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Evaluation of the Prevalence of Chronic Musculoskeletal Pain and Related Factors in Patients with Chronic Kidney Disease

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ABSTRACT

Background: Musculoskeletal disorders are one of chronic kidney disease's most common complications, potentially affecting an individual's functional status and quality of life. A major concern of healthcare professionals caring for CKD patients is to improve their quality of life. **Objective:** The study was conducted to evaluate the prevalence of musculoskeletal disorders in CKD patients and possible risk factors. **Patients and methods:** The study was conducted on 100 patients aged 19-76 years with CKD diagnosis according to Kidney Disease Improving Global Outcomes (KDIGO) criteria, selected from the renal hemodialysis units, nephrology, and rheumatology outpatient clinics of Tanta University Hospitals. Patients were divided into two groups according to The CKD-EPI creatinine Equation estimated GFR: **Group I**: included 32 patients with stages II, III and **Group II**: included 68 patients with stages IV, V. Musculoskeletal disorders were evaluated by the (COPCORD) Questionnaire. Data were collected including demographic, clinical, and laboratory data. Statistical analysis was carried out for all collected data using IBM, SPSS version 21. Statistical significance was determined at a P level ≤ 0.05. **Results:** Among 100 patients with CKD, there was a high prevalence of chronic musculoskeletal pain which was detected in 89.7% of patients in group II and 78.1% of patients in group I. 46.9% and 75% of patients in group I and group II respectively, had radiological abnormalities detected by imaging studies such as subperiosteal bone resorption, periarticular osteopenia, knee osteoarthritis and Achilles tendinopathy. Possible risk factors for musculoskeletal pain was hypertension, diabetes mellitus (DM), ischemic heart disease(IHD), Mineral Bone Disease in CKD (CKD-MBD), and hyperuricemia. **Conclusion:** The study suggested that musculoskeletal disorders are highly prevalent in CKD patients, so evaluation of prevalence and related factors will help in early management and improvement of quality of life.

Keywords: Musculoskeletal pain, diabetes mellitus, chronic kidney disease.

1. Introduction

Chronic kidney disease is extremely common and the Global Burden of Disease (GBD) studies have shown that CKD has emerged as a leading cause of worldwide mortality (Csaba and Kovesdy, 2022) . Musculoskeletal disorders contributed by CKD are increasing worldwide that result from abnormal mineral metabolism and extraskeletal calcification (Deme *et al.,* 2021). Individuals with CKD had various musculoskeletal manifestations such as arthralgia, carpal tunnel syndrome, muscle cramps, fibromyalgia, flexor tenosynovitis, pathological fracture, joint infection, and effusion (Lim and Ong 2013). Arthralgia is the most common musculoskeletal manifestation detected in CKD patients affecting mainly the large joints such as the knee, ankle, shoulder, elbow, and hip joints (Duncan *et al*., 1990). CKD patients with associated risk factors such as hypertension, DM, IHD, and hyperuricemia are at a greater risk of musculoskeletal disorders (Badve *et al*., 2011). CKD patients had various radiological abnormalities (Lacativa *et al*., 2009). Bone resorption is the most frequent

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abnormality recognized in CKD that results from increased osteoclastic activity, especially sub-periosteal bone resorption (Hsu *et al*., 2014).

The aim of this work was to evaluate the prevalence of musculoskeletal disorders in CKD patients and related risk factors.

2. Patients and Methods

Our study is a descriptive cross-sectional study. It was conducted on 100 patients aged from 19-76 years (42 males and 58 females) with a CKD diagnosis according to Kidney Disease Improving Global Outcomes (KDIGO) criteria. The patients selected from the renal hemodialysis units, nephrology, and rheumatology outpatient clinics of Tanta University Hospitals from May 2021 to May 2022. Patients were divided into two groups according to The CKD-EPI creatinine Equation estimated GFR:

Group I included 32 patients with stages II, III and **Group II** included 68 patients with stages IV, V.

