Evaluation of CKD-EPI Pakistan Equation for estimated Glomerular Filtration Rate (eGFR) in Pakistan

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Background:
Chronic Kidney Disease (CKD)

- Caucasians – 11 to 12%
- Survey in Karachi in 2006 (n=1177, cluster sampling from four randomly selected communities) - 11.8%
- Community cohort study in urban Karachi - 16.6% (2014)
- Population based cross sectional study in Karachi on 262 individuals above 40 years, 29.9 % had reduced GFR (2005)
- Exact prevalence unknown
Study Rationale: Measuring Renal Function

- Serum Creatinine (Cr) most common
- Serum Cr misses 20%
- Glomerular Filtration Rate (GFR) using 24 hour urinary creatinine clearance (CrCl)
- Modification of Diet in Renal Disease (MDRD)
- Cockcroft Gault (CG)
- Chronic Kidney Disease Epidemiology Collaboration formula (CKD-EPI)
To compare CKD-EPI, CKD-EPI Pak, CG and MDRD formulae with CrCl calculated through a timed urine collection.
Materials and Method:

* Cross sectional
* Collected data of subjects requesting CrCl: 6 months
* Section of Clinical Chemistry, AKU Karachi
* Inclusion criteria: ≥18 < 70 years of age
* Exclusion criteria: Subjects without height and weight

**Statistical Software:**
* SPSS version 22.0
* Analyze-it for MS-Excel

**Statistical tools:**
* Regression: correlation, slope, y-intercept
* Concordance
* Bland Altman Plot
### Materials and Method cont:
Models for Estimating GFR in adults

<table>
<thead>
<tr>
<th>Method of GFR calculation</th>
<th>Formulae</th>
</tr>
</thead>
</table>
| **CKD-EPI** (ml/min per 1.73 m²) | If SCr < 0.9 (for male): \(141 \times (\text{SCr}/0.9)^{-0.411} \times 0.993^{\text{Age}}\)  
If SCr > 0.9 (for male): \(141 \times (\text{SCr}/0.9)^{-1.209} \times 0.993^{\text{Age}}\)  
If SCr < 0.7 (for female): \(144 \times (\text{SCr}/0.7)^{-0.329} \times 0.993^{\text{Age}}\)  
If SCr > 0.7 (for female): \(144 \times (\text{SCr}/0.9)^{-1.209} \times 0.993^{\text{Age}}\) |
| **CKD-EPI Pak** (ml/min per 1.73 m²) | \(0.686 \times \text{CKD-EPI}^{1.059}\) |
Results:
\( n = 670 \)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Males ( n = 373 )</th>
<th>Females ( n = 297 )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td>55.7%</td>
<td>44.3%</td>
</tr>
<tr>
<td><strong>Age</strong> in years</td>
<td>51.5 (±16)</td>
<td>51 (±14.5)</td>
</tr>
<tr>
<td><strong>BMI</strong> in kg/m²</td>
<td>27.8 (±13)</td>
<td>27.6 (±5.8)</td>
</tr>
<tr>
<td><strong>Median Cr (Range)</strong> in mg/dL</td>
<td>1.4 (0.4-20.2)</td>
<td>1.0 (0.4-13)</td>
</tr>
<tr>
<td><strong>CrCl &lt; 60</strong> (mL/min per 1.73 m²)</td>
<td>20%</td>
<td>35.3%</td>
</tr>
</tbody>
</table>

* Expressed as mean (±SD)
Deming Regression Analysis

\[ y = 5.23 + 0.92(x) \]
\[ r^2 = 0.79 \]

\[ y = 7.9 + 0.92(x) \]
\[ r^2 = 0.79 \]

\[ y = 0.23 + 1.2(x) \]
\[ R^2 = 0.6112 \]

\[ y = 5.7 + 0.83(x) \]
\[ r^2 = 0.83 \]
Bland Altman Plot
(CKD-EPI Pak and CrCl)
### Diagnostic Ability* of CKD-EPI Pak, MDRD, CG and CKD-EPI versus CrCl

<table>
<thead>
<tr>
<th></th>
<th>MDRD</th>
<th>CG</th>
<th>CKD-EPI</th>
<th>CKD-EPI Pak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>87.2%</td>
<td>76.6%</td>
<td>81.8%</td>
<td>88.7%</td>
</tr>
<tr>
<td>Specificity</td>
<td>83.2%</td>
<td>89.8%</td>
<td>86.1%</td>
<td>79%</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>87.8%</td>
<td>91.5%</td>
<td>89%</td>
<td>85.4%</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>79%</td>
<td>72.9%</td>
<td>77.3%</td>
<td>83.4%</td>
</tr>
</tbody>
</table>

* Calculated for a threshold cut-off of 60 ml/min/1.73 m² taking CrCl as the reference.
## Agreement & concordance of CrCl versus eGFR formulae

<table>
<thead>
<tr>
<th>eGFR formulae</th>
<th>CrCl</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agreement (n)</td>
<td>Disagreement (n)</td>
<td>Concordance (%)</td>
<td></td>
</tr>
<tr>
<td>MDRD</td>
<td>562</td>
<td>108</td>
<td>83.9%</td>
<td></td>
</tr>
<tr>
<td>CG</td>
<td>553</td>
<td>117</td>
<td>82.5%</td>
<td></td>
</tr>
<tr>
<td>CKD-EPI</td>
<td>560</td>
<td>110</td>
<td>83.5%</td>
<td></td>
</tr>
<tr>
<td>CKD-EPI Pak</td>
<td>567</td>
<td>103</td>
<td>84.7%</td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

* Automatic reporting of eGFR using CKD-EPI Pak equation initiated
* Equations outperformed serum Cr
* Cost effective
* Feasible
A sample report from our lab

<table>
<thead>
<tr>
<th>Test</th>
<th>Current Result</th>
<th>Previous Results &amp; Date</th>
<th>Unit</th>
<th>Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERUM CREATININE</td>
<td>1.2</td>
<td>1.3 (25 Jul 2019)</td>
<td>mg/dl</td>
<td>(0.6-1.2)</td>
</tr>
<tr>
<td>eGFR</td>
<td><strong>39.81</strong></td>
<td>1.3 (17 Jul 2019)</td>
<td>mL/min/1.73 m2</td>
<td></td>
</tr>
</tbody>
</table>

**Interpretation:**

- Normal Renal Function: >= 60 mL/min/1.73 m²
- Some loss of renal function and requires medical attention: < 60 mL/min/1.73 m²

**Note:** The eGFR is calculated using isotope dilution mass spectrometry–traceable serum creatinine on Advia 1800 and patients age and gender according to the Chronic Kidney Disease Epidemiology Collaboration–Pakistan (CKD-EPI Pak) equation. This equation has been validated for adults 18 to 70 years of age.

teşekkür ederim