RELATIONSHIP BETWEEN SERUM ZINC CONCENTRATION AND PROTEINURIA IN PATIENTS WITH CHRONIC KIDNEY DISEASE

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Background

Zinc (Zn) is an essential trace element regarding cellular metabolism, tissue repair and inflammation. Serum zinc levels have been shown to decrease in ESRD patients, however, the corresponding serum zinc levels at the different pre-dialysis CKD stages, are not known. The purpose of this study is to analyze the association between serum zinc level and proteinuria in the patients with CKD

Methods

All clinical and laboratory data including measurement of serum zinc were obtained from 328 pre-dialysis CKD patients. Amount of proteinuria was measured by the total quantity of protein in a 24 hour-urine collection. Serum zinc concentration was evaluated by inductively coupled plasma mass spectrometer (ICP/MS).

Results

Median values of serum Zn and eGFR were 68.30 ug/dL and 34.35 ml/min/1.73m2 (IQR: 13.73-88.01 mg/dL), respectively. Serum Zn level showed positive correlation eGFR (r^2=0.037, $p<0.001$). On the other hands, serum Zn level negatively correlated with proteinuria ((r^2=0.064 $p<0.001$). We divided those patients into tertile groups by serum zinc concentration. When compared lower tertile group(T1) with other groups(T2-3), the lower tertile group of serum zinc concentration showed the smallest amount of proteinuria. ($p = 0.01$). Serum Zn level was independently associated with proteinuria of higher than 300mg/day (OR = 0.970, 95% CI 0.941 - 1.000; $p = 0.047$) after adjusting factors including diabetes, hypertension, eGFR and age.
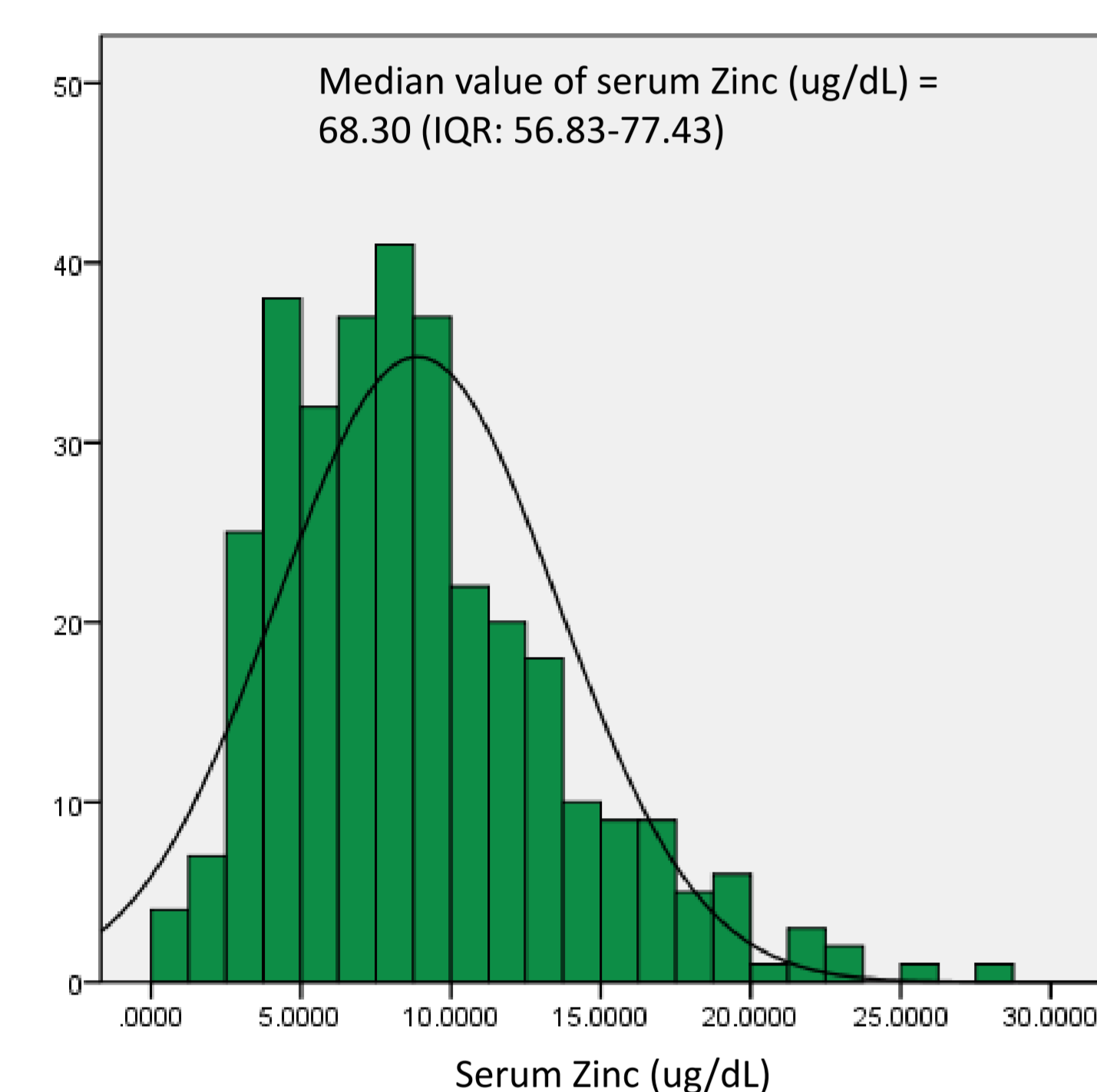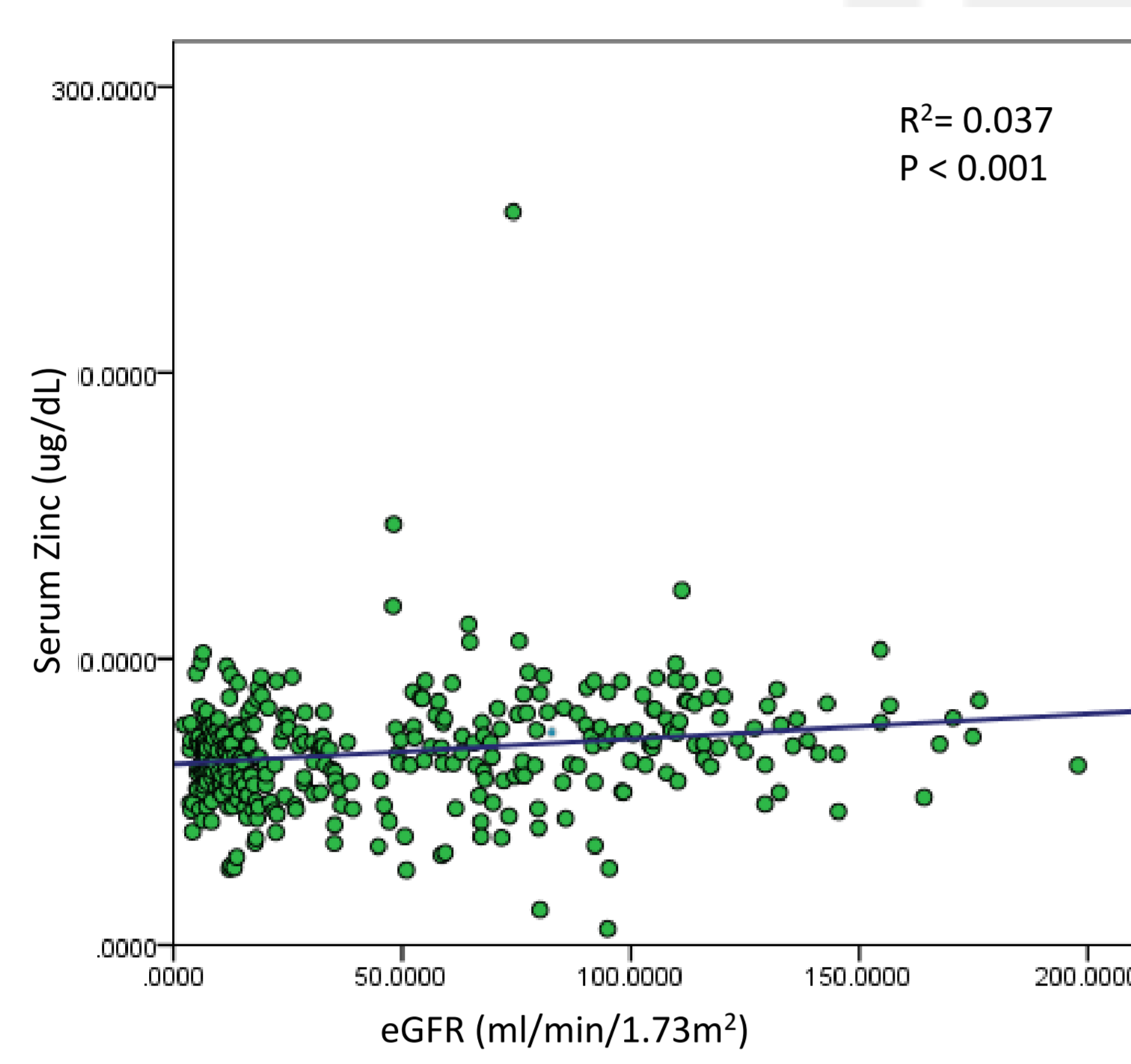

