Biological Forum – An International Journal **15(6): 739-747(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Osteodystrophy in Chronic Renal Patients –A Study based on Bilaspur District, Chhattisgarh

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(Received: 19 March 2023; Revised: 28 April 2023; Accepted: 21 May 2023; Published: 20 June 2023)
(Published by Research Trend)

ABSTRACT: As GFR loss progresses, disturbed mineral metabolism impairs bone microstructure and alters the bone remodelling process, known as CKD—mineral bone disease (MBD). CKD-MBD is characterized by (i) abnormal metabolism of calcium, phosphorus, parathyroid hormone (PTH), or vitamin D; (ii) abnormalities in bone turnover, demineralization, segmental linear growth or strength; (iii) Soft-tissue calcification, either vascular or extra-osseous. Uremic vascular calcification and osteoporosis are the most common complications associated with CKD-MBD. Uncontrolled bone turnover by uremic toxins or secondary hyperparathyroidism leads to impaired bone mineralization and difficulty for calcium and inorganic phosphate to enter bone, resulting in elevated serum calcium and inorganic phosphate. In this study an attempt was made to study the bone health of CKD subjects. 25 CKD patients were studied; their biochemical parameters and bone health related parameters were assessed. The study confirmed that a complex relationship existed between chronic kidney disease-mineral and bone disorders (CKD-MBD) with adverse outcomes in non-dialysis and dialysis patients both. Thus, the study proved the prevalence of Osteodystrophy in CKD patients as a serious co-morbid condition.

Keywords: Bone resorption and remodelling, chronic kidney disease, Parathyroid hormone, Dyslipidemia.

INTRODUCTION

Due to increasing life expectancy and the prevalence of lifestyle diseases, the incidence of chronic kidney disease (CKD) has increased by 30% in the last decade in India (Varma *et al.,* 2015). Physiological bone remodelling is an enduring and delicately coordinated process between bone formation and resorption (Rowe *et al*., 2023). It involves continuous removal of old bone, replacing it with newly synthesized proteinaceous matrix, and formation of new bone through subsequent mineralization of the matrix. Bone remodelling started with osteoclast (OC) activation followed by bone resorption followed by bone formation. Both resorption and formation are required to repair micro-fractures and to modify bone structure in response to stress (Hadjidakis *et al*., 2006). Bone turnover occurs in both cortical and trabecular bone, and trabecular bone has a relative higher turnover rate (Oftadeh *et al*., 2015). At the onset of chronic kidney disease (CKD), systemic mineral metabolism and bone structure begin to change, including glomerular filtration rate (GFR) loss. As GFR loss progresses, disturbed mineral metabolism impairs bone microstructure and remodelling—a condition known as CKD-mineral bone disease (MBD). Eriksen *et al.* (1996). Kidney Disease: CKD-MBD is characterized by: (i) abnormal metabolism of calcium, phosphorus, parathyroid hormone (PTH), or vitamin D; (ii) abnormalities in bone turnover, mineralization, volume linear growth or strength; (iii) Soft-tissue calcification, either vascular or extra-osseous (Waziri *et al*., 2019). Mineral and Hormonal Disturbances in CKD is one etiopathological cause. As GFR decreases, free serum calcium levels decrease and serum phosphorus increases (Blaine *et al*., 2015 & Piraino *et al.* (1988**).** Due to GFR loss, compensatory production of fibroblast growth factor 23 (FGF-23) reduces renal sodium-dependent phosphate transport protein (Npt)2a and Npt2c levels, resulting in increased urinary excretion of phosphate (Bergwitz *et al*., 2012). In response, the parathyroid glands increase production of PTH, which decreases the abundance of Npt2a and Npt2c in the proximal tubule, leading to increased urinary Pi excretion leading to decreased serum Pi levels (Weinman *et al*., 2012). FGF23 also inhibits the production of 1,25(OH)2D and thereby reduces intestinal Pi absorption, further reducing serum Pi levels. Reduced 1,25(OH)2D induces hypocalcemia and then persists stimulated PTH production, leading to secondary hyperparathyroidism (SHPT). (Sugimoto *et al*., 1990). As GFR continues to fall, this compensatory mechanism fails, leading to hyperphosphatemia, hyperparathyroidism, and increased serum FGF-23 concentration. Uremic osteoporosis related loss of bone

quality end-stage renal disease patients are also at high risk of bone fracture because of the high prevalence of uremic osteoporosis and MBD (Kazama *et al*., 2013 & Brandenburg & Floege 2008). Abnormal bone metabolism, a disordered bone micro-architecture, low bone mass and musculoskeletal fragility. Accumulated uremic toxins exhibit deleterious effects on bone metabolism and function and reduce bone quality and quantity (Martin *et al*., 2004).

