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Assessing pain levels and quality of life in peritoneal dialysis patients: a cross-sectional study

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Abstract

Background End-stage renal disease is a significant global health issue, and Peritoneal Dialysis (PD) is a vital treatment modality. The study aims to assess the Quality of Life (QoL) and pain levels in PD patients and explore potential influencing factors.

Methods A cross-sectional study was conducted in 2022 involving 76 PD patients at a referral tertiary dialysis center in Palestine. The study evaluated patient demographics, clinical data, laboratory measures, quality of life as assessed by the KDQOL-SF36, and pain levels as determined by the Brief Pain Inventory. Statistical analyses, including multivariate linear regression, were employed to identify relevant associations.

Results This study included 76 PD disease patients, with 68.4% being under the age of 60 and 53.9% being male. Almost one-third of the participants (34.0%) reported mild to severe pain, and 23.7% reported low to high interference levels. Pain severity was negatively correlated with supplement doses for both vitamin D3 ($p=0.049$) and calcium ($p<0.01$). Female patients reported higher pain severity ($p=0.001$) and interference ($p<0.007$) levels. The study revealed relatively higher QoL among our cohort of PD patients compared to previously published findings in similar settings, specifically for HD populations. Factors such as age, comorbid conditions, and duration of dialysis influenced QoL ($p<0.05$). Pain severity and interference were negatively correlated with QoL ($p=0.01$).

Conclusion This study provides valuable insights into the QoL and pain experiences of PD patients in Palestine. It underscores the importance of effective pain management strategies and holistic care to improve QoL in this patient population. Addressing psychological and emotional well-being is vital for optimizing treatment adherence and long-term outcomes.

Clinical trial number Not applicable.

Keywords End-stage renal disease, Peritoneal dialysis, Brief pain inventory, Quality of life, Pain severity

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Introduction

End Stage Renal Disease (ESRD) is the ultimate consequence of chronic kidney disease (CKD), which is responsible for many premature deaths worldwide [1]. Peritoneal Dialysis (PD), a form of kidney replacement therapy, involves placing a long-term catheter into the peritoneal cavity, utilizing the peritoneum as a dialysis membrane. The patient can self-administer PD at home or with assistance [2, 3].

The PD program at An-Najah National University Hospital had its beginnings in 2016. It is the largest PD center in Palestine, serving patients from across the West Bank and Gaza Strip. Over the years, it has evolved and expanded to address the increasing demand for kidney replacement therapy due to the growing number of ESRD patients. Since its establishment, it has experienced steady expansion, reaching 178 patients by December 2021. Despite facing limited resources and challenging conditions, it has achieved favorable outcomes [4].

Health-Related Quality of Life (QoL) is considered a crucial measurement of dialysis patients' physical and emotional well-being, and it is one of the major determinants of mortality and morbidity in ESRD patients [5–7]. ESRD patients suffer a considerable physical, emotional, and social burden in different aspects of their lives [8]. Due to its chronic nature, frequency, and the fact that most patients have additional conditions that make them dependent on others, PD may impact patients' quality of life. Previous studies have shown that ESRD patients have lower QoL than the general population [9, 10]. Some determinants of QoL among PD patients include age, gender, body mass index (BMI), comorbid conditions, and various laboratory markers [11, 12].

Pain is a frequent concern among dialysis patients, and it is crucial to address it effectively. The International Association for the Study of Pain defines pain as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage" [13]. Recent research indicates that 33% of PD patients experience pain [14], a notably higher percentage compared to the 20% reported in the general adult population [15]. The potential causes of Pain in ESRD patients have been identified in numerous studies, with disruption in bone mineral density (BMD) considered one of the significant contributors [16]. Limited studies have explored the impact of Pain on PD patients, with one study revealing its connection to symptoms of depression, sleep disturbances, and overall QoL [14]. Understanding the pain experienced by PD patients is essential for developing more effective interventions. It is imperative to prioritize the management of chronic pain in PD patients, both in clinical practice and research, as inadequate pain management can significantly disrupt various aspects of patients' lives, including their functional status, mood, and sleep [17, 18].