Figure 1. Distribution of serum zinc
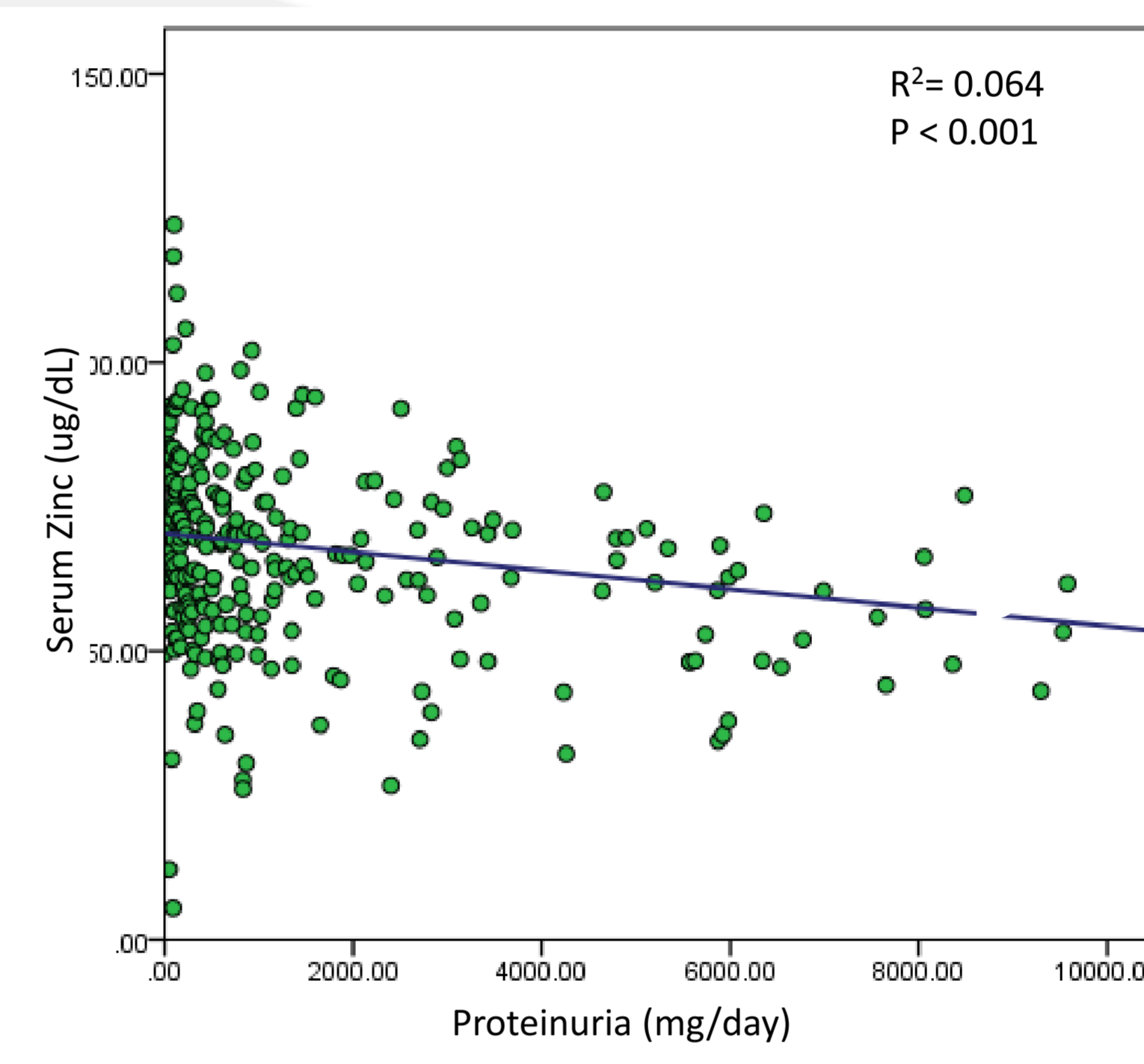

Figure 2. Serum zinc and eGFR
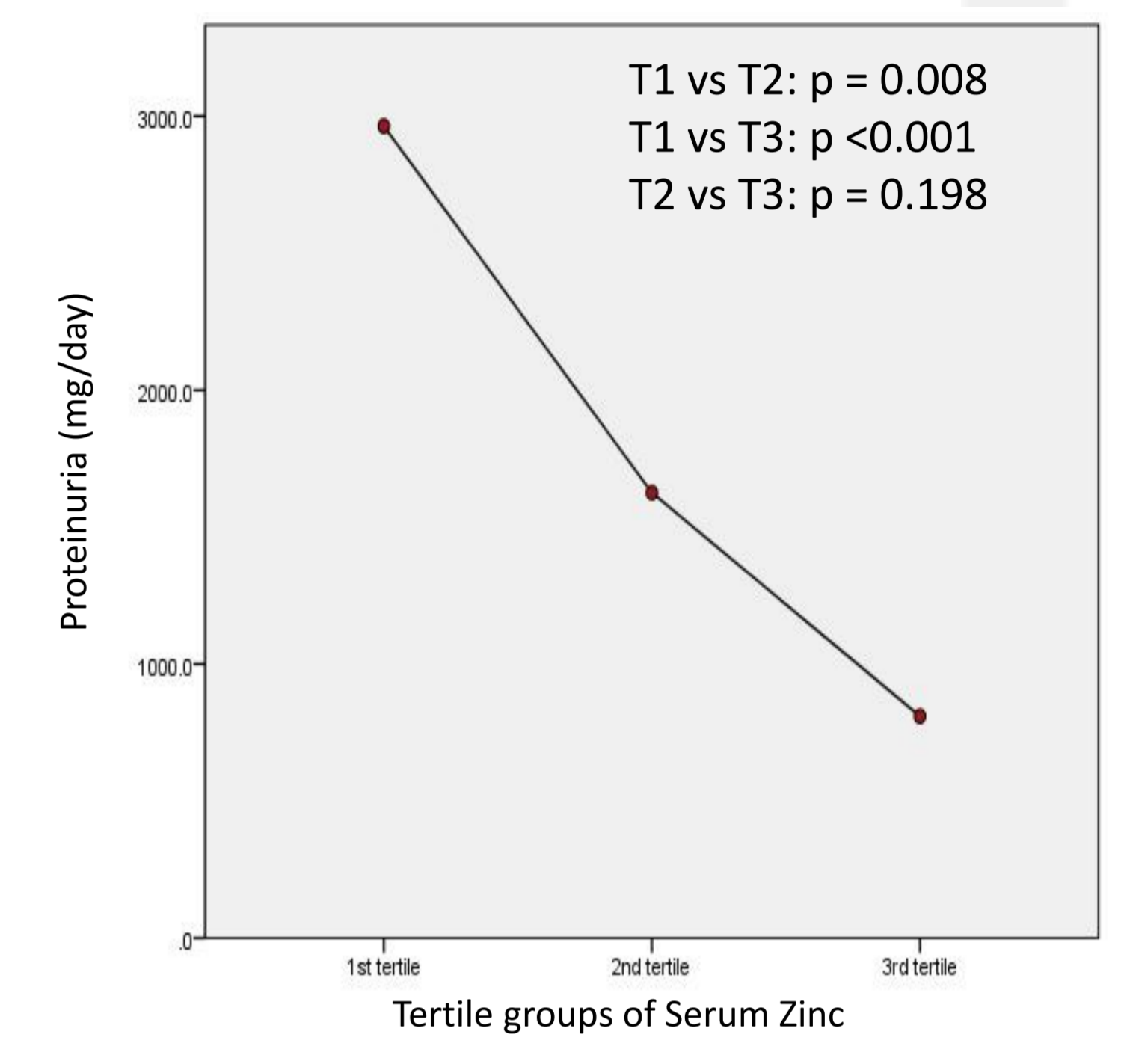

Figure 3. Serum zinc and proteinuria

Figure 4. Mean amount of proteinuria between tertile groups of serum zinc

Table 1. Baseline characteristics of all participants

Clinical and Laboratory parameters	Total (n=328)
Male, n(%)	158 (47.4)
Age	60.39 ± 19.47
BMI (kg/m²)	24.08 ± 4.53
Smoking, n(%)	77 (23.1)
Hypertension, n(%)	206 (61.9)
Diabetes, n(%)	132 (39.6)
Cardiovasc. Dz, n(%)	35 (10.5)
PAD, n(%)	2 (0.6)
Chronic HF, n(%)	27 (6.3)
CVD, n(%)	40 (12.0)
Hypothyroidism, n(%)	17 (5.1))
Serum Zinc (ug/dL)	68.30 (56.83-77.43)
WBC (10^9/L)	7.26 (5.67-9.61)
Segment neutrophil (%)	66.50 (57.55-77.98)
Hemoglobin (g/dL)	11.05 (9.20-12.70)
Hematocrit (%)	32.40 (27.30-36.70)
BUN (mg/dL)	33.60 (15.53-69.08)
eGFR (ml/min/1.73m²)	34.35 (12.51-82.51)
Serum Cr (mg/dL)	1.84 (0.85-4.37)