The following are the inclusion and exclusion criteria of our study:

The inclusion criteria included patients aged from 18-80 years old and Patients without spontaneous improvement or rapid progression of renal disease in the 3 months prior to the study.

The exclusion criteria included patients with acute illness require hospital admission in the past 3 months, Patients with cancer, and patients unwilling to participate in the study.

Provision of privacy: Privacy of all patient's data was guaranteed by a special code number for every patient's file that includes all his or her investigations.

2.1. Data collection

All the participants in the study were subjected to:

Consent: Permission was obtained from Research Ethics Committee as a part of the Quality Assurance Unit in the Faculty of Medicine at Tanta University to conduct this study and to use the facilities in the hospital. Informed written consent was obtained from all patients after a full explanation of the benefits and risks of the study.

History taking: Including age, gender, history of chronic diseases (DM, HTN, IHD, SLE, RA, other connective tissue diseases), onset, course, and duration of symptoms, family history of any immunological diseases, and drug history especially NSAID drugs.

Clinical examination: Measurement of systolic and diastolic blood pressure. Head, neck, chest, cardiac and abdominal examination to exclude subjects with any abnormal findings.

Musculoskeletal examination: Inspection: Inspection of joints for any swelling, skin changes, signs of inflammation or infection, scars, deformity, muscle wasting, and abnormal movements with a comparison between both sides.

Palpation: palpate the joint for any swelling and its nature, temperature, tenderness, related ligaments, tendons, and adjacent bony structures.

Joint movements: assessment of the range of motion both actively by the patients and passively by the examiner for any restriction of motion.

Laboratory investigations included Complete blood count, Blood urea, serum creatinine, estimated glomerular filtration rate (e GFR), Serum albumin level, Serum uric acid, Serum calcium (Ca), phosphorous (Ph), parathyroid hormone (PTH), Serum cholesterol, triglyceride and C-reactive protein (CRP) were measured in all subjects.

Imaging procedures included X-ray of the hands, wrists, pelvis, and sacroiliac joints. And musculoskeletal ultrasound on wrists & hands which is now the first choice in the early diagnosis of wide-spectrum tendon pathologies that occur in dialysis patients as tendon tears and calcification.

COPCORD Questionnaire: The Community Oriented Program for Control of Rheumatic Diseases was established in 1981 by WHO (World Health Organization) and ILAR (International League of Associations of Rheumatology), focusing on pain and disability caused by rheumatologic disorders in developing countries and aimed to recognize, prevent, and control rheumatologic disorders in communities with limited infrastructure and financial resources. An important part of a COPCORD survey is the subsequent development of an education program for health workers and the community. A number of countries including Egypt have already participated in this program and have used the WHO-ILAR COPCORD to determine the prevalence rates of rheumatic diseases in their countries.

Visual Analogue Scale (VAS score): it consists of a 10cm line, with two endpoints representing 0 (no pain) and 10 (extreme pain). Patients were asked to rate their current level of pain by placing a mark on the line.

2.2. Statistical analysis

Data were analyzed using the IBM® SPSS statistical software, version 21. Qualitative data were described using numbers and percentages. The Kolmogorov Smirnov test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, standard deviation, and median. Chi-squared test was used for comparing the qualitative data and when it was inappropriate it was replaced by the Monte Carlo test. A student t-test was used to compare the two means in different groups. Linear correlation analysis was done by Spearman coefficient correlation and used to test the positive or negative associations between different variables. For the risk estimated, linear regression was used to detect the predictor variables. The level of significance was adopted at $p<0.05$ and statistically highly significant at $P \leq 0.001$.