Several studies involving hemodialysis patients have consistently shown that pain is linked to a lower QoL [19, 20]. However, there has been less research on PD patients. Among the limited studies conducted on PD patients, one also found that pain is associated with a poorer QoL [14]. Improving QoL in dialysis patients has been associated with more adherence to treatment, which reflects positively on the disease course and overall survival [10, 21]. Therefore, it is essential to highlight the QoL and pain levels using different scales, particularly for PD patients from developing countries such as Palestine, where they suffer from hard socioeconomic status that affects their QoL. This study evaluated the QoL and pain levels experienced by patients with PD using standardized scales. Furthermore, it aimed to explore any potential variables related to these factors. This will help to provide valuable insights for healthcare workers, enabling them to address specific needs and implement measures that can ultimately enhance the overall well-being and outcomes of individuals with ESRD who are undergoing PD.

Methods

Study design and population

This cross-sectional study occurred from August to Dec 2022 at the NNUH dialysis center in Palestine. NNUH is a referral hospital with the largest dialysis center in Palestine and the only facility in the region that offers PD. Consequently, patients from across the West Bank of Palestine are referred to the NNUH dialysis center.

The study population is ESRD patients undergoing PD. These patients could conduct the dialysis independently and receive monthly check-ups in the dialysis center at NNUH. At the time of the.

Study, 102 patients were undergoing PD, of whom 76 PD patients were included. The criteria for inclusion were patients above 18 years of age who were on regular peritoneal dialysis, while severely ill or bedridden patients, as well as patients who refused to participate, were excluded from this study. The simple flowcharts in Fig. 1 demonstrate the exact process.

Measures and data collection

Upon obtaining informed consent from the participants, we gathered baseline demographic and clinical data. This information was obtained from their medical records and through direct patient communication. The data included the patient's age, gender, BMI, duration of PD, smoking status, presence of any other medical conditions, history of kidney transplant, past hemodialysis treatment, and menopause status for female patients. We obtained venous blood samples from each patient

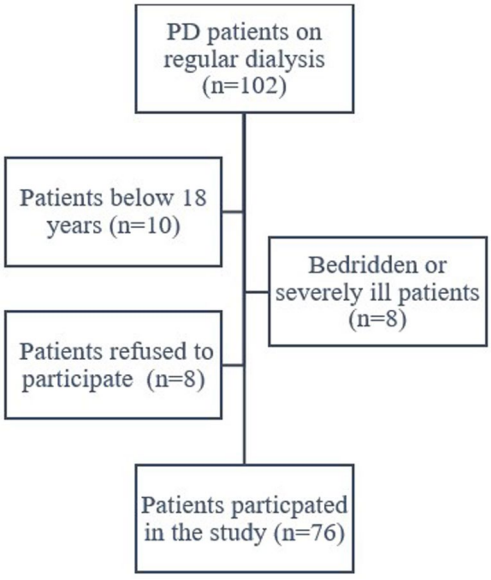

Fig. 1 Flowchart of patient recruitment and study process

during their regular monthly follow-up visits. These samples measured laboratory and biochemical markers such as albumin, calcium, phosphate, alkaline phosphatase, 25-HydroxyVitamin D, hemoglobin, and ferritin. The blood samples were immediately sent to the laboratory for analysis, and all measurements were performed on the same day. Each patient had one set of blood samples analyzed.

Vitamin D levels were assessed using the Elecsys kit. BMD assessments were conducted using DEXA scans (Hologic apparatus model Discovery WI S/N 82189) performed within the same month as other biomedical measurements.