METHODOLOGY

This multi-centre, retrospective, observational cohort study was designed to access the bone health in Chronic kidney disease patients. Specially with stage III onwards of CKD. Written informed consent was obtained from the participants due to the retrospective nature of the study; furthermore, some patients dropped their self in middle of the study. The work presented has been conducted in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for Experiments involving human beings. [http://www.wma.net/en/30publications/10policies/b3/index.html]

All subjects were followed up for one to two years from the date of study initiation. Patients who withdrew from treatment or underwent transplantation during the follow-up period were excluded.

Study Area. Bilaspur District.

Subjects Numbers. 25 of various age groups.

Inclusion Criteria. After checking primary and secondary data of the subjects, that matched with the biochemical parameters related with CKD—Like Low GFR, High serum levels of Urea, Creatinine, BUN, high Serum Phosphorus, Low Serum Calcium, low urinary volume.

Exclusion Criteria. Cases of renal cancer, subjects with renal transplantation, aggressive Cardio-renal syndrome, subjects with Primary Hyper-parathyroidism.

Data Collection Tools used. Personal contacts with subjects and via contacts in various Renal Clinics in Bilaspur district and collecting their details regarding their demographic data by filling details in pre designed format.

Estimating disease related biochemical parameters in serum samples of every subject. This study was carried out on CKD-stage III/IV/V patients before/after initiation of dialysis therapy in nephrology department of the Chhattisgarh Institute of Medical Sciences (CIMS), Subha Dubey's Hospital of Nephrology, District Hospital, Bilaspur, Unity Hospital, Bilaspur for study period from Oct. 2019 to Feb., 2023. At first, CKD- III/IV/V Stage patients were selected randomly according to inclusion criteria, then relevant history was taken and physical examination was carried out after taking permission of subjects. All the formalities related to medical ethics were followed. The following information was collected from each patient: (a) baseline demographics, e.g. age at time of study initiation, ethnicity, gender, smoking status, alcohol intake, primary cause of end-stage renal disease (ESRD) and presence of co-morbidities; (b) Biochemical parameters related with the very disease.

Biochemical Analysis. Baseline concentrations of the patients' serum ALP, haemoglobin and albumin were collected and reviewed. Serum calcium, phosphorus and PTH levels were measured at three time points: (a) baseline, or up to one month prior to study initiation; (b) one month after intervention initiation (i.e. during the first clinic visit); and (c) 4–6 months after intervention initiation (i.e. during the second clinic visit). Dialysis adequacy, measured in terms of urea level per week, was determined one month after intervention initiation. Data on the cause, frequency and duration of hospitalization, presence of peritonitis and survival status of the patient at the end of the one-year follow-up period was collected and reviewed.

Ethical Permission. The permission was taken from the subjects and also from the Ethical Committee of the Govt Bilasa Girls Autonomous College, Bilaspur, institute where the analytical work was done.

OBJECTIVES

Based on some related previous studies following objectives were drawn to conduct this work-

- To assess the initial serum Phosphorus level of the patients, hyper-phosphatemia is prevalent in Chronic Renal Patients; this etio-pathological condition has significant contribution for bone damage in CKD subjects.
- To assess the initial level of Calcium in serum of patients, because when the serum Phosphorus level gets high, simultaneously the serum Calcium level gets low, this induced hypocalcaemia has many adverse effects on body, bone and joints.
- To assess serum level of enzyme Alkaline Phosphatase, that is essential enzyme for mineralization of bones and teeth.
- To assess the Total Lipid profile of the patients as hyper-phosphatemia and parallel hypocalcaemia has proved dyslipidemia –precipitating effect. Also, CKD has adverse effect on serum lipid profile and many previous studies have proved association between dyslipidemia and bad bone health.
- To assess the level of C- reactive protein, because higher serum Phosphorus level increases sensitivity towards various infections and incidences of repeated infections are common in such patients. This precipitates higher level of C-reactive proteins as biomarker of infection and inflammation that also contributes to bone and joint deformity.
- To assess the serum level of Creatinine as this bio-indicator reflects the severity of CKD, because the excretion of Creatinine is hampered in chronic renal disorder and quantitatively co- related with the severity of the disease.
- To assess Haemoglobin gm % values as in CKD absence of REF (Renal Erythropoietin Factor) precipitates severe treatment resistant anaemia, which is biomarker of severity of CKD.
- To assess the total serum level of Parathyroid hormone, because elevated Phosphorus level changed the status of this very hormone or vice versa. Serum

