

Corrected Calcium Formula

Calcium measurement

Measured total calcium in serum comprises approximately 15% bound to organic and inorganic anions, 40% bound to albumin, and the remaining portion as biologically active ionized calcium (iCa). Ionized calcium determines biological effects and is the physiologically active form, while total calcium reflects both bound and unbound calcium.

Historically, "corrected calcium" formulas have been used to estimate biologically active calcium in hypoalbuminemic patients; however, recent evidence suggests this approach is flawed and unnecessary.

Corrected calcium formula

Despite their limitations, the use of corrected calcium formulas remains a common practice in clinical settings. The Payne formula, one of the most widely applied methods, is used to adjust serum calcium levels based on albumin concentrations. For reference, the formulas are as follows:

- **Corrected Calcium (mg/dL)** = $(0.8 * (\text{Normal Albumin} - \text{Pt's Albumin})) + \text{Serum Ca}$
 - **Corrected Calcium (mmol/L)** = $(0.02 * (\text{Normal Albumin} - \text{Pt's Albumin})) + \text{Serum Ca}$
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Current best practice

Direct measurement of ionized calcium is now the recommended method for evaluating calcium homeostasis.

Studies have shown that correction formulas often overestimate calcium levels, particularly in patients with hypoalbuminemia, chronic kidney disease (CKD), or end-stage renal disease (ESRD). These errors can lead to misclassification of hypercalcemia or hypocalcemia, resulting in inappropriate treatments and potential harm.

Direct ionized calcium measurement avoids these pitfalls and provides the most accurate assessment of calcium status. Modern point-of-care blood gas analyzers make ionized calcium measurement more accessible, allowing for timely and reliable results. In cases where ionized calcium measurement is unavailable, total calcium should be interpreted cautiously without applying correction formulas.

Additional notes

References

- Gauci, C. A. A., Moranne, O., Fouqueray, B., de la Faille, R., Maruani, G. A. A., Haymann, J.-P., Jacquot, C., Boffa, J.-J., Flamant, M., Rossert, J. A. A. C. A., Urena, P., Stengel, B. A. A. A. A., Souberbielle, J.-C., Froissart, M., & Houillier, P. (2008). Pitfalls of measuring total blood calcium in patients with CKD. *Journal of the American Society of Nephrology*, 19(8), 1592–1598. <https://doi.org/10.1681/asn.2007040449>
- Kenny, C. M., Murphy, C. E., Boyce, D. S., Ashley, D. M., & Jahanmir, J. (2021). Things we do for no reason™: Calculating a “corrected calcium” level. *Journal of Hospital Medicine*, 16(8), 499–501. <https://doi.org/10.12788/jhm.3619>
- Lian, I. A., & Åsberg, A. (2018). Should total calcium be adjusted for albumin? A retrospective observational study of laboratory data from central Norway. *BMJ Open*, 8(4), e017703. <https://doi.org/10.1136/bmjopen-2017-017703>
- Payne, R. B., Little, A. J., Williams, R. B., & Milner, J. R. (1973). Interpretation of serum calcium in patients with abnormal serum proteins. *British Medical Journal*, 4(5893), 643–646. <https://doi.org/10.1136/bmj.4.5893.643>
- Steen, O., Clase, C., & Don-Wauchope, A. (2016). Corrected calcium formula in routine clinical use does not accurately reflect ionized calcium in hospital patients. *Canadian Journal of General Internal Medicine*, 11(3), 14–21.