

## Correspondence

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### Prediction of cardiovascular outcome by the estimated glomerular filtration rate and estimated creatinine clearance in the high-risk hypertension population of the VALUE trial

Yoram Maaravi<sup>a</sup>, Michael Bursztyn<sup>b</sup> and Jochanan Stessman<sup>a</sup>

<sup>a</sup>Department of Rehabilitation and Geriatrics and <sup>b</sup>Department of Medicine, Hadassah-Hebrew University Hospital, Mt Scopus, Jerusalem, Israel

Correspondence to Yoram Maaravi, MD, Hadassah-Hebrew University Hospital, Jerusalem 91240, Israel  
Tel: +972 2 5844474; fax: +972 2 6731669; e-mail: maaravi@md2.huji.ac.il

We read with interest the article of Ruilope *et al.* [1] comparing kidney function assessment with the Cockcroft–Gault and Modification of Diet in Renal Disease (MDRD) formulas. Applying the Cockcroft–Gault equation, the MDRD equation and the formula suggested by Rule *et al.* [3], to which the authors referred but did not utilize, we found recently [2] some interesting observations.

- Among the elderly population (70 years of age, only slightly older than the average in the VALUE study [1]), the Rule *et al.* [3] equation identified the group of individuals having a low estimated glomerular filtration rate to be one-third of the number identified by the Cockcroft–Gault equation and about one-half of the number identified by the MDRD formula [2].
- The prediction of mortality for those individuals with reduced kidney function ( $< 60$  ml/min per  $1.73$  m<sup>2</sup>) was significantly better than that of either the Cockcroft–Gault equation or the MDRD formula.
- Individuals with a higher estimated glomerular filtration rate ( $> 60$  ml/min per  $1.73$  m<sup>2</sup>) had a much higher average value compared with the MDRD equation or the Cockcroft–Gault equation.

The Rule *et al.* [3] equation therefore seems to reduce misclassification of chronic kidney disease, while improving prediction of mortality.

We propose that the authors attempt to recalculate their results with this equation of Rule *et al.* [3], and foresee a better prediction than the MDRD.

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### Reply

Luis M. Ruilope, Alberto Zanchetti, Stevo Julius, Gordon T. McInnes, Julian Segura, Tsushung A. Hua, Michael A. Weber and Ken Jamerson

Hypertension Unit, 12 de Octubre Hospital, Madrid, Spain

Correspondence to Luis M. Ruilope, Unidad de Hipertensión, Hospital 12 de Octubre, Madrid, Spain

We have read the letter by Bursztyn *et al.* related to our article describing and comparing the capacity of prediction of future cardiovascular events of the estimated glomerular filtration rate and creatinine clearance in the patients included in the VALUE study. Our data indicate that estimation of glomerular filtration rate is more sensitive to predict future outcome in those patients. The search for the most adequate formula reflecting renal function remains a matter of investigation and our intention was to compare the two most widely recognized and used formulas. It was not our intention to compare those with other formulas and the paper they refer to [1] was published after our publication was finished and sent to the *Journal of Hypertension*. The data described by the authors are of interest but our actual capacity to analyse this other formula are really limited. On the other hand the difference in age between the population analyzed by them and the one included in the VALUE study could complicate efforts to correctly analyze the conclusions.

### Reference

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### Need to clarify when measurements should be made during the day for home blood pressure monitoring

Pascal Bovet<sup>a</sup>, Arnaud Chiolerio<sup>a</sup>, Michel Burnier<sup>b</sup> and Fred Paccaud<sup>a</sup>

<sup>a</sup>Institute of Social and Preventive Medicine (IUMSP), University Hospital (CHUV) and University of Lausanne, Lausanne, Switzerland and <sup>b</sup>Division of Nephrology and Hypertension Consultation, University Hospital (CHUV), Lausanne, Switzerland

Correspondence and requests for reprints to Pascal Bovet, Institute of Social and Preventive Medicine (IUMSP), Bugnon 17, 1005 Lausanne, Switzerland  
E-mail: pascal.bovet@chuv.ch

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In a recent study and an accompanying editorial comment [1,2], the reproducibility of home blood pressure (HBP) over subsequent days was evaluated in adults. In another recent paper, Stergiou *et al.* reported norms for HBP in children [3]. HBP was measured on 'rising and before going to bed' in the study on adults and in the 'morning' and 'evening' in the study on children. Hence, in the two instances, the morning readings may have been measured quite early, i.e. before adults go to work or children go to school, while the evening readings may have been measured quite late in the day.

In view of the circadian variation of blood pressure [4–6], with trends toward highest values in the late morning/early afternoon and lowest values during the night, a measurement strategy for HBP based on readings taken early in the morning and late in the afternoon/evening may underestimate a person's mean daytime blood pressure. Irrespective of other confounding factors (e.g. white coat effect, masked hypertension), HBP might be expected to be lower than office readings (generally taken during working hours) and daytime ambulatory blood pressure monitoring (ABPM) (based on readings taken throughout the day). Typically, HBP was lower than ABPM in the study of Stergiou *et al.* [3]. In children, higher blood pressure with ABPM than with HBP [7,8] has been related to physical activity during daytime. A systematic difference between HBP and ABPM is likely to be accentuated if readings for one method (HBP) but not the other one (ABPM) are made before children are fully physically active. In adults, HBP tends to be more closely related to daytime ABPM and the cut-off values to define elevated blood pressure have been defined similarly for both methods (135/85 mmHg) [9].

These issues raise two types of considerations. First, future studies should systematically examine the relation of the HBP readings over time of day (e.g. at 1 h intervals) in both sufficiently large and diverse samples of adults and children. Second, recommendations should go beyond the currently vague advice to assess HBP 'in the morning and evening' [9] and give more precise time ranges for HBP measurement, in order to improve the comparability of HBP between the same individuals over time and between different individuals. This would also help define the minimal number of readings necessary to assess HBP, which might turn out to be different for adults and for children: so far, this number is unknown [2].

Showing that HBP differs based on early/late readings versus average of all daytime readings would not necessarily mean that HBP should not be based on a limited set of readings recorded early and late in the day. A simplified HBP strategy (e.g. early and late readings only) might be preferred for the sake of convenience, as long as values of such a simplified strategy can be explicitly related to the actual average daytime blood pressure (if we knew, for

example, that the average of two duplicate self-measured systolic/diastolic blood pressure (BP) readings taken, say, at 07.00–09.00 hours and at 16.00–18.00 hours was, generally, lower by  $X/Y$  mmHg than the average of all readings based on a series of self-measured duplicate readings taken every hour during daytime in adults, and respectively in children).

Alternatively, if it is shown that HBP differs whether based on early/late readings versus (more numerous) readings taken throughout the day, one should evaluate if it would be more appropriate to also include mid-day readings in standard HBP, weighing potentially improved validity against the added inconvenience of taking more measurements at less convenient periods of the day. In addition, further studies are needed to assess the value of HBP in predicting cardiovascular disease or – particularly in children – proxy indicators such as left ventricular hypertrophy or artery intima-media thickness.

The issue of when HBP should be assessed during the day may be just as important a factor as the minimal number of daily readings, the minimal number of days on which HBP needs to be recorded, and several other factors that can impact on HBP [10]. The bottom line is that the reliability of HBP (whether used for diagnostic or follow-up purposes) would benefit from explicit and well-standardized procedures.

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