We used the Brief pain inventory (BPI) to assess pain. It consists of 15 divided into two sections; the first assesses the pain severity, and the second assesses interference with daily life. The assessment of pain severity involved using four different questions, namely the evaluation of the worst, least, average, and current pain levels. Chronic pain was defined as pain persisting for three months or more, based on the widely accepted definition established in the literature [22]. Each question was rated on a scale from 0 (no pain) to 10 (worst pain). An overall measure of pain intensity was obtained by calculating the mean value derived from the responses to these four questions. Pain severity was classified as mild (1–4 points), moderate (5–6 points), or severe (7–10 points). The pain interference score comprised the mean of seven items: activities in general, mood, mobility ability, sleep, work, interpersonal relationships, and life opportunities; each item was rated between 0 (no interference) and 10 (complete interference). Pain interference was classified as no interference (0 points), low interference (1–4 points), and high interference (5–10 points). The validity and reliability of BPI has been proven in the literature [23], including the Arabic version [19, 24]. The Cronbach's alpha for pain severity and interference were found to be 0.92 and 0.85, respectively, indicating excellent reliability.

We used the Kidney Disease Quality of Life Short Form-36 (KDQOL-SF36) to assess QoL, which consists of 36 questions. The calculated overall score is 100; the higher the score, the better the patient's QoL. The KDQOL-SF36 Score was summarized into Physical Component Summary (PCS) and Mental Component Summary (MCS). Physical functioning (10 questions), physical role (4 questions), bodily discomfort (2 questions), and general health (5 questions) comprise the PCS's four dimensions. MCS includes four dimensions: vitality (3 questions), social functioning (4 questions), role emotive (5 questions), and mental health (2 questions). Both MCS and PCS scores were calculated as the average of these dimensions. This form is valid and reliable, as studies have shown [25] and its Arabic version [19, 26]. The Cronbach's alpha for PCS and MCS were 0.92 and 0.89, respectively, suggesting excellent reliability.

We used the Arabic versions of the KDQOL-SF36 and BPI, both of which have been previously validated for use in Arabic-speaking populations. The reliability and validity of these tools have been established as mentioned in earlier studies [24, 26]. The questionnaires were administered through face-to-face interviews during patients' routine monthly follow-up visits at the dialysis center to ensure comprehension and accuracy.

Statistical analysis

The data collected in this study was entered and analyzed using IBM SPSS for Windows V.21.0. No missing data were reported in this study. We assessed the data for normality using the Shapiro-Wilk test. Medians were used if the data was not normally distributed. Frequency and percentages were used to describe the categorical data. The correlation was investigated using Spearman's correlation coefficients. A multivariate linear regression analysis was used to determine variables associated with pain severity, pain interference, Physical Component Summary, and Mental Component Summary. The model incorporated the parameters statistically significant in the univariate analysis and other relevant variables indicated by the literature. The regression model used the variance inflation factor to detect the multicollinearity between independent variables. We did not find a problem with multicollinearity between the independent variables. Statistical significance was set at p-value ≤ 0.05.

The study and its protocols received approval from the Institutional Review Board committee of An-Najah National University [Reference #: Med. Feb. 2022/21]. Necessary permissions were obtained from the hospital.

Table 1 Clinical and laboratory characteristics of the study participants

	Frequency (%)	Mean ± SD
Age *Total*		49.5 ± 16.5
Age ≥ 60 years	24 (31.6%)	
Age < 60 years	52 (68.4%)	
Gender		
Male	41 (53.9%)	
Female	35 (46.1%)	
Social Status		
Married	47 (59.5)	
Not Married	32 (40.5%)	
Body Mass Index *Total*		25.4 ± 5.5
Underweight	6 (7.9%)	
Normal	35 (46.1%)	
Overweight	35 (46.05)	
Duration of Peritoneal Dialysis *(Months)*		23.0 ± 15.0
Total Duration on Dialysis *(Months)*		75.4 ± 53.3
Hypertension*(Yes)*	57 (75.0%)	
Diabetes Mellitus *(Yes)*	25 (32.9%)	
Smoking History *(Yes)*	27 (35.5%)	
History of Hemodialysis *(Yes)*	57 (75.0%)	
History of Transplant *(Yes)*	13 (17.1%)	
Menopause Status *(Yes)*	18 (51.4%)	
Alkaline Phosphatase (*U/L)*		122.3 ± 67.1
PTH (pg/ml)		439.4 ± 323.2
Albumin *(g/dl)*		3.65 ± 0.43
25 Vitamin D		10.8 ± 7.6
Calcium Measured *(mg/dl)*		9.1 ± 0.71
Phosphate *(mg/dl)*		5.46 ± 1.56
Ferritin *(ng/ml)*		576.7 ± 588.8

All procedures were carried out in compliance with relevant national guidelines and regulations, laws, and the Declaration of Helsinki. Patient participation was voluntary, and they were provided with a clear explanation of the study's goals, objectives, and potential risks. No identifying information was collected. Data access was limited to the study team for research purposes only. All study participants provided their informed consent.

