comorbidities	181,41	6(0–8)	
Respect for hygiene-dietary rules			
yes	151,98	4(0–7)	0.78**
No	154,88	4(0–7)	
Body Mass Index Kg/m^2			
< 18.5	129,09	0(0–6)	
18.5–24.9	152,30	4(0–7)	0.088*
25–29.9	167,07	5(0–8)	
≥ 30	177,02	6(0–8)	
Dialysis vintage/ Months			
< 24	115,39	0(0–5)	**< 0.001***
24–48	146,73	3(0–6,5)	
> 48	173,47	6(0–7,50)	
Vascular access			
AVF proximal	165,37	5(0–7)	0.2*
AVF distal	154,40	4(0–7)	
Tunneled catheter	129,00	0(0–5)	
Interdialytic weight gain %			
≤ 4	149,14	4(0–7)	0.31**
> 4	158,90	5(0–7)	
Dialysis session duration			
< 4	180,89	5(2–7)	0.085**
⩾4	151,41	4(0–7)	

* Kruskal-Wallis test

** Mann-Whitney U test

Significant result in bold type $p < 0.05$

severity and pain interference in HD patients compared to the findings of this research [24].

Sociodemographic factors

Pain severity and pain interference scores increased with advancing age and females, which aligned with Marzouq's study [24]. This finding could be related to the fact that advancing in age is associated with a change in the balance of pain modulation, characterized by a decrease in pain inhibition [25]. Besides, age-related psychosocial changes can additionally affect pain [25]. For the sex differences in pain, the contribution of biological factors such as sexual hormones could explain the difference in pain perception, pain behaviors, and thresholds between both sexes [26]. Widowed and illiterate hemodialysis patients suffer from higher levels of pain severity and pain interference. In addition, unemployed patients, and those who had less than < 297 $ as a monthly income had high pain interference scores, which have been found in other research [24, 27]. This finding is in line with the literature that underscores the negative correlation between social support and pain intensity [28]. Furthermore, disparities in pain perception according to education level could be due to the disparities in the attitude of educated subjects and illiterate regarding medical use and addiction. Moreover, patients with literacy issues in less developed regions might have an access problem to quality pain healthcare [29]. The relationship between economic level and pain can be justified by the fact that a low income may prevent a patient from accessing costly pain management treatments, and limit their ability to get medical care [30].

HD patients living in urban areas had higher pain severity and interference than rural residents. This result was in contrast with that reported by Khaled [31]. The

Table 3 Chronic pain interference score according to socio-demographic, clinical, and dialysis characteristics

Variable	Mean rank	Median (Q1-Q3)	*P* value
Age			
18-49years	126.03	0(0–36)	**< 0.001***
50-65years	162.32	25(0–47)	
> 65years	177.41	33.5(0-45.75)	
Gender			
Male	133.58	0(0–36)	**< 0.001****
Female	173.01	28(0–51)	
Residence			
Urban	164.57	25(0-46.5)	**0.03****
Rural	143.5	9(0–41)	
Level of study			
Illiterate	171.99	32(0-47.5)	**< 0.001***
Primary	113.07	0(0–24)	
College	105.45	0(0–21)	
High school	113.08	0(0-34.25)	
Marital status			
Single	127.3	0(0-31.5)	**0.013***
Married	155.12	20(0–44)	
Divorced	143.04	0(0-44.5)	
Widowed	183.11	33(4.5–48)	
Occupation			
Unemployed	158.58	21(0–45)	**0.041****
Employed	132.53	0(0-37.25)	
Mode of transport			
Car	156.22	21(0–45)	0.14**
Foot	131.84	0(0-34.25)	
Living conditions			
With family	154.34	17(0–45)	0.7**
Alone	143.95	16.5(0-28.25)	
Health coverage			
Coverage of economically diminished	153.43	17(0–44)	0.23**
Employee coverage	211.67	33(31-NA)	
Monthly income			
< 297 $	155.95	21(0–45)	**0.029****
> 297 $	96.05	0(0–13)	
Smoking status			
Current smoker	106.5	0(0–36)	0.13**
Non-smoker	155.11	20.5 (0–45)	
Number of comorbidities			
No comorbidity	124.14	0(0-32.5)	**< 0.001***
1 to 2 comorbidities	144.22	6(0–42)	
> or equal 3 comorbidities	184.48	35(0–54)	
Respect for hygiene-dietary rules			
yes	152.23	17(0–44)	0.81**
No	154.77	21(0-45.25)	
Body Mass Index Kg/m²			
< 18.5	127.3	0(0-35.75)	0.89*
18.5–24.9	153.37	17(0–45)	
25–29.9	165.33	25(0–50)	
≥ 30	176.33	33(0–58)	
Dialysis vintage/ Months			
< 24	114.53	0(0–19)	**< 0.001***
24–48	149.9	13(0–42)	
> 48	172.62	33(0-47.5)	
Vascular access			
AVF proximal	168.15	29(0-46.5)	0.28*
AVF distal	153	17(0–44)	
Tunneled catheter	136.27	0(0-36.75)	
Interdialytic weight gain %			
≤ 4	150.04	15(0–42)	0.41**
> 4	157.98	21(0–46)	
Dialysis session duration			
< 4	192.09	35(4–51)	**0.015****
⩾4	150.33	14(0-43.75)	

