Validation of CKD-EPI and MDRD equations by inulin clearance in Saudi Population

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BACKGROUND

Estimation of glomerular filtration rate (eGFR) is essential for assessment of chronic kidney disease (CKD) staging. However, validation of predictive equations of GFR is essential by comparing to inulin clearance in various population and clinical situation.

AIM

The aim of this study is to validate Chronic Kidney Disease-Epidemiology Collaboration (CKD-EPI) and Modification of Diet in Renal Disease (MDRD) equations in diverse clinical subsets by comparing the GFR measured by inulin clearance.

METHODS

This cross-sectional study consisting of 31 Saudi adults was performed in affiliation with King Saud University, Riyadh, Saudi Arabia on 2014 to calculate the GFR using MDRD and CKD-EPI by comparing to GFR measured by inulin clearance in all subjects.

RESULTS

Total of 31 participants with 23 CKD and 8 transplant patients was included to compare GFR inulin through validated CKD-EPI and MDRD. Mean age was 42.2±15 years, with 19 males and weight of 68.7±18 kg. Mean and standard deviation of GFR in inulin, CKD-EPI and MDRD was detailed in the table. Bland-Altman plots demonstrated that the mean difference between the inulin clearance and the standard mean of CKD-EPI is -1.1vs. MDRD of 3.2.
Also, CKD-EPI exhibited insignificant difference in GFR as compared to inulin clearance in patients with CKD, renal transplant patients, obese patients, aged and males.

TABLE 1. THE CLINICAL CHARACTERISTICS OF STUDY PARTICIPANTS

Variable	Mean±SD	Range
Age	42.26 ± 15.45	19-74
Male	19	
Height (cm)	160.58 ± 10.6	134 – 178
Weight (kg)	68.76 ± 18	42.6 – 131.7
Body Surface Are (m²)	1.73±0.23	1.35 – 2.5
Serum Creatinine (ml/min/1.73m²)	199.8±164.15	51 – 815
GFR Inulin (ml/min/1.73m²)	51.54±33.8	5.47 – 128.7
GFR CKD EPI Creatinine (ml/min/1.73m²)	52.61±34.39	6 – 119

TABLE 2. MEAN AND STANDARD DEVIATION OF GFR IN INULIN CLEARANCE COMPARING TO ESTIMATED GFR BY PREDICTIVE EQUATIONS IN DIFFERENT SUBSETS.

	Mean±SD Inulin Clearance (ml/min/1.73m²)	CKD-EPI creatinine		MDRD	
		Mean±SD eGFR (ml/min/1.73m²)	pValue	Mean±SD eGFR (ml/min/1.73m²)	pValue
Total patients	51.54±33.8	52.61±34.39	0.490	48.35±31.5	0.028
CKD patients	46.3±35.6	47.6±35.9	0.499	44.2±33.4	0.22
Transplant patients	66.6±23.7	67±26.5	0.874	60.25±23.2	0.025
Male patients (n=19)	58.5±32.8	58.3±34.8	0.9	53.5±31	0.008
Female patients (n=12)	40.6±34	43.6±33	0.213	40.2±31.6	0.88
<40 years (n=12)	60.5±35	64.8±36	0.202	58.5±33	0.459
40–60 years (n=14)	48±35.6	47.6±35.7	0.736	44±33	0.032
>60 years (n=5)	39.6±25	37.2±18	0.538	36.0±16.3	0.427
BMI <30 kg/m² (n=23)	52.6±35	53.8±36	0.423	49.7±34	0.03
BMI ≥30kg/m² (n=8)	48.5±31.8	49±28.06	0.907	44.38±24.4	0.363

TABLE 3. PERFORMANCE OF PREDICTIVE EQUATIONS FOR ESTIMATION OF GFR IN RELATION TO MEASURED GFR INULIN LEVEL OF BIAS PRECISION AND LIMITS OF AGREEMENT.