Results

Background characteristics of the patients

A total of 76 PD Patients participated in this study. Around 31% ($n = 24$) of patients were above 60. Approximately 46% ($n = 35$) were females, and 83% had been on PD for over a year. Of the participants, 75% ($n = 57$) were previously on HD, and 44% ($n = 35$) of patients were transferred to PD based on their preference. In comparison, 31% ($n = 25$) were transferred due to difficult vascular access., and 17% ($n = 13$) had a history of kidney transplant. The baseline demographic, clinical, and laboratory characteristics of the patients are displayed in Table 1. It is important to note that all patients with hyperparathyroidism in this study had secondary hyperparathyroidism, as no cases of primary hyperparathyroidism were observed.

Table 2 Spearman correlation of clinical and laboratory variables with pain status

	Pain severity *r* (*P* value)	Pain interference *r* (*P* value)
Age	0.069 (0.556)	0.140 (0.226)
BMD Femoral	-0.098 (0.403)	-0.065 (0.578)
BMD Lumbar	-0.048 (0.682)	-0.129 (0.271)
BMI	0.096 (0.411)	0.098 (0.399)
Duration of PD	0.155 (0.181)	0.046 (0.696)
Total Duration on Dialysis	-0.154 (0.185)	-0.177 (0.126)
1,25 Vit D Dose	-0.226 (0.049*)	-0.103 (0.377)
Ca Sup Dose	-0.268 (0.019*)	-0.282 (0.014*)
Sevelamer Binder Dose	0.004 (0.974)	0.04 (0.730)
25 Vitamin D Levels	0.086 (0.459)	0.118 (0.310)
ALP	-0.068 (0.562)	-0.041 (0.724)
PTH	0.043 (0.715)	-0.028 (0.813)
Albumin	-0.013 (0.914)	-0.024 (0.836)
Calcium	0.123 (0.291)	0.076 (0.513)
Phosphate	-0.061 (0.599)	0.029 (0.803)
Ferritin	0.034 (0.768)	0.061 (0.598)
Hemoglobin	-0.073 (0.529)	-0.066 (0.571)

* r: Correlation Coefficient

Pain severity and interference

Almost one-thirds of the patients who participated in the study ($n = 12$, 34.0%) reported mild to severe pain on the BPI severity scale, and 23.7% ($n = 14$) reported low to high interference levels. Pain severity was negatively correlated with supplement doses for both vitamin D3 ($p = 0.049$) and calcium ($p < 0.01$). In the univariate analysis no significant correlation was found between both pain severity and interference with age, BMD, social status and DM. Additionally, no significant correlation was found with duration of PD, total duration of dialysis, as well as calcium and 25 vitamin D lab results (Table 2). In the multivariate linear regression model, female patients have associated higher pain severity as well as pain interference score (β, 2.083, 95%CI, 0.867–3.299, $p = 0.001$; β, 1.425, 95%CI, 0.404–2.446, $p = 0.007$); (Table 3).