3. Results

The total studied patients were 100 patients with CKD included 42 males (40%)and 58 females (58%) were divided into two groups **Group I** included 32 patients (15 patients with stages II, 17 patients with stage III) and **Group II** included 68 patients (26 patients with stages IV,42 patients with stage V). The mean age of the studied patients was 50.12+ 13.99 years old. (Table 1)

Table 1: Demographic data among the studied cases

Demographic data	**Cases (n = 100)**	
Gender	**No.**	**%**
Male	42	42%
Female	58	58%
Age (Years)		
Min.–Max	19 – 76	
Mean ± SD.	50.12+ 13.99	
Stages of Chronic kidney disease	**No.**	**%**
Group I	**32**	**32.0%**
Stage 2	15	15.0%
Stage 3	17	17.0%
Group II	**68**	**68.0%**
Stage 4	26	26.0%
Stage 5	42	42.0%

The results showed that hypertension was the most frequently associated chronic disease among the studied cases (72%) followed by DM (25%) followed by IHD (21%). regarding the history of connective tissue diseases, 7% of the studied cases were diagnosed as RA, 6% were diagnosed as SLE. (Table 2).

Table 2: History of chronic diseases among the studied cases

History of chronic diseases	Cases (n = 100)	
	No.	%
Diabetes mellitus	25	25.0%
Hypertension	72	72.0%
Ischemic heart disease	21	21.0%
Rheumatoid arthritis	7	7.0%
Systemic lupus Erythematosus SLE	6	6.0%

Articular deformities in the studied CKD patients were mainly in the form of flexion deformity of the elbow and knees joints and wrist subluxation.

The results showed that articular deformity is more common in group II represented by 63.2% in comparison with group I which represented by 37.5%. We divided the cause of articular deformity into immune and non-immune related, 93.1% of the articular deformity in group II is not related to auto immune diseases. There was a significant correlation between the presence of articular deformity and patients with advanced stages of CKD in group II (p value =0.02) (Table 3).

Table 3: Percentage of articular deformity, muscular pain and tenosynovitis and restricted range of motion between the two groups

	Group I (n = 32)		Group II (n = 68)		Test of sig. (p value)
	No.	%	No.	%	
Articular deformity					
Yes	12	37.5 %	43	63.2 %	
Autoimmune	9	75%	3	6.9%	P = 0.02*
Non-immune	3	25%	40	93.1%	
No	20	62.5 %	25	36.8 %	
Muscular pain and tenosynovitis					
No	7	21.9%	7	10.3%	P = 0.12
Yes	25	78.1%	61	89.7%	
Restricted range of motion in different joints					
No	31	96.9%	30	44.1%	P ≤ 0.001*
Yes	1	3.1%	38	55.9%	

Statistically significant at P ≤ 0.05 & Statistically highly significant at P ≤ 0.001

Also, 78.1% & 89.7% of the patients in group I and group II respectively had musculoskeletal pain. The most common is myalgia, arthralgia, recurrent muscle cramps and peripheral neuropathy. Tenosynovitis especially flexor tenosynovitis is very common in CKD patients. There was no significant difference between the two groups (p value = 0.12) (Table 3).

There was a higher prevalence of restricted range of motion in participants in group II represented by 55.9% in comparison with participants in group I represented by only 3.1%. The restricted range of motion were mainly at the shoulder, wrist joints, lumbar spine, and the small joints of the hands which impair their hand functions. There was a significant correlation between the restricted range of motion in different joints and patients with advanced stages of CKD in group II (p value = 0.001) (Table 3).

The mean serum calcium level in CKD patients in group I was 8.8± 0.65 mg/dl while in patients in group II was 8.2 ± 0.76 mg/dl. The mean serum phosphorus in CKD patients in group I was 3.9 ± 0.89 mg/dl while in CKD patients in group II was 5.2 ±1.6 mg/dl. Additionally, the mean PTH level in CKD patients in group I was 70.37 ± 38.25 Pg/ml while in patients in group II was 350.48 ± 350.25Pg/ml. The mean ca ×ph product in CKD patients in group I was 34.25 ± 7.80 while in patients in group II was 42.66 ± 10.39. This study demonstrated that the mean serum uric acid in

CKD patients in group I was 8.0 8 ±1.81 mg/dl while in patients in group II was 9.27 ±1.58 mg/dl (P value ≤0.001) (Table 4).