Category	GFR Mean±SD	Bias	95% CI for Bias	SD of Bias Precision	Limits of agreement
GFR Inulin (ml/min/1.73m²)	51.54 ± 33.8				
MDRD (ml/min/1.73m²)	48.35 ± 33.7	-0.32	-6.02 – 0.32	7.71	-18.3, 11.92
CKD-EPI-Creatinine (ml/min/1.73m²)	52.6 ± 34.4	1.07	-2.05, 4.19	8.5	-15.6, 17.76

FIGURE 1. CORRELATION OF EGFR DETERMINED BY CKD-EPI CREATININE AND GFR MEASURED BY INULIN CLEARANCE
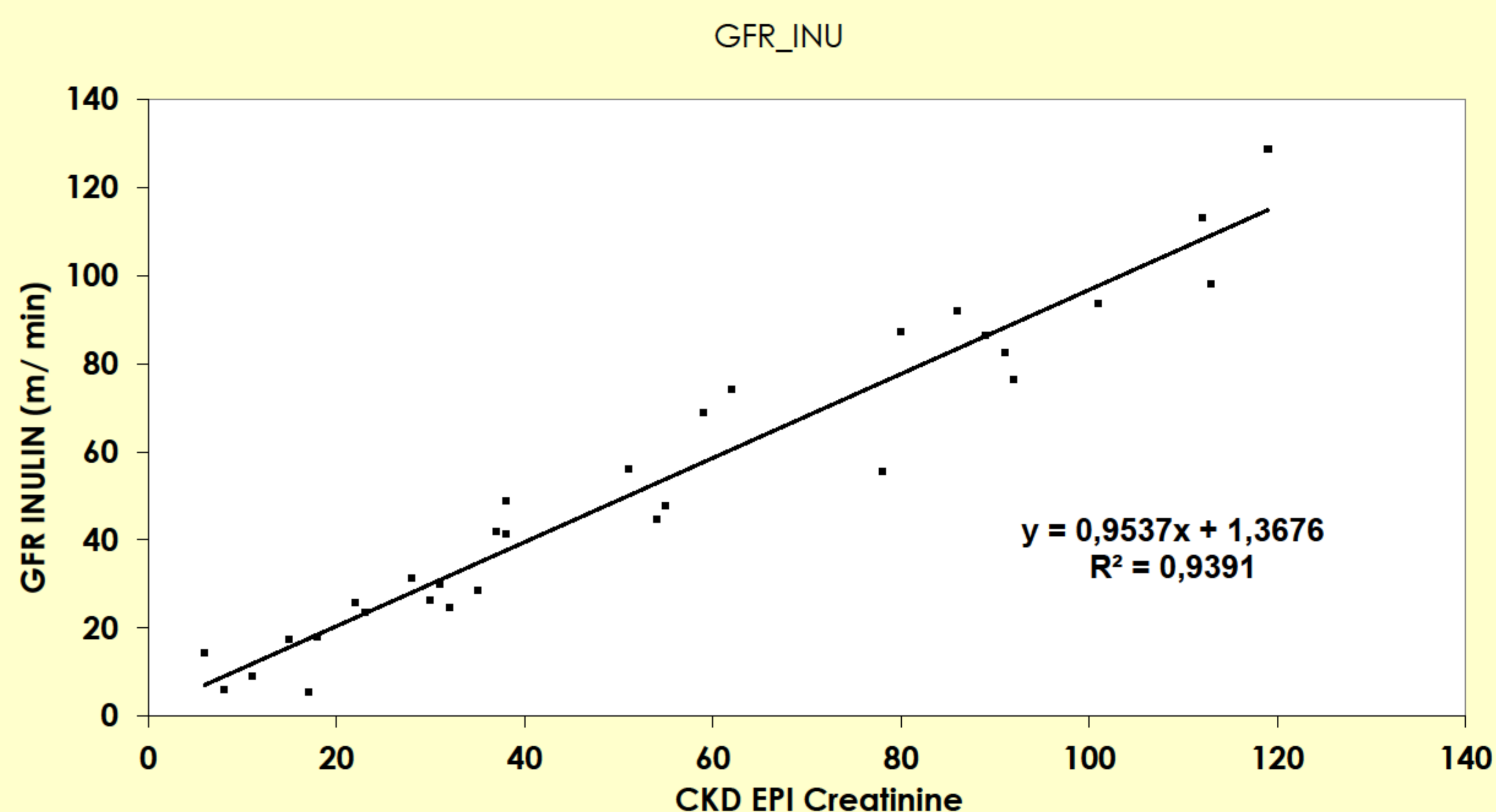