Quality of life

For the QoL, the median score was 57.5 ± 25.4 for PCS and 67.2 ± 24.3 for MCS. The mean results for each component are demonstrated in Supplementary Table 1. The univariate analysis showed a significant negative correlation between age and BMI with PCS and MCS ($p < 0.05$). Both pain severity and interference showed a significant negative correlation with PCS and MCS ($p < 0.01$). However, the PCS correlated significantly with albumin levels and calcium supplement dose ($p < 0.05$). On the other

Table 3 Factors significantly associated with pain severity and interference scores according to multiple linear regression analyses

Variable	Pain severity			Pain interference		
	B (95%CI)	Adjusted B (95%CI)	aP value	B (95%CI)	Adjusted B (95%CI)	aP value
Age	0.01 (-0.01- 0.05)	0.01 (-0.02- 0.05)	0.403	0.02 (-0.00- 0.05)	0.02 (-0.00- 0.05)	0.078
Gender *(Female)*	2.04 (0.93–3.14)	2.08 (0.86–3.29)	0.001*	1.15 (0.21–2.10)	1.42 (0.40–2.44)	0.007*
Hypertension *(Yes)*	0.99 (-0.36- 2.36)	1.33 (-0.16- 2.83)	0.079	0.96 (-0.14- 2.07)	0.83 (-0.43- 2.10)	0.193
History of Fractures *(Yes)*	2.13 (-0.02- 4.30)	1.10 (-1.04- 3.26)	0.308	1.27 (-0.51- 3.06)	0.77 (-1.03- 2.59)	0.395
Duration of PD	0.01 (-0.02- 0.05)	0.00 (-0.03- 0.04)	0.923	0.00 (-0.03- 0.03)	-0.00 (-0.04- 0.02)	0.713
Vit D3 Dose	-1.27 (-2.60- 0.05)	-0.90 (-2.24- 0.43)	0.18	-0.52 (-1.63- 0.58)	-0.02 (-1.14- 1.09)	0.965
25 Vitamin D	-0.02 (-0.09- 0.05)	0.01 (-0.06- 0.08)	0.791	-0.01 (-0.07- 0.05)	0.01 (-0.04-0.08)	0.613
Alkaline Phosphatase	0.00 (-0.01- 0.01)	0.00 (-0.00- 0.01)	0.315	0.00 (0.00- 0.01)	0.00 (0.00- 0.01)	0.081
PTH	0.00 (-0.00- 0.00)	0.00 (-0.00- 0.00)	0.997	-0.00 (0.00–0.00)	-0.00 (-0.00- 0.00)	0.37
Phosphate	-0.26 (-0.65- 0.11)	-0.06 (-0.45- 0.32)	0.735	-0.1 (-0.41- 0.21)	0.08 (-0.24- 0.40)	0.629
Ferritin	0.00 (-0.00- 0.00)	0.00 (-0.00- 0.00)	0.831	0 (0.00–0.00)	0 (0.00–0.00)	0.925

* B: Beta Coefficient, P: p value, aP: adjusted p value

Table 4 Spearman correlation of clinical and laboratory variables with Quality-of-Life status

	Quality of life/PCS *r* (*P* value)	Quality of life/MCS *r* (*P* value)
Age	-0.469 (0.01*)	-0.337 (0.01*)
BMD Femoral	0.066 (0.572)	-0.084 (0.475)
BMD Lumbar	-0.142 (0.226)	-0.143 (0.221)
BMI	-0.241 (0.036*)	-0.228 (0.047*)
Duration of PD	-0.136 (0.242)	0.037 (0.75)
Total Duration on Dialysis	0.114 (0.327)	0.229 (0.067)
1,25 Vit D Dose	0.147 (0.206)	0.075 (0.52)
Ca Sup Dose	0.272 (0.018*)	0.154 (0.184)
Sevelamer Binder Dose	-0.01 (0.935)	-0.009 (0.937)
Pain Severity	-0.508 (0.01*)	-0.396 (0.01*)
Pain Interference	-0.512 (0.01*)	-0.458 (0.01*)
25 Vitamin D Levels	0.059 (0.615)	0.053 (0.648)
ALP	-0.026 (0.821)	-0.114 (0.325)
PTH	-0.054 (0.643)	0.034 (0.772)
Albumin	0.304 (0.01*)	0.131 (0.259)
Calcium	-0.275 (0.016*)	-0.200 (0.084)
Phosphate	0.142 (0.22)	0.066 (0.568)
Ferritin	-0.179 (0.122)	-0.145 (0.213)
Hemoglobin	0.102 (0.383)	-0.074 (0.524)