* Kruskal-Wallis test

** Mann-Whitney U test

Significant result in bold type $p < 0.05$

result can be explained by the fact that nearby natural areas buffer the relationship between pain-related catastrophizing and pain severity and moderate the link between pain-related rumination and pain intensity, leading to a reduction in CP severity [32].

Dialysis and clinical factors

Dialysis vintage was one more variable associated with pain severity and pain interference. This result matched previous research [33], and the biological mechanism could explain the evidence. The long duration of HD was involved in increased beta-2-microglobulin in the blood leading to dialysis-related amyloidosis which causes bone and joint pain [34]. However, no medical treatments are currently available to address these symptoms [34].

The number of painful sites was an additional significant variable associated with pain severity and pain interference. Likewise, a recent study found that the number of CP sites was associated with the presence and severity of neuropathic pain and its symptoms [35]. Furthermore, the higher number of painful sites increases the risk of low workability with a dose-response relationship and enhances the number of healthcare contacts and medical care-related costs [36, 37]. This relationship may be described by the effect of multi-chronic painful sites on health conditions across a range of physiological systems and biomarkers such as ferritin [38]. Thus, multisite pain is considered an acceptable diagnostic criterion, leading to less ambiguity in practice [39].

Another interesting finding was the number of comorbidities that correlate to pain severity and pain interference. Similarly to Lemes's research, the number of comorbidities was a predictor variable of CP and

Table 5 Multiple linear regression analysis for associated factors of pain severity score

	B	Sig	95% Confidence Interval for B	
			Lower bound	Upper bound
(Constant)	-2.643	0.017	-4.815	-0.472
Age	0.318	0.108	-0.071	0.706
Gender	0.622	**0.022**	0.090	1.154
Residence	-0.090	0.734	-0.612	0.432
Level of studies	-0.2	0.303	-0.581	0.181
Marital status	-0.071	0.667	-0.395	0.253
Number of comorbidities	0.6	**0.001**	0.257	0.943
Number of painful sites	1.423	**< 0.001**	1.238	1.608
Dialysis vintage	0.623	**< 0.001**	0.315	0.932
PTH	0.003	**< 0.001**	0.001	0.004

PTH: parathyroid hormone

Sig: Significant

Table 6 Multiple linear regression analysis for associated factors of pain interference score

	B	Sig	95% Confidence Interval for B	
			Lower bound	Upper bound
(Constante)	-20.487	0.086	-43.863	2.889
Age	2.777	**0.049**	0.035	5.518
Gender	5.384	**0.007**	1.468	9.301
Residence	-0.337	0.847	-3.777	3.103
Level of studies	-1.437	0.260	-3.941	1.067
Marital status	-0.842	0.435	-2.960	1.276
Occupation	1.844	0.476	-3.239	6.926
Monthly income	-4.041	0.399	-13.449	5.366
Number of comorbidities	4.301	**< 0.001**	2.034	6.569
Number of painful sites	9.140	**< 0.001**	7.934	10.346
Dialysis vintage	4.506	**< 0.001**	2.465	6.547
Dialysis sessions duration	-0.373	0.902	-6.349	5.603
PTH	0.018	**< 0.001**	0.010	0.025

PTH: parathyroid hormone

Sig: Significant

disability [40]. Comorbidities can exacerbate CP through enhancing peripheral nociception, leading to central and peripheral pathophysiological modifications associated with CP [41, 42], and/or activation of attention circuits, arousal, or stress, leading to dysregulation of the pain modulation system [43, 42]. This complex link is mediated by several biological, psychological, and social mechanisms [43], adding to the vicious cycle of pain-stress-reactivity [44].