$$y = 0,9537x + 1,3676$$
$$R^2 = 0,9391$$

FIGURE 2. EGFR DETERMINED BY MDRD AND GFR MEASURE BY INULIN CLEARANCE

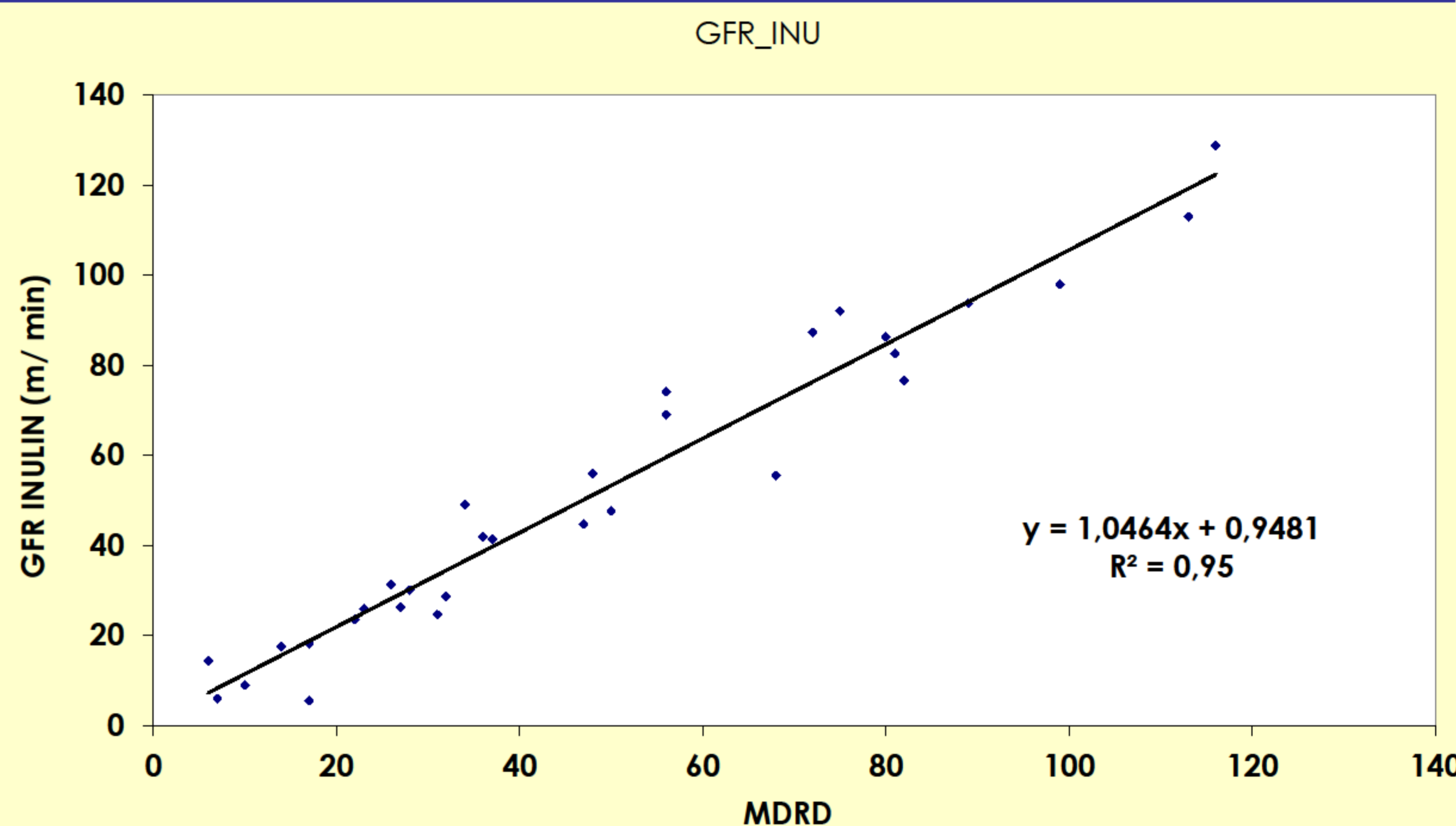$$y = 1,0464x + 0,9481$$
$$R^2 = 0,95$$

FIGURE 3: BLAND AND ALTMAN PLOT COMPARING