* r: Correlation Coefficient, PCS: Physical component summary, MCS: Mental component summary

hand, calcium lab results were negatively correlated with PCS ($p < 0.05$); the higher the calcium level, the lower the PCS. There was no significant correlation between PCS, MCS, and social status or the total duration of dialysis ($p > 0.05$) (Table 4). Two multivariate models were performed to detect the association with PCS and MCS. These two response variables were independently associated with gender, age, BMI, BMD Femoral neck, BMD Lumbar spine, duration of PD in months, Vit D3 dose, Ca dose, pain severity score, pain interference score, binder dose, 25 Vitamin D, alkaline phosphatase, PTH, albumin, Ca lab, phosphate, ferritin, hemoglobin, HTN, DM, smoking, and history of fractures.

PCS was negatively associated with age (β, -0.417, 95%CI, -0.726–0.107, $p = 0.009$), pain interference score (β, -4.963, 95%CI, -7.368–2.558, p = < 0.001), and HTN (β, -13.792, 95%CI, -26.827– -0.756, $p = 0.038$). Additionally, MCS was negatively associated with age (β, -0.605, 95%CI, -0.884– -0.327, $p < 0.001$), BMD Lumbar spine (β, -5.902, 95%CI, -10.35– -1.45, p = < 0.001), pain interference score (β, -5.074, 95%CI, -7.23– -2.91, $p = 0.038$), and HTN (β = 12.91, 95%CI -26.37– -3.24, $p = 0.013$). However, albumin was positively associated with MCS (β, 12.91; 95% CI, 1.35–24.47; $P = 0.029$) (Table 5).

Discussion

In this study, we assessed QoL and pain levels in PD patients. ESRD patients suffer lower QoL and higher pain levels than the general population [12]. This contributes to significant mortality and morbidity in this vulnerable patient group. In our study, we measured QoL using KDQOF-36 short form; the median of both PCS and MCS were 63.8 and 73.3, respectively. Our study found higher QoL scores in PD patients compared to a similar study in Turkey, with substantially lower medians for PCS (39.3) and MCS (42.1) [27]. Lower scores were attributed to factors such as fatigue, depression, and poor nutritional status. These factors, specifically depression, were highlighted as significant contributors to reduced QoL. However, our study did not address these factors. Local healthcare systems, social support, and access to treatment may also play a role in these differences. Although, 59.5% of the patients in our study were married compared to 75.6% in Turkish. Future studies focusing on fatigue, depression, and nutritional status could offer a more detailed explanation for these disparities in QoL.

However, one study in Palestine on hemodialysis patients reported a median PCS of 41.4 and MCS of 54.0 [19]. Other studies confirm this result, as one meta-analysis reported higher QoL in PD than in hemodialysis

Table 5 Multivariable linear regression analysis showing independent variables associated with Quality-of-Life components

