



COMMENT ON BOYKO AND JENSEN

Do We Know What Homeostasis Model Assessment Measures? If Not, Does It Matter? Diabetes Care 2007; 30:2725–2728

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When Boyko and Jensen (1) published their thoughts on the characteristics of HOMA of insulin resistance (HOMA-IR) (2), they resorted to comparing it with QUICKI (3). They searched for a mathematical relationship between these surrogate indices of insulin resistance, which are the most widely used as both have the same biological basis: fasting serum levels of insulin and glucose. For this purpose, the authors estimated the logarithm of HOMA-IR and the inverse of QUICKI, proceeding finally to an equalization of equations. The mathematical facts appear to be right, but the resulting equation $\log(\text{HOMA}) = 1/\text{QUICKI} - 1.35$ does not work.

The authors would have detected by means of relevant checking that their results differ from those obtained by the direct calculation of indices. Although probably most of the experienced clinicians have soon detected where the error lies, Antuna-Puente et al. (4) and who knows how many others have fallen into it.

Let us see how to obtain the right formula for converting from one to another index.

The formula for QUICKI is

$$\text{QUICKI} = 1/[\log(\text{glucose}) + \log(\text{insulin})] \quad (1)$$

It can also be expressed by its inverse

$$1/\text{QUICKI} = \log(\text{glucose}) + \log(\text{insulin}) \quad (2)$$

In both formulas, glucose is expressed in mg/dL and insulin in $\mu\text{U/mL}$; $\log()$ is the common logarithm.

The formula for HOMA-IR is

$$\text{HOMA-IR} = (\text{glucose} \cdot \text{insulin})/22.5 \quad (3)$$

where insulin concentration is also expressed in $\mu\text{U/mL}$ but glucose is in mmol/L. The conversion of glucose from mmol/L to mg/dL is $\text{glucose} [\text{mg/dL}] = 18 \cdot \text{glucose} [\text{mmol/L}]$. Therefore, the HOMA-IR formula when glucose is expressed in mg/dL and insulin is in $\mu\text{U/mL}$ is

$$\text{HOMA-IR} = (\text{glucose} \cdot \text{insulin})/(22.5 \cdot 18)$$

that resolves to

$$\text{HOMA-IR} = (\text{glucose} \cdot \text{insulin})/405 \quad (4)$$

After taking common logarithm in this last formula, we have

$$\log(\text{HOMA-IR}) = \log(\text{glucose}) + \log(\text{insulin}) - 2.61 \quad (5)$$

Finally, the substitution in Eq. 5 by the equivalent values from the Eq. 2 gives us

$$\log(\text{HOMA-IR}) = (1/\text{QUICKI}) - 2.61 \quad (6)$$

Clearing the QUICKI value, we find

$$\text{QUICKI} = 1/[\log(\text{HOMA-IR}) + 2.61] \quad (7)$$

It seems clear that the direct calculation of each one of the mentioned indices is easier and more accurate than the somewhat imprecise Eqs. 6 and 7. In the rare need to calculate one index from another because source data are unavailable, it should be noted that each value of HOMA-IR precisely relates to one value of QUICKI and vice versa.

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