Parathyroid level has gross affect on bone health in CKD victims.

- To assess the serum Albumin gm/dL value, as lower Serum Albumin level is expected due to its increased urinary excretion.
- To assess the BUN-Blood Urea Nitrogen as it is proved indicator of CKD and related complications.
- To assess the status of GFR-Glomerular Filtration Rate, as it is sole determinant of the grade of CKD.
- To assess the volume of urine as low urinary volume is common in CKD.
- To assess the level of Homocysteine as it is indicator of Cardio-renal syndrome.
- To assess ERS (Erythrocyte sedimentation rate), as this is indicator of inflammation and infection due to CKD driven hyper-phosphatemia.
- To assess Serum level of Vitamin D and BMD (Bone Mass Density) as these are indicators of bone health.

Methodology for Biochemical Estimations

- The Haemoglobin gm % value was estimated by using Heamoglobinometer based on Acid Haematin method, of Delux Company. Some samples were analyzed in 5 parts Heamogram Machine of Ever life Company.
- The various parameters related with RBCs as were also estimated by using Haematology analyzer of Ever life company in the research centre, Govt Bilasa Girl's College, Bilaspur as Mean Corpuscular Diameter (MCD µ), Mean Corpuscular Thickness (MCT µ), Mean Corpuscular Volume (MCV Cubic µ),Mean Corpuscular Haemoglobin (MCH microgram) and MCHC% (Mean corpuscular Haemoglobin Concentration %).
- Serum Creatinine level was measured by using kit of MERCK company, Catalogue no- EIACUN, in auto-analyzer. (Star 100) in the research centre Govt Bilasa Girl's College, Bilaspur, CG. Creatinine in a protein free solution reacts with Alkaline Picraete and produces a red colour complex, which is measured calorimetrically at 520 nm.
- C-reactive protein (CRP mg/L) was assessed by using kit of Span Diagnostics, reagent kit, Surat [Code 25934] used for in vitro detection of C - reactive protein (CRP) in human sera in auto-analyser by agglutination method. 50 micro ml serum was mixed with 1 ml reagent, clumping was indication of positive test.
- Serum Urea was estimated by Auto analyzer Star 100 by using kit of Span Diagnostics. (Kit No 46123). The serum Urea was hydrolyzed by Unease enzyme in to Ammonia and Carbon Dioxide; the produced Ammonia reacted with Hypochlorite and Phenolic Chromogen and produced coloured Indophenols. The optical density of the developed colour was measured at 578 nm.
- Serum Blood Urea Nitrogen (BUN/ dL) was estimated by using Kit of Stress Marq Biosciences, Catalog SKT-213 (2 Plate kit) in Biochemistry Auto analyzer star 100.
- Serum Alkaline phosphatase was measured by Spectrophotometer at 405 nm by directly mixing serum with 2-amino, 1-proponal (AMP) buffer at 10.5 pH.
- The GFR [Glomerular Filtration Rate was estimated in Dr Dubey's Clinic, Bilaspur by Inulin Clearance method, by using the formula. GFR = UV/P, where
- U = Urinary Concentration of the substance
- V = Urine flow rate (urinary volume)
- P = Average plasma concentration.
- The GER report was provided by the hospitals, they used inulin (MW 5200 dalton) as marker in most cases; Iothalamate was used in some cases as marker. According to Kidney Disease Outcome Quality Initiative (KDOQI)

guidelines Patients with e GFR <15 ml/min/1.73m2 ≥ 3 months was considered as CKD-V(11). Glomerular filtration rate (e GFR) was also estimated from serum creatinine level by using Modification of Diet in Renal Disease (MDRD) prediction equation. The MDRD equation: GFR (ml/min/1.73m^2) = 186X (Scr)-1.154 X(Age)-0.203 X (0.742 if female).