24hr-proteinuria (mg/day)	600.0 (171.79-2012.19)
Serum total protein(g/dl)	6.43 ± 0.99
Serum albumin (g/d)	3.63 (3.13-7.19)
fT4 (ng/dL)	1.14 (0.94-1.29)
TSH (uIU/mL)	1.71 (1.03-3.12)
Ferritin (ng/ml)	143.10 (69.90-255.21)
CRP (mg/L)	3.10 (0.67-20.77)
HbA1c (%)	6.21 ± 1.46
ALP (IU/L)	226.0(177.25-278.0)

Table 2. Determinants of serum Zinc

Linear regression model	Unadjusted		Adjusted multivariate	
	Slope difference	P value	Slope difference	P value
Gender, female	0.655	0.772	-2.726	0.299
Age, per 1 year	-0.214	<0.01	-0.228	0.010
BMI, per kg/m²	-0.320	0.242	-0.175	0.509
Smoking	-4.176	0.116	-0.001	0.928
HBP	-2.067	0.376	-2.681	0.383
DM	-2.450	0.287	-3.205	0.274
Anemia	-6.600	0.007		
Hb, per 1mg/dL	1.456	0.001	-0.008	0.991
Hct, per 1%	0.557	0.001		
BUN, per 1mg/dL	-0.081	0.007		
Cr, per 1mg/dL	-0.727	0.061		
eGFR, ml/min/1.73m²	0.046	0.015	0.037	0.392
Total protein, per 1mg/dL	4.915	<0.001		
Serum albumin, per 1mg/dL	11.176	<0.001	8.456	0.001
ALP, per 1 IU/L	0.006	0.481	0.034	0.002
Intact PTH, per 1pg/mL	-0.001	0.945	-0.010	0.323
1,25(OH)2 Vit D, per 1pg/mL	0.029	<0.001	0.021	0.890
25(OH) Vit D2+D3, per1pg/ml	-0.017	0.744	-0.001	0.992
24-hr urine protein (mg/day), per 1mg/day	-0.002	<0.001		

Table 3. Multivariate binary logistic regression analysis for proteinuria with serum zinc

	Proteinuria > 300mg/day	
	Slope difference (95% CI)	p
Gender, female	0.927 (0.555 − 1.548)	0.771
Age, per 1 year	0.986 (0.970 − 1.002)	0.087
HBP	1.047 (0.545 − 2.010)	0.890
DM	0.715 (0.389 − 1.316)	0.281
Zn, per 1 mg/dL	0.982 (0.968 − 0.996)	0.011
eGFR, per 1 ml/min/1.73m²	0.985 (0.978 − 0.992)	< 0.001

Conclusion

Higher serum Zn level in CKD patients was related to lesser amount of proteinuria. These results suggest that serum Zn could be used as a predictor for progressive proteinuria in patients with CKD.

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