Variable	Physical component summary			Mental component summary		
	B (95%CI)	Adjusted B (95%CI)	aP value	B (95%CI)	Adjusted B (95%CI)	aP value
Age	-0.55 (-0.87- -0.23)	-0.41 (-0.72- -0.10)	0.009	-0.75 (-1.06- -0.43)	-0.60 (-0.88- -0.32)	0.001
Gender (Female)	-4.85 (-16.02- 6.32)	1.57 (-8.52- 11.67)	0.757	-14.75 (-25.95- -3.55)	-7.79 (-16.89- 1.29)	0.091
BMI	-1.14 (-2.13- -0.14)	-0.71 (-1.88- 0.45)	0.227	-1.15 (-2.19- -0.11)	-0.93 (-1.97- 0.10)	0.078
BMD lumbar spine	-1.75 (-5.77- 2.25)	-1.28 (-6.47- 3.90)	0.623	-1.70 (-5.87- 2.46)	-5.90 (-10.35, -1.45)	0.01
Duration of PD	0.04 (-0.32- 0.42)	-0.01 (-0.35- 0.32)	0.937	-0.38 (-0.77- 0.00)	-0.38 (-0.67- -0.09)	0.011
Vit D3 Dose	4.91 (-7.79- 17.62)	0.92 (-10.55- 12.40)	0.872	10.06 (-3.03- 23.15)	2.95 (-7.34- 13.26)	0.569
25 Vitamin D	0.24 (-0.48- 0.98)	0.18 (-0.46- 0.82)	0.576	0.48 (-0.27- 1.25)	0.26 (-0.31- 0.84)	0.373
Hypertension (Yes)	-21.44 (-33.38- -9.50)	-13.79 (-26.82- -0.75)	0.038	-22.32 (-34.77- -9.88)	-14.81 (-26.37- -3.24)	0.013
DM (Yes)	-9.47 (-21.18- 2.23)	-4.26 (-15.63- 7.10)	0.456	-9.83 (-22.04- 2.37)	-5.67 (-15.85- 4.50)	0.27
Albumin	6.34 (-6.83- 19.52)	5.44 (-7.79- 18.69)	0.415	17.83 (4.64–31.02)	12.91 (1.35–24.47)	0.029
Calcium	-8.18 (-15.86- -0.49)	-3.84 (-10.97- 3.28)	0.286	-8.94 (-16.92- -0.95)	-4.11 (-10.50- 2.28)	0.204
Pain Interference	-5.46 (-7.79- -3.13)	-4.96 (-7.36- -2.55)	0.001	-6.48 (-8.80- -4.16)	-5.07 (-7.23- -2.91)	0.001
Pain Severity	-4.02 (-5.97- -2.06)	-2.16 (-5.41- 1.07)	0.186	-5.26 (-7.16- -3.36)	-2.42 (-5.32- 0.47)	0.10

B: Beta Coefficient, P: p value, aP: adjusted p value

[28]. Patients undergoing hemodialysis usually go to dialysis centers twice or thrice a week for three to four hours per session, which may influence their professional and personal lives. On the contrary, PD may be performed independently or with the help of a caregiver at home, at work, or in any other clean place. This treatment model can be performed several times per day, every 4–5 h, and with a more extended pause period at night, which saves time and offers patients more autonomy and flexibility [8].

After adjusting for confounders in the multivariate analysis, we found age to be significantly negatively correlated with both PCS and MCS, which is also reported across different patient populations [28]. Comorbidities like hypertension were also significantly negatively correlated with both PCS and MCS. Comorbidities exacerbate complications, increasing patient complaints and decreased QoL [19, 28, 29]. Also, both PCS and MCS significantly negatively correlated with pain interference scores, indicating higher pain levels lead to worse QoL. However, only MCS was significantly positively correlated with albumin levels, as albumin is a marker of nutritional status and higher albumin levels are associated with a better mental state, as reported in the literature [30]. Additionally, MCS was significantly negatively correlated with the duration on dialysis; this could be explained by the more time the patient spends undergoing dialysis, the worse their state of mind will become. One-third of our PD patients reported chronic pain, similar to a previous study conducted in China among PD patients [14] and is also consistent with previous studies conducted in Palestine and China among hemodialysis patients [19, 31].

Our evaluation of the BPI revealed a median pain severity score of 4.8 and a median interference score of 3.6. In line with previous research, we observed that females exhibited higher pain severity levels than males [32]. This may be attributed to biological, hormonal, and psychosocial factors influencing pain sensitivity [32]. However, the literature presents conflicting findings. While some studies suggest that females demonstrate higher pain tolerance in chronic pain conditions, potentially due to psychological resilience or sociocultural expectations, others indicate that females do not consistently exhibit higher pain tolerance, particularly when compared to males in similar contexts [33]. These discrepancies highlight the complexity of gender-related differences in pain perception and suggest the need for further research to clarify these relationships. Furthermore, psychological factors, such as depression and stress, may amplify pain sensitivity in females, creating a potential bidirectional interaction between pain and psychological comorbidities [34, 35].

