ISSN: 3067-2376
Research Article
Journal of Comparative Medicine Research Reviews and Reports

Relationship Between Vitamin D Levels and Bone Mineral Density in Patients with Chronic Kidney Disease

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Submitted: 02 January 2026 **Accepted:** 08 January 2026 **Published:** 13 January 2026

Citation: *Montaño Azor, L., Romero Rodríguez, E. M., & Serrano Varo, P. (2026). Relationship between vitamin D levels and bone mineral density in patients with chronic kidney disease. J of Comp Med Res Rev Rep, 3(1), 01-02.*

Abstract

Background: *Chronic kidney disease (CKD) is characterized by progressive loss of renal function, often remaining asymptomatic until advanced stages. Alterations in mineral metabolism, particularly involving phosphorus, parathyroid hormone (PTH), and vitamin D, play a crucial role in bone health and disease progression in CKD. Identifying modifiable factors in earlier stages may help delay renal deterioration and related complications.*

Objective: *To analyze the relationship between mineral metabolism parameters and renal function in patients with stage 3 chronic kidney disease, with particular focus on factors associated with bone mineral density and disease progression.*

Methods: *A prospective, multicenter observational study was conducted in the province of Córdoba, Spain, involving patients aged ≥18 years diagnosed with stage 3 CKD (estimated glomerular filtration rate 30–60 ml/min/1.73 m²). Participants were followed for one year. Clinical, biochemical, and renal function parameters were collected, including PTH levels, fractional phosphorus excretion, and glomerular filtration rate.*

Results: *A positive correlation was observed between parathyroid hormone levels and fractional phosphorus excretion ($R^2 = 0.1837$), though with notable variability. Additionally, glomerular filtration rate demonstrated a negative correlation with age ($R^2 = 0.2686$), indicating a moderate decline in renal function with increasing age.*

Conclusions: *The weak association between PTH and phosphorus excretion suggests that additional regulatory mechanisms influence mineral metabolism in CKD. The inverse relationship between age and renal function aligns with established patterns of renal aging. These findings highlight the complex interaction between mineral metabolism and kidney function and support the importance of early monitoring and intervention in patients with stage 3 CKD.*

Keywords: Chronic Kidney Disease, Vitamin D, Bone Mineral Density, Mineral Metabolism, Parathyroid Hormone, Phosphorus.

Introduction

Chronic kidney disease is characterized by the progressive deterioration of kidney function, with its progression often marked by the absence of symptoms until the advanced stages of the disease. It is important to identify variables that influence disease progression in order to modify them when possible and to establish a basis for future research.

In patients with chronic kidney disease (CKD) who do not yet require dialysis, elevated serum phosphorus (P) levels are associated with a faster progression to end-stage renal disease and predict mortality. Even in the general population, a high-normal serum phosphorus concentration has been observed as a predictor of mortality.

Material and Methods

A prospective, multicenter observational study will be conducted in the province of Córdoba (through the Córdoba-Guadalqui-

vir Primary Care Health District in collaboration with the Reina Sofía Hospital of Córdoba and the Maimonides Institute for Biomedical Research of Córdoba), with a follow-up period of one year.

Initial Hypothesis

Reducing intestinal phosphorus absorption in earlier stages (CKD stage 3) may help slow the progression of kidney function deterioration and delay the need for dialysis.

The aim of our study

Analyze the progression of kidney function in patients with CKD stage 3 and, consequently, delay the initiation of dialysis.

Study Population

Patients being over 18 years of age (≥18), patients with stage 3 CKD (GFR estimated by the CKD-EPI formula between 60-30 ml/min/1.73 m2 for more than 2 months), negative pregnancy test, patient able to understand the study procedures and giving informed consent.

Results

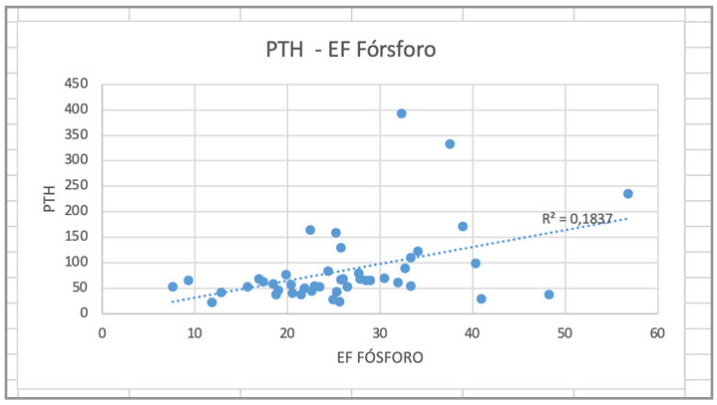

Figure 1: Correlation between PTH and fractional phosphorus excretion ($R^2 = 0.1837$).

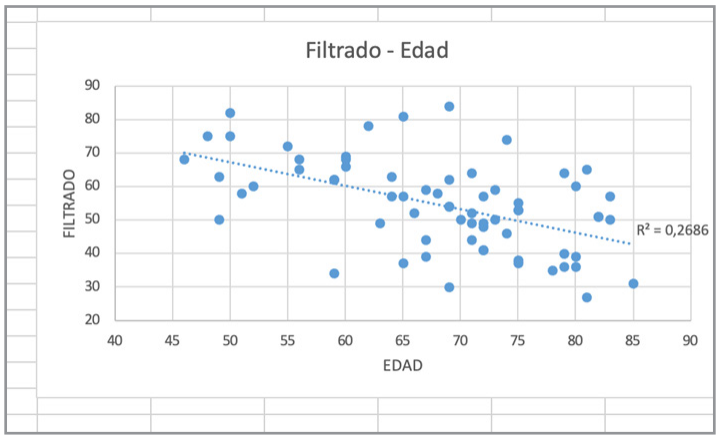

Figure 2: Correlation between glomerular filtration and age ($R^2 = 0.2686$).

A positive correlation was observed between parathyroid hormone (PTH) and fractional excretion of phosphorus ($R^2 = 0.1837$), although with wide variability and several outliers. In addition, glomerular filtration showed a negative correlation with age ($R^2 = 0.2686$), indicating a moderate decline in renal function with increasing age.

Conclusions

The weak association between PTH and phosphorus excretion suggests the involvement of additional regulatory mechanisms. In contrast, the inverse relationship between age and filtration is consistent with the progressive decline in renal function described in previous studies. These findings underscore the interplay between mineral metabolism and renal aging.