- The ratio of BUN: Creatinine was calculated.
- Urine output was estimated by collecting 24 hours urine in pot. (ml, Average of 3 days).
- Total Lipid Profile was assessed, because in renal problems and also due to anaemia driven hypoxia abnormal serum lipid profile is observed in many CKD based studies. All routine colorimetric estimations was performed on spectro-photometer '106', and colorimeter '114', [5-filters] (Systronics, India), Blood sample (2 ml) was collected and all analytics was done on serum and not on plasma, as EDTA interferes with lipid estimation procedures particularly with high density lipoprotein [HDL]. The blood samples obtained was stored at room temperature and then centrifuged at 4° to 8° C for 6 to 8 min at 3500 rpm to remove serum from the blood.
- Cholesterol in the blood sample was determined by the one step procedure of Wybenga *et al (*1970). (Catalog no-25924). This procedure was based on the oxidation of Cholesterol to Cholesterol Oxidase (CHO). This is again oxidized to Cholest 4-en 3-one and Hydrogen Peroxide. Hydrogen peroxide formed reacts with 4-amino antipyrine and 4-chlorophenol in the presence of peroxide (POD) to produce pink coloured quinonemine dye. The intensity of the colour produced was proportional to the cholesterol concentration in the sample.

HDL in the blood/serum samples was determined by the procedure of Gorden *et al.* (1977). The procedure was based on the principle of production of Hydrogen Peroxide, which finally gave blue colour. The optical Density of the developed color was measured at 600 nm, which was proportional to the HDL in the test sample. For the estimation of HDL mg (%) the diagnostic Kit of Span Diagnostics Ltd was used (Catalog No. 25924).

Triglyceride in the blood/serum samples was determined by the procedure of Bucolo David *et al.* (1973). The procedure was based on the principal of production of red colored dye, Quinoneimine, which

absorbed sharply at 510 nm. For the estimation of Triglyceride (mg/100 ml) the diagnostic kit of Chema diagnostics Ltd Glaxo was used which was azide free (catalog No. 77034) (6× 250 ml).

Calculation for the serum value of LDL was done by using Friedwld's Formula –LDL-C= (TC)-(HDL-C)-(TG/5)

- Estimation of Serum Calcium was done by OCPC (Ortho-Cresolphthalein Complexone) method by using the kit of "Lab Care" in auto analyzer, model no-Star 21 Plus. 1 ml vial of reagent was mixed with 0.5 ml serum. The calcium in the patient serum/plasma reacts with OCPC to form a purple coloured complex. The intensity of the colour is directly proportional to the concentration of calcium in the sample. The concentration is measured calorimetrically at a wavelength of 578nm (550–590nm) and compared with that of a standard.
- Estimation of serum Phosphorus was also done by using kit of Lab care and by using auto analyser, models no Star 21 Plus. In the reaction, inorganic phosphorus reacts with Ammonium Molybdate in an acidic solution to form a coloured Phosphomolybdate complex. The system monitors the change in absorbance at 365 nm at a fixed time interval. This change in absorbance is directly proportional to the concentration of phosphorus in the sample.
- Serum Albumin gm % was assessed because in renal disorders albuninurea is common, and serum Albumin level gets low parallel to the severity of the disease. The level was assessed by using auto-analyzer, model no 121 star, with the use of diagnostic kit for albumin analysis of Span company. Also, total protein gm % level was assessed by using the Kit of the same company, because it is expected that total protein status is also significantly reduced in CKD.
- Serum level of hormones were estimated by using Mini Vidas 500. As due to disturbed electrolytic profile of the CKD subjects, Parathyroid hormone is elevated, hormones from gonads are depressed, Insulin resistance is developed, as Insulin estimation facility is not available, thus C-Peptide was measured, which is quantitatively equal with Insulin. Kits of Eagle Biosciences were used for hormonal estimation of Parathyroid hormone, for estimation of serum C-peptide level kit of Invitrogen was used. Kit of India mart was used for the estimation of Thyroid hormone (T_4). Kit of Elabscience was used for the estimation of Testosterone hormone.
- Erythrocyte sedimentation rate was estimated by using Centrifuge with rpm more than 1000/min.
- The serum Vitamin D level was collected as secondary data from the clinics and pathological labs.

