Glomerular Filtration Rate in Healthy Indian Adults by the Modification of Diet in Renal Disease Equation

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Research Article

Abstract: **Background:** The age and gender difference in serum creatinine is known. However, there is sparse literature on the influence of age and gender on glomerular filtration rate (GFR) estimated by the Modification of diet in renal disease (MDRD) equation. Recent guidelines recommend automatic reporting of estimated glomerular filtration rate (eGFR) using the abbreviated MDRD equation with every request for serum creatinine. **Aim:** To calculate GFR estimated by the MDRD equation and to analyze the effect of age and gender on GFR. **Setting and Design:** This was a retrospective analysis of data from the medical records of a South Indian tertiary care teaching institute. **Materials and Methods:** Cumulative results for serum creatinine in 2831 individuals who attended outpatient department between June 2012 and May 2013, aged 21–80 years was collected and GFR values were calculated by MDRD equation. They were divided into six different age groups viz. 21-30 years, 31-40 years, 41-50 years, 51-60 years, 61-70 years and 71-80 years. GFR calculated by MDRD equation was compared between different age groups and gender using appropriate statistical methods. **Results:** GFR showed a decreasing value as age advanced in both the genders. GFR was higher in male subjects. A significant difference in the mean GFR values estimated by MDRD equation was also observed between different age decades in both genders.

Key words: Serum creatinine, glomerular filtration rate, Modification of diet in renal disease, age, gender.

Introduction

In clinical practice, glomerular filtration rate (GFR) is usually estimated from the serum creatinine concentration. But, GFR is poorly inferred from serum creatinine alone. To circumvent this limitation, several equations have been developed to estimate GFR from the serum creatinine concentration adjusted for age, sex, body weight and demographic factors [1]. The equation proposed by Cockcroft and Gault in 1976 is widely used throughout the world [2],[3]. Several equations have been proposed so far, but the currently recommended equation is that developed and validated from the Modification of diet in renal disease (MDRD) Study [4]. This equation is superior to the traditional Cockcroft-Gault equation for prediction of radionuclide determined GFR of <60 ml/min [5]. In recent years, the MDRD group developed three multiple regression models that improved the prediction of GFR from the serum creatinine concentration [6]. The first includes urinary urea excretion and the second is derived from demographic factors combined with serum creatinine, urea and albumin; the third, which was used in the current study, uses demographic factors and serum creatinine (MDRD abbreviated equation [6]). This study was conducted to estimate GFR by MDRD equation from serum creatinine and to assess the influence of age and gender variations on GFR.

Materials and Methods

In this retrospective study, data were retrieved from the medical records department of MIMS General Hospital, Nellimarla, Vizianagaram of South India. The record of patients proved to have serum creatinine between June 2012 and May 2013 was analyzed for the present study. Individuals who may have an abnormality in serum creatinine as a result of myocardial infarction, stroke or cerebrovascular disease, diabetes, hypertension, or any kidney disease, any drug therapy in the last 6 months were excluded from the study. Exclusion of these conditions provided a study group wherein the influence of age and gender could be studied. Serum creatinine was estimated in 2831 individuals by a kinetic alkaline picrate method (Jaffe method). The quality of results throughout the study was validated through regular internal quality control procedures and participation in an external quality assessment scheme. The individuals were divided into six different age groups, i.e. 21-30 years, 31-40 years, 41-50 years, 51-60 years, 61-70 years and 71-80 years. In each individual, the GFR was also estimated from the serum creatinine concentration by using the MDRD equation. The following abbreviated MDRD equation [6] was used:

186 × (serum creatinine (mg/dl)$^{-1.154}$ × (age in years)$^{-0.203}$ × (0.742 if female).

Data was presented as mean. Statistical analyses was performed using the SPSS version 20.0 and the level of statistical significance was $p<0.05$.

Results and Discussion

Cumulative results for serum creatinine levels were retrieved for 2,831 outpatients over the study period of 1 year. The study population belonged to the age 21 to 80 years, male subjects were 1,631 and female subjects were 1,200. Male:female ratio of the study population was 1.36:1. Table 1 shows age and gender wise distribution of study population.