Table 4: Serum calcium, phosphorus, parathyroid hormone (PTH) and serum uric acid between the two groups

		Group I (n = 32)	Group II (n = 68)	t test (p value)
Serum calcium mg/dl	Min.–Max	7.0 -10.0	5.3 – 9.5	**3.6 (≤0.001)***
	Mean ± SD.	8.8 ± 0.65	8.2 ± 0.76	
Serum phosphorus mg/dl	Min.–Max	2.8 – 7.4	2.5 – 7.9	**5.2 (≤0.001)***
	Mean ± SD.	3.9 ± 0.89	5.2 ±1.6	
Ca ×Ph product	Min.–Max	22.4 – 65.1	21.0 – 67.5	**4.01 (≤0.001)***
	Mean ± SD.	34.25 ± 7.80	42.66 ± 10.39	
PTH Pg/ml	Min.–Max	26 – 215	27 – 1933	**4.6 (≤0.001)***
	Mean ± SD.	70.37 ± 38.25	350.48 ± 350.25	
Serum uric acid mg/ dl	Min.–Max	3.0 – 11.0	5 – 17	**3.3 (≤0.001)***
	Mean ± SD.	8.08 ±1.81	9.27 ±1.58	

t: independent sample Student's t test. *: Statistically highly significant at P ≤ 0.001

This results demonstrated that 75% of patients in group II and 46.9% of patients in group I had radiological abnormalities, the most common radiological abnormalities were subperiosteal bone resorption especially terminal phalanges, osteopenia and fractures. While knee osteoarthritis and Achilles tendinopathy were the most common abnormal finding in the musculoskeletal US.

So, there was a higher significant correlation between the prescence of radiological abnormalities and patients with advanced stages of CKD in group II (p value = 0.007) (Table 5).

Table 5: Percentage of radiological abnormalities between the two groups

Radiological abnormalities	Group I (n = 32)		Group II (n = 68)		Test of sig. (p value)
	No.	%	No.	%	
Yes	15	46.9 %	51	75 %	P = 0.007*
No	17	53.1 %	17	25 %	

*: Statistically significant at P ≤ 0.05

The results showed that there was a significant correlation between musculoskeletal pain in CKD patients and gender being more common in females than males. Also, a significant correlation between musculoskeletal pain in CKD patients and associated risk factors such as HTN, DM and IHD. Musculoskeletal pain in CKD patients is positively correlated with CKD stages being more common in advanced stages than early stages of CKD.

We found a significant correlation between musculoskeletal pain in CKD patients and hypocalcemia, hyperphosphatemia, and high PTH levels, elevated Ca ×Ph product, hyperuricemia and elevated serum cholesterol and triglyceride levels (Table 6).

There was a positive significant correlation between VAS score and advanced stages of kidney disease, low Hb level, impaired all renal function tests (blood urea, serum creatinine, e GFR), increased serum cholesterol and triglyceride level and hyperuricemia. There was no significant correlation between VAS score and age, serum calcium, serum phosphorus, PTH, Ca ×Ph product and serum albumin. (Table 7).

Table 6: Logistic regression for predictor factors affecting musculoskeletal pain in chronic kidney disease

	Standardized Coefficients		t	Sig.	95% Confidence Interval	
	Beta	Std error			Lower Bound	Upper Bound
Age	-0.046-	0.070	0.428	≤0.001*	0.833	1.095
Female gender	-0.317-	0.984	0.104	0.009*	0.106	5.010
BMI	-0.271-	0.239	1.292	0.009*	0.478	1.217
Family history of rheumatologic disease	-2.790-	1.063	6.885	≤0.001*	0.008	0.494
HTN	-0.017-	0.023	0.523	0.047*	0.940	1.029
DM	0.024	0.041	0.348	0.017*	0.946	1.110
Ischemic heart disease	-0.300-	0.597	0.253	0.011*	0.230	2.387
CKD stages	0.016	0.003	4.307	0.04*	0.478	1.217
Serum calcium	0.024	0.041	0.348	0.003*	1.008	1.494
Serum phosphorus	-0.30-	0.597	0.253	0.004*	1.000	1.012
PTH	0.056	0.030	4.279	0.006*	0.540	1.929
Cholesterol	-1.737-	1.368	0.290	≤0.001*	0.946	1.110
TG	-2.046-	0.070	3.428	≤0.001*	1.944	3.097
Serum uric acid	-1.317-	0.984	0.104	≤0.001*	1.944	2.097
Ca ×Ph product	-0.017-	0.023	0.523	≤0.001*	1.008	1.494