RESULT AND DISCUSSION

It is obvious from the about data that the average height of CKD subjects studied was 5.008 ft that is shorter than the height of an average Indian adult-5.5 ft.

The average weight was 55.55 kgs although the weight is appropriate for the height of the patient but it is lesser then the weight of an average adult Indian male. The observed BMI was within the healthier range – 23.81 may be this is due to water retention because of to hypo-proteinemia and albuminuria like co morbid conditions in the studied CKD victims Zheng *et al.* (2019).

The observed biochemical parameter showed the adverse biochemical profile of the studied subjects.

Due to lesser renal efficiency the serum urea ml/dL value was 80.09 % higher than the normal range, this finding matches with the work done by Seki *et al.* (2019). Likewise, the serum creatinine value was observed 29.23 % higher than the healthy parameter. The trend high serum creatinine level in CKD subjects matches with the study done by Rathi *et al.* (2012). The glomerular filtration rate was 37.77 % lower than the normal GFR. The urinary Excretion of creatinine was significantly higher (51%) due to higher serum level of creatinine. The UACR value was lower than the normal value although the albumin excretion was observed drastically increased via urine but on the other hand the excretion of creatinine was also increased. Thus, the UACR did not crossed the normal range. These findings match with the study done by Ren *et al.* (2021).

The blood urea nitrogen was 18.21 % increased due to hampered excretion of nitrogenous products during the condition of chronic renal disease. A study done by Kim *et al.* (2021) also showed the trend of higher blood urea nitrogen in CKD subjects. We have taken the parameters related to end products of nitrogen metabolism in studied subjects because in CKD prevalence of uremic osteoporosis is very common. The uremic toxins not only affected the neurological system of the subjects but also down regulate the expression of parathyroid hormone receptors and thus disturbed the bone turnover rate. The accumulation of nitrogen metabolites significantly reduced the bone formation signalling pathway to osteocytes as concluded by Alonso *et al.* (2021) in their study.

The table depicts the condition of aggravated dyslipidemia in studied subjects. The condition of hypercholesterolemia (161.60% increased), hyper-triglyceridemia (181.70% increased) with significantly lower serum HDL values (35.29 % decreased), with higher levels of Low Density Lipoprotein levels (375.55% increased). This atherogenic pattern of lipid profile not only made the CKD victims prone to develop cardiac diseases but also their bone health is affected via hyperparathyroidism, low growth hormone, low gonadalial hormone. Many previous studies also revealed the association of higher LDL with low bone mass. The CKD driven dyslipidemia worked via increased oxidative stress, systematic inflammation with increased orthoclastic activity as shown by the study done by Anagnostis *et al.* (2022).

The electrolyte profile of the studied subjects showed clear picture of hypocalcemia (41 ↓ %), along with hyperphosphatemia (149% ↑), Ca X Pmg/dL (772.72 %↑) extremely high, C-reactive protein (3813.33%↑) significantly elevated with reduced serum level of Alkaline Phosphatase enzyme (244.53 % ↓). Status of

hypocalcemia was also observed by Goyal *et al.* (2022) in their study.

Lower serum calcium level was might be due to non-conversion of hydroxyl vitamin D into its active form 1,25-dyhydroxy vitamin D by the damaged kidney, this active vitamin D increased absorption of calcium from the intestine and excretion of phosphorus on the other hand in healthy condition, this process stopped in damaged kidney (Williams *et al.*, 2009).

Calcitonin is elevated during the chronic renal disease Goyal *et al.* (2022) which also shares the condition of hypocalcemia with hyperphosphatemia due to increased oestoclastic activity. The increased excretion of albumin along with poor albumin availability also makes the condition adverse because albumin is the protein that bounds body calcium majorly and prevents its excretion.

Increased level of parathyroid hormone due to this electrolyte disturbance caused hyperphosphatemia along with hypo-calcimea, also the reduced GFR was one significant cause for the hyperphosphatemia in this very study. This matches with the study done by Yuen *et al.* (2016).

The condition of higher level of phosphorus is always correlated with increased rate of infection and inflammation Kravitz *et al.* (1993) thus the level of c-reactive protein is observed extremely high which is biomarker of inflammatory condition. Alkaline phosphatise is observed drastically reduced in this study, that might be the cause of poor bone health of subjects. The diseased kidneys also affected the hepatic health and the resulted hepato -renal syndrome might be the cause of reduced production of alkaline phophatase enzyme by the hepatocellular cells (Lata *et al.*, 2012).