Table 1: Age and gender wise distribution of study population

Age group in years	Male	Female	Total
21-30	223	173	396
31-40	309	239	548
41-50	262	270	532
51-60	341	237	578
61-70	357	204	561
71-80	139	77	216
Total	1631	1200	2831

Data of serum creatinine values of study population was collected. Mean and standard deviation (SD) of the same were calculated and represented age and gender wise in Table 2.

Table 2: Age and gender wise serum creatinine values of study population

Age group in years	Male		Female		p-value
	Mean	SD	Mean	SD	
21-30	0.87	0.12	0.84	0.08	0.0029
31-40	0.94	0.17	0.85	0.09	<0.0001
41-50	0.94	0.17	0.91	0.16	0.0362
51-60	0.98	0.18	0.91	0.13	<0.0001
61-70	1.01	0.18	0.96	0.17	0.001
71-80	1.04	0.17	0.99	0.20	0.0638

p-value <0.05 indicates statistically significant difference

Statistically significant difference was observed in serum creatinine values between males and females of all the age groups except 71- 80 years (p=0.0638) of age. Use of estimating equations to track longitudinal changes in GFR is desirable for both clinical and research purposes provided that estimated glomerular filtration rate (eGFR) change offers a valid estimate of true (measured) GFR change. Due to well recognized limitations of serum creatinine concentration as an index of kidney function, international organizations now recommend the use of GFR estimating equations based on serum creatinine and other demographic and clinical variables, and that clinical laboratories report estimated GFR whenever serum creatinine is ordered [7].Table 3 presents age and gender wise mean and SD of eGFR by MDRD equation of study population.

Table 3: eGFR by MDRD equation of study population

Age group in years	Male		Female		p-value
	Mean	SD	Mean	SD	
21-30	115	15.85	89	10.51	<0.0001
31-40	100	19.74	83	10.89	<0.0001
41-50	96	17.07	74	13.22	<0.0001
51-60	86	18.15	71	10.26	<0.0001
61-70	82	17.70	65	12.11	<0.0001
71-80	78	17.63	64	16.13	<0.0001

p-value <0.05 indicates statistically significant difference

A renal function of <90 ml/min by MDRD was found in 837 males (29.56% of 2831) of 51-80 year age group and in all the females (42.39% of 2831). There was a statistically significant difference between males and females regarding the GFR. Similar findings have been suggested by other researchers also[8],[9].

GFR showed a decreasing value as age advanced. Khatami et al[9] observed an inverse association between age and GFR in both the genders. The mean GFR for male subjects in the present study population was compared using one-way analysis of variance (ANOVA). A statistically highly significant difference ($p<0.0001$) was observed between the age groups. Similar comparison for GFR by one-way ANOVA revealed a statistically highly significant difference ($p<0.0001$) between females of different the age groups. The difference between age decades and genders may be due to the fact that smaller body size has lower metabolic demands and shorter individuals require less renal function. There are several possible reasons for decreased accuracy at higher levels of GFR. Thus present study outlines clearly the influence of age and gender on eGFR. Age and gender-wise eGFR values of the present study population were compared with a similar study by Lippi G. et al in 16,631 individuals from Verona, and it showed a similar distribution. The comparison is put forth in the form of table 4.

Table 4: Comparison of eGFR values of present study with that of Lippi G. et al

Age group in years	Male		Female	
	Present study	Lippi G. et al	Present study	Lippi G. et al
21-30	115	108	89	107
31-40	100	102	83	101
41-50	96	97	74	94
51-60	86	92	71	88
61-70	82	86	65	81
71-80	78	79	64	76

Conclusion

In conclusion, MDRD equation can be satisfactorily used for estimation of GFR from serum creatinine values. The significant difference, as obvious from the present study, in eGFR between different age groups of both male subjects and female subjects highlights the need for considering the influence of these demographic factors on GFR which is regarded as the best index of kidney function. There are certain limitations for the present study with use of MDRD equation. Transformation of serum creatinine to eGFR according to the MDRD-eGFR algorithm or a similarly derived algorithm does not compensate for the physiological differences between age groups and gender.

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