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# The association between metabolic acidosis and bone mineral density in pre-dialysis chronic kidney disease: results from the KNOW-CKD cohort

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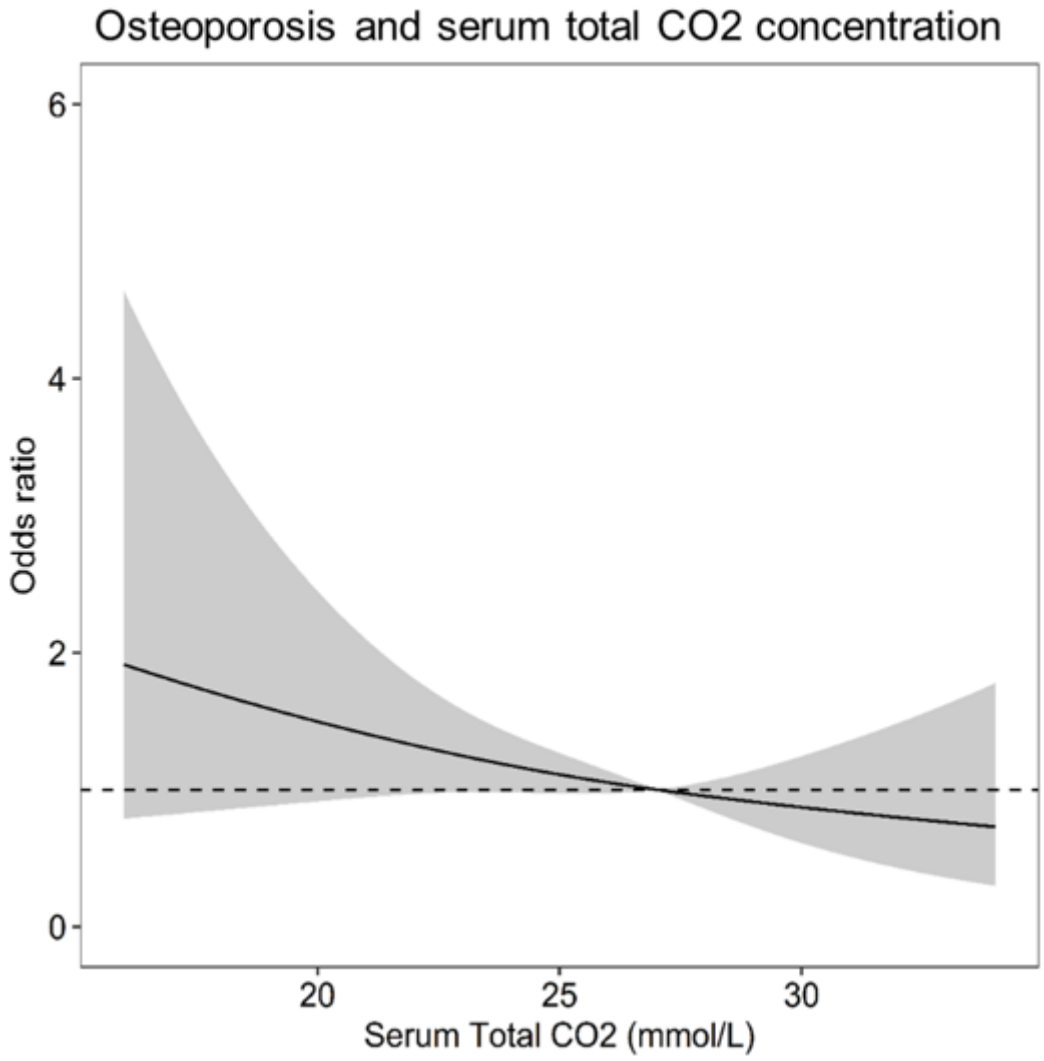
**Objectives:** Metabolic acidosis leads to lower bone mineral density(BMD), which is a risk of osteoporosis. We evaluated the relationship between serum total $CO_2$($tCO_2$) and BMD in the chronic kidney disease(CKD) population.

**Methods:** We analyzed 1,529 patients with CKD stages 1 to 5(pre-dialysis). The predictor was serum $tCO_2$ level measured at baseline. tCO2 was analyzed either as a continuous or a categorical variable of 3 levels (low<22, normal 22-29.9, high≥30mmol/L). The outcome was osteoporosis at baseline. Osteoporosis was defined as a Z score≤-2.0 for those under 50 years of age and a T-score≤-2.5 for over 50 years of age based on the lowest BMD at three measurement points. Among the patients who measured BMD both at baseline and after 4 years(N=885), the reduction of BMD over four years in lumbar vertebra L1, femur neck(FN), and total hip(TH)(defined as BMD at 4 years – BMD at baseline<0) was defined as a longitudinal outcome. The associations between continuous level and low group of $tCO_2$ and outcomes were assessed using multivariable logistic regression with adjustment for the age and sex.

**Results:** The low $tCO_2$ as a continuous variable (adjusted odds ratio[OR] 0.92, confidence interval[CI] 0.88-0.97, $P$<0.001) and the low $tCO_2$ group were related to osteoporosis (adjusted OR 1.95, CI 1.02-3.87, $P$=0.05). For subgroup analysis according to CKD stage, this tendency remained significant in CKD stage 3a to 5 as continuous $tCO_2$(adjusted OR 0.93, CI 0.87-0.99, $P$=0.046) and the lowest group of $tCO_2$(adjusted OR 1.24-9.64, $P$=0.026), but not in the early CKD patients. There was a significant relationship between the low tCO2 group and TH BMD reduction at 4 years(adjusted OR 1.18, CI 1.02-1.37, $P$=0.025), but not in the L1 and FN BMD reduction.

**Conclusions:** In CKD patients, low serum $tCO_2$ was associated with osteoporosis, and decrease of BMD at 4 years might be related to low serum $tCO_2$.

Figure 1. The relationship between osteoporosis and serum total CO2 concentration


Osteoporosis and serum total CO2 concentration
Odds ratio
6
4
2
0
20
25
30
Serum Total CO2 (mmol/L)