The hormonal profile of the subjects showed the condition of hyperphosphatemia along with reduced gonadal hormons, insulin resistance and hypothyroidism Rathi *et al.* (2012).

The parathyroid hormone was observed drastically elevated

In the studied subjects (2536.23 % ↑), with lower level of serum testosterone (57.5 %↓) (Rathi & Ramachandran 2012), this disturbed hormonal profile mostly existed as co-morbid condition with the condition of CKD.

The changed electrolytic profile in CKD victims makes hyper secretion of parathyroid hormone, but might be due to deficiency of growth hormone, mental stress and other co-morbid conditions precipitated reduced level of sex hormones with related symptoms in CKD patients. This changed biochemistry was also observed by Piccoli *et al.* (2010).

As CKD is proved to affect the pituitary-thyroid axis, thus hypothyroidism is common among CKD patients, also due to less availability of T_3 and T_4 binding protein – albumin the serum level of thyroid hormone goes down in CKD patients as indicated by many previous studies. The observed co-morbid condition of hypothyroidism might be the root cause of reduced renal blood flow (RBF) and low GFR in this study.

The condition of hyper-insulineimia with increased level of c-peptide was observed (33.2 % ↑), this might be due to disease driven hepato-renal syndrome in CKD subjects, because healthy hepatic cells used to clear excess insulin hormone produced , but due to comorbid condition of hepatic insufficiency in CKD patients , the insulin clearance might be reduced and precipitated the condition of hyperinsulinimia as also observed by Schrauben *et al.* (2019).

Erythrocyte sedimentation rate (ESR) was many times increased (328.9% ↑) which is bio marker of increased infection and inflammation, this might be observed due to the condition of hyper-phosphatemia in CKD patients as also observed by Guo *et al.* (2020) in their related research.

The conversion of hydroxyl vitamin D into its active form 1,25-dyhydroxy vitamin D by the damaged kidney was hamper as observed by the lower level of vitamin C much below than the normal serum value of this vitamin also noticed by Pazianas *et al.* (2021).

The lumber spin bone mass density (BMD) was observed lower due to quenching of calcium and demineralization of bone, might be due to active osteoplasty via hyperparathyroidism, this finding matches with the work done by Huang *et al.* (2020).

Total protein was observed lower than the normal serum value due to less production of protein from the liver with increased urinary excretion, might be due to hepto-renal syndrome (Seyedzadeh *et al*., 2022).

Renal efficiency ratio (EFR) was observed lower than the normal value as expected, because of reduced renal blood flow. Renal efficiency ratio is the indicator of renal functional capacity, it is a ratio between glomerular filtrate formed per minute, divided by the blood flow through kidney per minute, as the CKD progresses the value of REF is observed declining proportionately (Weis, *et al.*, 2013).

The above haematological parameters showed that the studied CKD patient were having Normocytic, and Normochromic anaemia with no signs of iron deficiency in CKD patients, must be due to reduced production of Renal Erythropoietin factor (REF).

In every studied age group some subjects were observed having Osteitis Fibrosa Cystica (OFC) as diagnosed by orthopedicians of the contacted hospitals. This might be due to over production of parathyroid hormone as we have observed in subject's biochemical profile. This peculiar condition was observed only in those CKD patients who were having their GF value less than 40 ml.

A dynamic Bone Disease (ABD) was observed only in that CKD patient who were on continuous dialysis since last 3-5 years. Osteomalacia is observed is most of the studied subjects is all age groups might be due to hypocalcaemia, hypoprotenemia, hyperparathyroidism and hyperosteoclaystic activity (Zhang *et al*., 2023).

Table 1: Co-morbid Factors related with CKD.

Factors	No. of Victims	Percentage
Anemia	17	68 %
Hypocalcaemia (<8.1mg/dl)	23	92%
Hyper-phosphataemia (>5.5 mg/dl)	25	100%
Product of Ca and P (> 5.5 mg^2/dl^2)	24	96%
C-reactive Protein	25	100%

Table 2: Physical Factors related with CKD subjects.