Statistically significant at P ≤ 0.05 & Statistically highly significant at P ≤ 0.001

Table 7: Spearman correlation between VAS score and other parameters among the studied cases

Cases	VAS score with a median in Group I = 6 Group II = 8	
	r	P-value
Age	0.006	0.95
CKD Stages	0.40	≤0.001*
HB	-0.23	0.002*
TLC	0.15	0.13
Platelets	0.25	0.02*
Blood urea	0.36	≤0.001*
Serum creatinine	0.23	≤0.001*
e- GFR	-0.25	≤0.001*
Serum calcium	-0.13	0.12
Serum phosphorus	0.15	0.13
PTH	0.16	0.11
Cholesterol	-0.29	≤0.001*
TG	-0.23	≤0.001*
Serum albumin	-0.045	0.56
Serum uric acid	0.30	≤0.001*
Ca ×Ph product	0.13	0.19

Statistically significant at P ≤ 0.05 & Statistically highly significant at P ≤ 0.001

4. Discussion

Musculoskeletal disorders contributed by chronic kidney disease are increasing worldwide, which are a leading causes of co-morbidities, disability, and low productivity, which potentially affect an individual's functional status and quality of life (Deme *et al.*, 2021).

In this study, we found a higher prevalence of musculoskeletal disorders among women than men which may be due to physiological differences in the biology of women's muscles, tendons, and ligaments and that women may have greater sensitivity to pain and discomfort than men.

This study results were in agreement with Wijnhoven *et al.* (2006) this cross-sectional study carried out on 1169 patients. A total of 38% of patients complained of chronic musculoskeletal pain, and was more prevalent in women than in men (49% VS 28%).

In contrast to this study, Haroon *et al.* (2018) conducted a cross-sectional study at Ain Shams University Hospital, included 49 patients diagnosed with renal failure and found that men have a higher prevalence of musculoskeletal disorders than women.

In this study, the age of participants ranges from 19- 76 years with a mean ± SD of 50.12±13.9. we found a higher prevalence of musculoskeletal disorders among older patients than in younger patients because with aging musculoskeletal tissue had increased risk of bone fragility, decrease in ligament elasticity and decreased muscular strength and function.

This study results were in agreement with Caravaca *et al.* (2016) a cross-sectional study in Canada that demonstrated that patients between the ages of 40–64 years were three times more likely to develop MSDs than patients between the ages of 19 and 29 years.

In contrast to this study, Kennedy *et al.*, (2014) demonstrated in a cross-sectional study in the United States that older patients are at low risk of MSDs due to atrophy of the muscles at older ages.

Also, we found that participants with HTN as a risk factor were more likely to develop MSDs as hypertension is associated with alterations in endogenous pain regulatory systems (pain inhibitory and facilitatory pathways) leading to decreased pain threshold, insufficient blood flow to the muscles and associated hyperuricemia.

These findings were in agreement with Deme *et al.* (2021), a cross-sectional study conducted on 302 participants at Saint Paul Hospital, Addis Ababa, Ethiopia demonstrating that MSDs in CKD patients are significantly associated with HTN.

In the previous study, we found that participants who had diabetes mellitus as a risk factor were more likely to develop MSDs as hyperglycemia and advanced glycation end products may induce chronic inflammation which lead to systemic changes in body organs and affects cartilage and bone health that may cause progressive joint damage, stifiness and pain.

