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Converting Urine Protein-to-Creatinine Ratio to Urine Albumin-to-Creatinine Ratio: Evaluating the Diagnostic Accuracy of Simple versus Complex Formulas in Albuminuria Detection

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Objectives : Recent studies indicate that converting the urine protein-to-creatinine ratio (uPCR) to the urine albumin-to-creatinine ratio (uACR) using formulas could compensate for the absence of uACR in performing risk assessments for Chronic Kidney Disease (CKD). This study evaluates the effectiveness of both a simple and a complex formula in screening for albuminuria using uPCR in a Taiwanese cohort.
Methods : Our study included individuals aged 18-90 years who had at least two sets of simultaneous uPCR and uACR measurements from the ignite Hyper-intelligence (iHi) Data Platform at China Medical University Hospital. We excluded urine samples with creatinine levels below 30 or above 300 mg/dL. Simple and complex formulas were used to estimate the uACR based on uPCR (Figure). The correlation and agreement between actual and predicted uACR values were assessed using Pearson method and the Bland-Altman approach. For patients whose predicted uACR failed to detect albuminuria as per the actual uACR in the first paired measurements, we subsequently calculated the positive detection rate of albuminuria within the 90, 180, and 365 follow-up timeframes.
Results : This study examined 2,024 patients, with a median age of 60.6 years, and a 65% male majority. Correlation coefficients between actual uACR and uACR predicted by simple and complex formulas were 0.953 and 0.973, respectively. The Bland-Altman plots (Figure) summarize the patterns of agreement and proportional bias. Among 1,225 patients with initial actual uACRs exceeding 30 mg/g creatinine, we found false negative rates (FNR) of 2.0% with the simple formula and 7.6% with the complex formula. During a 90-day follow-up, 55.6% of subsequent available urine samples indicated albuminuria when analyzed using the simple formula, compared to 40.5% identified by the complex formula (Table).
Conclusions : In the Taiwanese population, using a simple formula to predict uACR from uPCR for albuminuria screening is practical, given its low FNR and cost-effectiveness.

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Figure. Bland-Altman plots illustrate the concordance of actual uACR measurements with those predicted by the simple (left panel) and complex (right panel) models. On the x-axis, we plot the mean of the predicted and actual values, while the y-axis displays the difference between these values (predicted minus actual). The blue line indicates the median difference and is accompanied by a confidence interval (represented by the blue dotted lines), while the red line depicts the linear regression line with its confidence interval (shown by the red dotted lines). The black dotted line denotes the zero difference line and the limits of agreement. Due to concerns with plot readability, the lower limit of agreement in the left panel is not displayed.

Simple model: uACR =exp (1.32*ln(PCR)-2.64)

Complex model: uACR = exp (5.3920 + 0.3072*log(min(uPCR/50, 1)) + 1.5793*log(max(min(uPCR/500, 1), 0.1)) + 1.1266*log(max(uPCR/500, 1)))

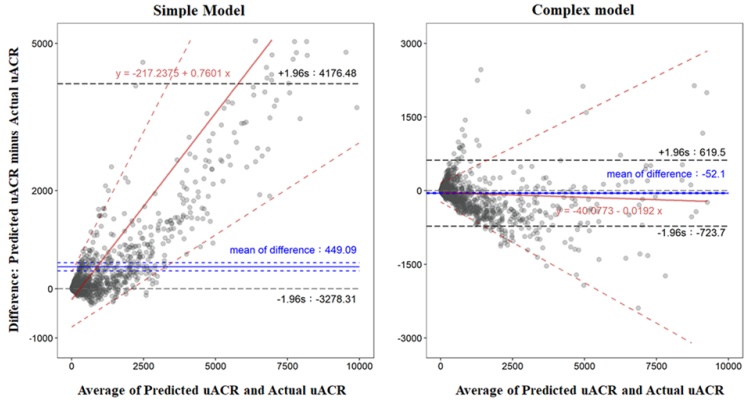

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Table. The proportion of false negatives over follow-up periods of 90, 180, and 365 days among patients who initially presented with albuminuria but were falsely categorized as negative according to the predicted uACR from both simple and complex predictive models.

Model	Follow-up positive rate within 90/180/365 days					
	90 days		180 days		365 days	
	Available patient (N)	Positive prediction (n (%)[a])	Available patient (N)	Positive prediction (n (%)[a])	Available patient (N)	Positive prediction (n (%)[a])
Simple [1]	9	5 (55.56)	14	7 (50.00)	20	12 (60.00)
Complex [2]	42	17 (40.48)	58	28 (48.28)	77	40 (51.95)

[a]: The percentage of patients who could be classified as albuminuria at least one time within the follow-up timeframe of 90, 180, 365 days

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2. Sumida K, Nadkarni GN, Grams ME, et al. Conversion of Urine Protein-Creatinine Ratio or Urine Dipstick Protein to Urine Albumin-Creatinine Ratio for Use in Chronic Kidney Disease Screening and Prognosis : An Individual Participant-Based Meta-analysis. *Ann Intern Med*. 2020;173(6):426-435. doi:10.7326/M20-0529