Age	Numbers	Height cms	Weight In Kgs	BMI
20-24	5	151.11 cms	51.3 Kgs	22.5
25-35	5	149.73 cms	49.21 Kgs	22.16
3 6-45	5	154.02 cms	56.44 Kgs	23.81
46-55	5	153.56 cms	54.15 Kgs	22.84
56-65	5	154.89 cms	66.68 Kgs	27.78
AVERAGE	**25**	**152.66** cms	**55.55** Kgs	**23.81**

(Values expressed as × $mg.ml^{-1}$ serum and are presented as Mean value ± Standard Deviation)

Table 3: Biochemical Parameters of the CKD Subjects.

Age	Serum Urea mg/dL	Serum Creatinine mg/dL	GFR ml/min/1.73m²	Urine Ceratinine gm/kg	Albumin in urine mg/day	Urine Albumin: Creatinine ratio (UACR) Al / Cr	BUN mg/dL
20-24	27.5	1.4	67	2.8	57	20.35	12.92
25-35	33.12	1.7	59	4.1	59	14.39	15.56.
36-45	38.07	1.9	63	3.2	69	21.5	17.89
46-55	41.31	1.8	44	1.9	61	32.10	19.41.
56-65	40.09	1.6	47	3.1	57	18.38	18.84
Average Value	**36.018**	**1.68**	**56**	**3.02**	**60.6**	**21. 344**	**16.55**
Normal value	**20**	**1.3**	**90**	**2.0**	**2.0**	**Below 30**	**7-20**
Deviation from the normal value	**80.09 % ↑**	**29.23 %↑**	**37.77 %↓**	**51%↑**	**2930% ↑**	**32.18 % ↓**	**18.21 %↑**

(Formula applied for calculation of BUN = 0.47 × serum urea)

Table 4: Lipid Profile of the CKD Subjects.

Age group	Cholesterol	Triglyceride	HDL	LDL
20-24	3.02±0.13	1.54±0.19	0.33±0.11	2.11±0.36
25-35	2.99±0.28	1.93±0.32	0.29±0.19	2.44±0.26
36-45	2.76±1.33	2.87±0.44	0.41±0.20	1.56±0.11
46-55	2.26±1.28	2.35±0.59	0.38±0.13	2.37±0.63
56-65	3.66±1.20	2.89±0.66	0.27±0.18	2.22±0.08
Average Value	**2.93**	**2.31**	**0. 33**	**2.14**
Normal values	**1.12±0.33**	**0.82±0.24**	**0.51±0.10**	**0.45±0.14**
Deviation from the normal value	**161.60 % ↑**	**181.70 % ↑**	**35.29 % ↓**	**375.55 % ↑**

Table 5: Biochemical Parameters of the CKD Subjects.

Age	Serum Calcium mg/dl	Serum Phosphorus mg/dL	Ca X P mg/dL	CRP mg/dL	Serum Alkaline Phosphatase IU/L
20-24	5.8	9.9	50	14.5	205
25-35	6.1	8.6	45	9.1	311
36-45	5.9	10.2	48	10.9	287
46-55	6.3	9.8	53	12.3	171
56-65	5.4	11.3	44	11.9	318
Average Value	**5.9**	**9.96**	**48**	**11.74**	**258.4**
Normal value	**9-11**	**3.4-4.5**	**5-5. 5**	**0. 3**	**44-147**
Deviation from the normal value	**41 % ↓**	**149% ↑**	**772.72 % ↑**	**3813.33%↑**	**244.53% ↓**

Table 6: Biochemical Parameters of the CKD Subjects.

Age	Serum Parathyroid Pg/ml	Serum Testosterone ng/dL	Thyroid T4 µg/dL	c-peptide ng/ml	ESR mm/h
20-24	144	285	5.11+1.01	2.4	29
25-35	139	333	5.09+1.5	3.1	31
36-45	157	345	6.3+ 0.09	3.8	24
46-55	208	479	5.73 +2.03	3.3	28
56-65	227	470	4.93 +1.11	4.09	36
Average Value	**175**	**382.4**	**3.43**	**3.33**	**29.6**
Normal Values	**1.6-6.9**	**800-1000**	**4.5-11 µg/dL**	**0.5-5 mU /L**	**1.6-6.9**
Deviation from the normal value	**2536.23 %↑**	**57.5 % ↓**	**61.88 %↓**	**33.2 % ↑**	**328.9% ↑**

Table 7: Biochemical Parameters of the CKD Subjects.