Several musculoskeletal disorders have been related to DM such as:

Limited joint mobility, diabetic neuropathy, charcot osteoarthropathy, osteoarthritis, gout, diabetic muscle infarction, diabetic amyotrophy, fibromyalgia syndrome, dupuytren`s contracture, adhesive capsulitis, osteoprosis, carpal tunnel syndrome and flexor tenosynovitis.

These results were in agreement with Wijnhoven *et al.* (2006) whose cross-sectional study demonstrated that DM is a major risk factor for MSDs in CKD patients.

We found that participants having IHD as a risk factor were more likely to develop MSDs than those who have not.

This study results were in agreement with Chiang *et al.* (2018), a retrospective cohort study at the National Health Research Institutes that demonstrated that MSDs in CKD patients are significantly associated with IHD.

In contrast to this study Hsu *et al.* (2019), this prospective cohort study conducted at the CKD center of the Chang Gung Memorial Hospital, Keelung, Taiwan demonstrated that MSDs in CKD patients were not significantly associated with HTN, DM nor IHD.

We found that patients with advanced stages of CKD (stages 4-5) were more likely to develop MSDs than patients with early stages of CKD (stages 2-3).

This was in agreement with Caravaca *et al.* (2016) whose cross-sectional study demonstrated a high prevalence of musculoskeletal disorders in advanced stages of CKD.

In contrast to this study, Deme *et al.* (2021) demonstrated in this cross-sectional study that advanced stages of CKD were less likely to develop MSDs than early stages of CKD and this may be due to higher number of participants in stage I of this study.

We found that chronic musculoskeletal pain is very prevalent in patients in group II (89.7%) as well as in group I (78.1%). the most common of which was myalgia, arthralgia, recurrent muscle cramps, and peripheral neuropathy. also tenosynovitis especially flexor tenosynovitis is very common in CKD patients.

This study results were in agreement with Gamondi *et al.* (2013) this cross-sectional study conducted on 123 patients with chronic kidney disease stage 5, on dialysis, treated in nephrology units in southern Switzerland, demonstrated that chronic pain is present in up to 82% of patients.

Also, Afifi *et al.* (2019) this cross sectional study conducted on 53 patients with ESRD demonstrated that arthralgia was the most common musculoskeletal manifestation. The most common arthralgia was knee arthralgia (60.4%), followed by ankle arthralgia (56.6%), shoulder arthralgia (20.7%), lumbar spine pain, and hip arthralgia.

These were in disagreement with Jokar and Adle (2016), this cross sectional study conducted on 43 patients with ESRD on HD reported that arthralgia is only present in 21.5% of patients.

We found that 55.9% of patients in group II especially patients on HD had restricted range of motion at the joints, especially the shoulder joints, wrist joints, lumbar spines, and the small joints of the hand which may be due to associated skeletal muscle dysfunction and atrophy that cause an overall decrease in muscle strength which impair their hand function.

These results were in agreement with Duruöz et al. (2013) this cross sectional study reported that impaired hand function is very common in HD patients.

We found that 63.2% of patients in group II had articular deformities not related to autoimmune diseases such as SLE and RA. Articular deformities were mainly in the form of flexion deformity of the elbow and knees joints and wrist subluxation.

These findings were in agreement with Haroon *et al.* (2018) this cross-sectional study demonstrated that flexion deformities of the elbow are present in 16.3% of the patients and of the knees in 10.2% of the patients.

We found that patients in group II had a higher VAS score compared to those in group I (8 Vs 6) respectively.

This study results were in agreement with Maria *et al.* (2020) this cross-sectional study was conducted among CKD patients and demonstrated that patients with early stages of CKD had a lower VAS score than patients with late stages of CKD.