Laboratory factors

Several studies demonstrated the association between pain severity and PTH [45]. As highlighted in this study, PTH was associated with CP severity and interference. PTH is a biological marker characterizing renal osteodystrophy that manifests as bone pain. On the one hand, the PTH changes bone morphology to maintain calcium levels in HD patients through the bone catabolic effect of PTH by activating the PTH 1 receptor [46], the other hand, PTH 2 receptor activation stimulates the nociceptive A-fiber and this sensitization increases after nerve injury [47]. However, pain is reduced after parathyroidectomy [48].

The relationship analysis of the present research revealed that female, HD patients with a number of comorbidities, dialysis vintage, the number of pain sites, and level of PTH were significantly associated with pain severity and interference. This fact could be attributed to the interaction of the biological, and sociodemographic factors with other variables in complex ways to impact pain [25].

In agreement with existing evidence, the factors associated with pain severity were almost factors associated with pain interference. This finding could be related to a strong correlation between pain and pain interference (spearman correlation 0.962, $p < 0.001$). This result is expected considering pain was the barrier to functional activities in HD. This fact can be explained by the negative impact of CP on several substantial areas of life, including sleep, attending social events, maintaining an independent lifestyle, the ability to exercise, performing domestic tasks, walking [49], and a sedentary lifestyle [50].

The present research had a few limitations, first, the study was limited to a specific cohort of hemodialysis patients; all patients were from the same geographic area which may make the results non-generalizable to all HD. Second, data collection was carried out during dialysis sessions, which may have affected the patient's perception of pain and, as a result, the interpretation of pain severity. Third, the cross-sectional design limits deducing the causes of the relationships observed between pain severity, pain interference, and independent variables. Therefore, longitudinal research on pain severity and pain interference is important, using the information on the patients interviewed as part of the monitoring process. Nevertheless, the multi-center setting, substantial sample size, and unique research provide an association analysis of CP severity and interference with PTH and a number of painful sites, demonstrating the relevance of the results. Future studies are required on pain severity pathways and interference by exploring pain types, pain sites, other biomarkers, and pain management. Furthermore, it is important to assess the impact of each chronic disease on pain severity and pain interference.

Conclusions

Chronic pain was a frequent symptom in patients undergoing HD. The subgroup with increased pain severity included patients of advanced age, female, with lower education levels, urban residency, married, subjects living with multiple comorbid conditions, with length dialysis vintage, those with a high number of painful sites, and with increased PTH level. Predictors of pain severity scores include gender, number of comorbidities, dialysis vintage, number of pain sites, and PTH level. This study demonstrated a moderate correlation between PTH and pain severity, and a strong correlation between pain severity and a number of pain sites. Healthcare providers should focus more attention on CP in patients undergoing HD. Assessing and reducing the severity of pain and its interference must be a priority in the care of this population through evaluating and managing modifiable factors. The findings of this research can contribute to prioritizing and taking care of the factors that might be considered as a key part of multidisciplinary pain management and improving pain outcomes. In addition, developing clinical and practical strategies to limit pain's decline and impact must be implemented to improve health-related quality of life.

Abbreviations

ESKD End-stage kidney disease
HD Hemodialysis; CP: Chronic pain
PTH Parathyroid hormone; IQR: Interquartile

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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Not applicable.

Author contributions

FZB conducted the study, participated in collecting data, and drafted the original manuscript. NA contributed to the conception and design of the study. YI performed the statistical analysis and interpretation. MA participated in collecting data and interpretation. AE and MC supervised, critically reviewed, and finalized the manuscript. All authors read and approved the final manuscript.

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Data availability

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request. (due to data confidentiality)

Declarations

Ethics approval and consent to participate

The study was conducted following the tenets of the Helsinki Declaration, and approved by the Ethics Committee for Biomedical Research of the MOHAMMED V Faculty of Medicine and Pharmacy in RABAT (CERB 28 – 24). Written informed consent was acquired from every participant. All methods complied with all applicable guidelines and regulations and all data was preserved confidentially.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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