THE GFR CALCULATED BY THE CKD-EPI CREATININE FORMULA WITH THE GFR MEASURED BY THE INULIN CLEARANCE
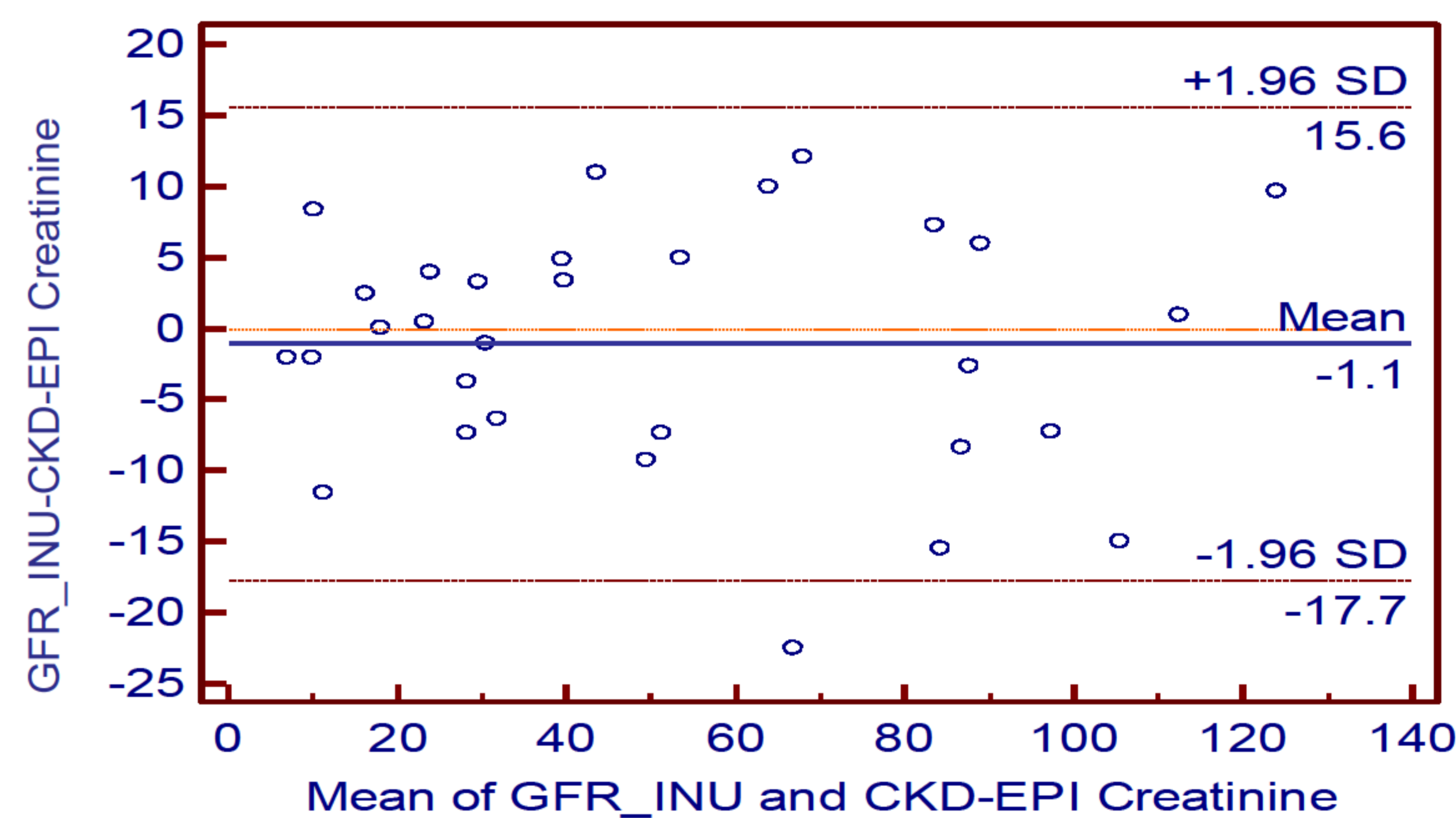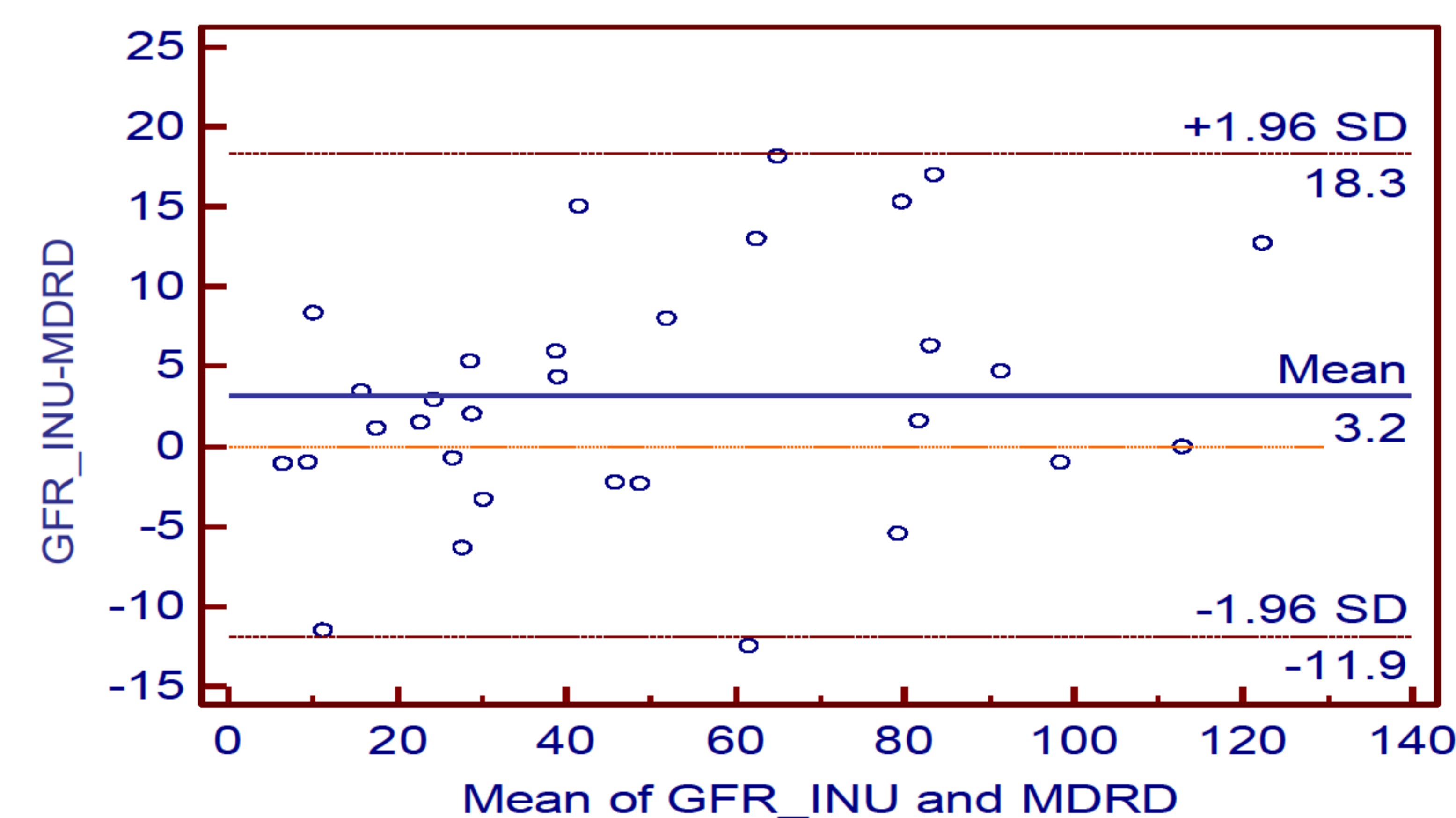

FIGURE 4: BLAND-ALTMAN PLOTS COMPARING THE GFR CALCULATED BY MDRD WITH THE GFR MEASURED BY THE INULIN CLEARANCE

CONCLUSION

Present study reveals that GFR measured by CKD- EPI equation is closer to measured GFR through gold standard inulin in CKD and transplant patients in Saudi population.