We found that hypocalcemia, hyperphosphatemia, and high PTH levels are major risk factors for MSDs in CKD patients. Because in CKD there is inhibition of calcification and inefficient filtration which lead to hypocalcemia, and hyperphosphatemia which stimulates PTH secretion leading to increase bone resorption and decrease bone density. Many complications can result from secondary hyperparathyroidism such as bony pains and muscular pains, increased risk of fractures, morphological abnormalities affecting bones and joints, and vascular and soft tissue calcification (Douthat *et al.*, 2013).

These results were in agreement with El-Najjar *et al.* (2014) this cross-sectional study carried out on 144 HD patients demonstrated that a high PTH level of (80.4%), hypocalcemia at (50.5%), and hyperphosphatemia at (43.6%) in the studied patients.

These results were in disagreement with Hsu *et al.* (2019) This prospective cohort study demonstrated that patients with chronic musculoskeletal pain had similar serum calcium, phosphate, and PTH levels as those patients without chronic musculoskeletal pain. This suggests that renal bone disease may not be the cause of chronic musculoskeletal pain in CKD patients.

We found that increased calcium × phosphate product levels were strongly associated with chronic musculoskeletal pain in CKD patients. This may be explained by vascular calcification and calcification-related micro-angiopathy and ischemic bone pain correlated with elevated calcium × phosphate product levels.

These results were in agreement with Cozzolino *et al.*, (2001) This cross-sectional study demonstrated that increased calcium-phosphate product causes a progressive increase in calcium deposition in the coronary arteries, mitral and aortic valves in patients with advanced renal failure with increased vascular calcification that contribute to chronic musculoskeletal pain in CKD patients.

We found that chronic musculoskeletal pain in CKD patients was positively correlated with hyperuricemia as a risk factor. Recent studies suggest that serum uric acid may have a variety of pro-inflammatory, pro-oxidative, and vasoconstrictive actions. Hyperuricemia is a factor in the development of hypertension, metabolic syndrome, type 2 diabetes, coronary artery disease, and progression of CKD.

These finding were in agreement with Haroon *et al.* (2018) This cross-sectional study demonstrated that hyperuricemia is a major risk factor for chronic musculoskeletal pain in CKD patients which is present in 37% of the studied cases.

Also, Badve *et al.* (2011) This cross-sectional study on the role of uric acid in the deterioration of renal function and progression of chronic kidney disease and demonstrated that hyperuricemia is a major risk factor for chronic musculoskeletal pain in CKD patients.

We found that patients in group I, II had radiological abnormalities of 46.9%, and 75% respectively. The most common abnormal radiological findings were subperiosteal bone resorption of the terminal phalanges and osteopenia. These abnormal findings are related to secondary hyperparathyroidism. The most common musculoskeletal US abnormalities were knee effusion, osteophytes, and Achilles tendinopathy.

These results were in agreement with Lacativa *et al.* (2009) This cross-sectional study carried out on 73 patients on regular HD in the city of Rio de Janeiro, Brazil demonstrated that all the studied patients resented evidence of bone resorption on radiographs. The most prevalent types were subperiosteal resorption of the phalanges and the distal ends of the clavicles, which were both present in 69 patients (94.5%).

These results were in disagreement with Vhora *et al.* (2015) an observational study carried out on 60 patients with CKD demonstrated subperiosteal resorption of the terminal phalanges in 35% of patients, osteopenia in 25% of the patients, and this may be contributed to the shorter HD duration in this study.

5. Conclusion

Musculoskeletal disorders are highly prevalent in CKD patients, especially with advanced stages CKD. Associated risk factors such as hypertension, DM, IHD, and hyperuricemia increase the risk of musculoskeletal disorders in CKD patients. Musculoskeletal disorders in CKD patients are positively correlated with hypocalcemia, hyperphosphatemia, hyperparathyroidism, and elevated Ca Ph. product. Radiological abnormalities are very common in CKD patients. Early detection and good management of musculoskeletal disorders in CKD patients help to improve their quality of life. Musculoskeletal Ultrasound is now the best choice to detect musculoskeletal disorders in CKD patients.

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