Age	Vitamin D ng/ ml	LS-BMD	Total Protein gm%	Renal Efficiency ratio (REF)
20-24	16	0.88 + 0.15	4.9	0.11
25-35	12	0.63+0.01	5.6	0.09
36-45	14	0.51+0.03	4.1	0.13
46-55	18	0.48+0.13	6.3	0.10
56-65	13	0.66+0.11	4.2	0.08
Average Value	**14.6**	**0.632**	**5.02**	**0.10**
Normal Values	**20 ng/ml**	**0.973+0.97**	**6.0-8.3 g/dL**	**0.17**
Deviation from the normal value	**27 %↓**	**35.04 %↓**	**39.51%↓**	**41.17%↓**

(REF Formula = Glomerular filtrate formed / Blood Flow per minute (120 / 770 =0.17)

Table 8: Haematological Parameters of the CKD Subjects.

Age	MCV Cubic µ	M.C.D µ	M.C.T µ	M.C.H microgram	MCHC %
20-24	84 .3 + 2.0	7.1 + 2.3	1.8 + 0.9	24.4 + 2.3	27.0 + 3.6
25-35	82.1 + 1.2	7.2 + 1.6	2.2 + 1.1	26.5 + 2.2	29.9 + 3.2
36-45	85.4 + 1.4	6.9 + 2.1	1.8 + 0.7	25.3 + 1.6	30 .6 + 1.6
46-55	84.0 + 2.2	7.6 + 1.9	2.0 + 0.8	27.2 + 1.4	26.5 + 0.1
56-65	82.6 + 1.6	7. 2 + 2.3	1.7 + 1.1	28.4 + 1.2	28.3 + 2.6
Average Value	**83.68**	**7.2**	**1.9**	**26.36**	**28.46**
Normal Values	**87cubic µ**	**7.3 µ**	**2.2 µ**	**31 pg/cell**	**36g/dL**
Deviation from the normal value	**3.81% ↓**	**1.36% ↓**	**13.63% ↓**	**14.96% ↓**	**20.94% ↓**

Table 9: Bone Disease Prevalence in the CKD Subjects.

Age	No of Patients	Osteitis Fibrosa Cystica (OFC)	Adynamic Bone Disease (ABD),	Osteomalacia
20-24	8	2	1	7
25-35	6	1	2	6
36-45	8	1	1	7
46-55	6	2	1	6
56-65	8	2	2	8

CONCLUSIONS

In conclusion, the mechanisms underlying bone loss and repeated fractures in CKD patients are complex and incompletely understood. In contrast to bone biopsy, currently available non-invasive diagnostic measures to detect both quantitative and qualitative bone loss are clinically inadequate as screening or diagnostic techniques. The further relevant researches should continue to investigate the detailed mechanisms of patho-physiology and should focus to seek targeted therapy for quality and quantity-related bone loss in CKD patients.

Thus a complex relationship observed existed between chronic kidney disease and mineral and bone disorders (CKD-MBD) with adverse outcomes in non-dialysis and dialysis patients. This study proved the prevalence of Osteo-dystrophy in CKD patients as serious co-morbid condition.

FUTURE SCOPE

As in Chhattisgarh, which is stone belt of India, due to hardness of water in CG, incidences of renal damage are like epidemic here, thus osteodestrophy being common co-morbid condition during renal

insufficiency, should be considered while monitoring any such cases to avoid CKD related osteodystrophy.

Acknowledgement. We extent our sincere thanks to Dr Vijay Mishra, Othopedician, District Hospital, Bilaspur, Dr Subha Dubey, Nephrologist, Raipur, Dr Vikrant Singh (MD. Medicine, Unity Hospital, Bilaspur), Dr Saquib Ali (MBBS. Unity Hospital, Bilaspur), Dr Aahutosh Kori (MD. Medicine, CIMS Bilaspur), Dr Mrityunjai Saraf (Nephrologist, Bilaspur). Dr. Yamini kashyap (MBBS. CIMS, Bilaspur).
Conflict of Interest. None.

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How to cite this article: Seema Mishra and Shweta Tamrakar (2023). Osteodestrophy in Chronic Renal Patients –A Study based on Bilaspur District, Chhattisgarh. *Biological Forum – An International Journal*, *15*(6): 739-747.