No significant correlation was observed between 25 Vitamin D levels, pain, and QoL scores. However, significant correlations were found in hemodialysis patients, as some studies have reported [19], but no studies found in the literature assessed those associations in PD patients independently. This could be secondary to low sample size as only 25% of our study population reported pain.

Our study revealed that there is no significant correlation between BMD), pain, and the PCS of QoL. However, we did observe a negative correlation between BMD in the lumbar spine and the MCS of QoL. This aligns with a study conducted among postmenopausal women in India, which found that lower BMD readings have a detrimental effect on QoL, particularly in terms of physical functioning. Notably, there was no significant association between BMD and the psychological aspects of QoL. Furthermore, they indicated that individuals with lower BMD readings reported significantly higher pain scores [36]. Similarly, a study conducted among the geriatric

population in Austria identified an inverse relationship between BMD and QoL [37]. However, it is worth noting that no prior studies of this nature have been conducted among PD or hemodialysis patients. Therefore, further research is recommended to assess the correlation between BMD, pain, and QoL specifically among PD patients.

There are several potential limitations to this study. Firstly, using a cross-sectional study design means we cannot definitively establish a cause-and-effect relationship between variables of interest. Secondly, because the study was carried out at a solitary clinical center, we must exercise caution when generalizing the findings. Finally, our sample included only 76 patients, which could limit the ability to conclude relationships between the variables in the study. Further studies are needed with a larger sample size and a longer time to study the variables in more detail. Although we aimed to provide comprehensive socio-demographic details, the patients' years of education were not recorded in our dataset. This information could offer further insights into the relationship between education level and patient-reported outcomes such as quality of life and pain severity, and we recommend including it in future studies. However, this study is the first in the region among PD patients. Furthermore, this study tried to examine more variables that could influence pain levels and QoL, which is rare in the literature on this patient's population.

Conclusions

the study found that PD patients in this group had a comparatively higher QoL than other patient populations undergoing various types of dialysis despite the challenges and resource limitations the local healthcare system faced. However, many PD patients still experience chronic pain, which can negatively impact their overall wellness. The study found that pain severity and interference were negatively related to QoL, stressing the importance of appropriate pain management measures in PD patients. Furthermore, age, concomitant diseases such as hypertension, and dialysis duration all impacted QoL. These findings emphasize the need to address not only the physical components of PD but also these people's psychological and emotional well-being. Notably, this study sheds light on a previously understudied population of PD patients in Palestine. While the data show that QoL in this region is higher than in others, healthcare practitioners should still prioritize interventions to manage pain and enhance overall QoL in PD patients, especially given the possible impact on treatment adherence and long-term outcomes.

Abbreviations

BPI	Brief Pain Inventory
BMI	Body Mass Index
CKD	Chronic Kidney Disease
DEXA	Dual-Energy X-ray Absorptiometry
ESRD	End-Stage Renal Disease
HD	Hemodialysis
KDQOL	SF36-Kidney Disease Quality of Life Short Form-36
MCS	Mental Component Summary
MD	Bone Mineral Density
NNUH	Al-Najjah National University Hospital
PCS	Physical Component Summary
PD	Peritoneal Dialysis
QoL	Quality of Life
PTH	Parathyroid Hormone

Supplementary Information

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Supplementary Material 1

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Author contributions

ZN and ZH contributed to the idea conception. ZN, ZH, and MA planned the study and its methodology and critically reviewed and finalized the manuscript. AB, RT, ASh, and ASa collected the data. KJ, RT, AB, A.Sh and DA performed data analysis and prepared the initial draft of the manuscript under ZN supervision. All authors revised and approved the submission of the final version of the manuscript.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author Zaher Nazzalznazzal@najah.edu upon request.

Declarations

Ethics approval and consent to participate

informed consent was obtained from participants. In addition, permission to use the Brief Pain Inventory (BPI) from MD Anderson Symptom Tools was granted by the authors (MD Anderson Cancer Center). The study and its protocols received approval from the Institutional Review Board committee of An-Najah National University [Reference #: Med. Feb. 2022/21]. Necessary permissions were obtained from the hospital. This study adhered to the ethical principles outlined in the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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