



LETTER TO THE EDITOR

A surprising journey into the conversion of urinary protein creatinine ratio to urinary albumin creatinine ratio as needed in the Kidney Failure Risk Equation

Brecht Mertens¹, Sabine Verhofstede², Daniel Abramowicz^{1,2} and Marie M. Couttenye^{1,2}

¹University of Antwerp, Belgium and ²Department of Nephrology, Antwerp University Hospital, Belgium

Correspondence to: Marie M. Couttenye; E-mail: marie.couttenye@uantwerpen.be

When trying to validate the Kidney Failure Risk Equation (KFRE) in our patients with chronic kidney disease Stage 4–5 [estimated glomerular filtration rate (eGFR) <30 mL/min/1.73 m²], we came upon the need to convert urinary protein creatinine ratio (UPCR) to urinary albumin creatinine ratio (UACR) [1, 2]. Indeed, in our retrospective database, a large part of the extracted patients had only UPCR measured.

Tangri *et al.* seem to have encountered the same problem. In their original study calculating the KFRE [1], they mention that 24-h protein excretion was converted to UACR. The authors report that in 1723 patients, UACR was measured on a spot urine sample, while in 1923 patients it was calculated from 24-h protein excretion. However, the formula for this conversion was not described. Instead we read:

Using a formula derived from the Irbesartan in Diabetic Nephropathy Trial study, 24-hour urinary protein excretion was transformed to an albumin-to-creatinine ratio. (19)

'Reference #19' is the Irbesartan trial reported by Parving *et al.* [3]. However, Parving *et al.* did not measure protein in the urine: they only measured UACR! In a more recent article, the meta-analysis on the Tangri score [2], the authors mention that calculation of UACR starting from different protein measurements was necessary. In this publication, we found:

Alternative measures of urine protein excretion (protein to creatinine ratio, 24-hour urine collection, urinary dipstick) were transformed to the ACR using previously developed equations. (6, 17, 18)

We felt relieved to find references where we would finally solve the above-mentioned mysteries, but they fell short of our expectations. Indeed,

'Reference #6' is the original article [1],
'Reference #17' is the Irbesartan trial [3].

And neither of these two articles describes any formula to convert UPCR to UACR. 'Reference #18' refers to a study by Grams *et al.* [4] stating that:

The one-year risk equation and method for converting urine PCR to urine albumin-creatinine ratio (ACR) was obtained through personal communication with Dr. Tangri.
The PCR (mg/mg) was converted to ACR (mg/g) by dividing by 0.0017566 if female and 0.002655 if male. (24)

Finally, a formula! However, 'Reference #24' to our surprise, refers to the Tangri *et al.* original article, in which no formula for converting UPCR to UACR is given [1].

We decided to validate the formula given by Grams *et al.* [4] and measured both UPCR (mg/mg) and UACR (mg/mg) on the same sample of urine in 35 male patients with a median (range) eGFR of 15 (10–29) mL/min/1.73 m² and a median (range) UPCR of 2.49 (0.13–10.88) mg/mg, and in 24 female patients with a median (range) eGFR of 14 (12–20) mL/min/1.73 m² and a median (range) UPCR of 1.74 (0.10–12.12) mg/mg. Figures 1 and 2 show a Bland–Altman plot for both females and males. A positive UACR difference means that the formula underestimates our measured values, a negative UACR difference means an overestimation.

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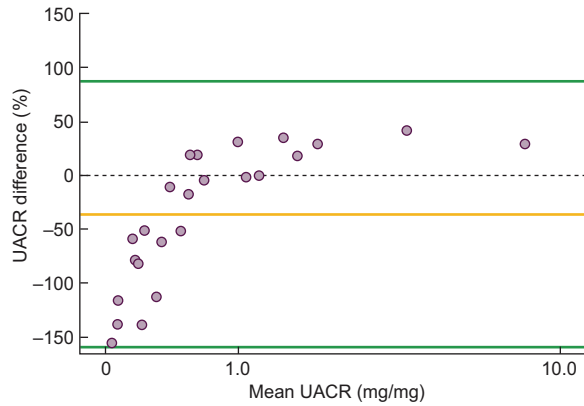


FIGURE 1: The mean of the measured and calculated ACR (from the PCR according to Grams et al. [4]) in a spot urine sample of 24 female patients is plotted against the difference (%) between these two values. Orange line shows mean difference (-36.3%). Green lines show the 95% confidence interval of our dataset (-160.2%; +87.6%).

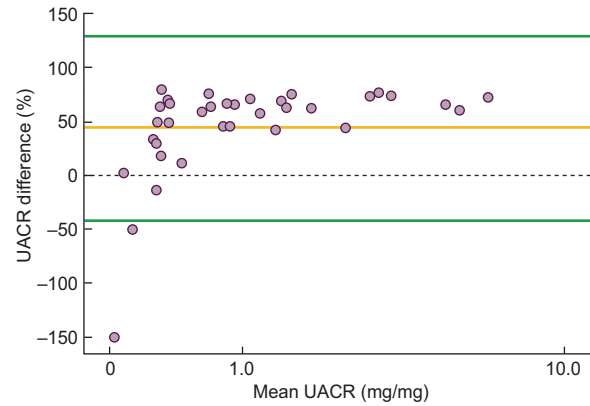


FIGURE 2: The mean of the measured and calculated ACR (from the PCR according to Grams et al. [4]) in a spot urine sample of 35 male patients is plotted against the difference (%) between these two values. Orange line shows mean difference (+44.8%). Green lines show the 95% confidence interval of our dataset (-41.8%; +131.3%).

In our population, we calculated the following formula to convert UPCR into UACR:

$UACR \text{ (mg/mg)} = -0.171 + 0.780 \times UPCR \text{ (mg/mg)}$. No significant difference was found between men and women.

We compared our formula with the formulas recently described by Weaver et al. [5]. Our findings fall within the given 25–75th percentile range, thus validating their results.

In summary, for the calculation of the KFRE, one of the necessary parameters, the UACR, is often not available in routine clinical practice. To our surprise, given the popularity and the wide use of the KFRE, until recently the conversion was poorly described. Does fake news also exist in the field of nephrology? The gap in our knowledge was recently filled by Weaver et al. [5].

CONFLICT OF INTEREST STATEMENT

The results presented in this article have not been published previously in whole or part.

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