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Renal Function in Adults at AL-Sadder Teaching Hospital Outpatient Baghdad: A Comparison between Normal and Abnormal Cases

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Abstract

Objective: the aim of this paper is to assess the glomerular filtration rate (eGFR) and the prevalence of kidney insufficiency in adult outpatients with normal S. Cr.

Results: The study involved a total of 200 participants with standard S. Cr. By utilizing the MDRD equation, the average glomerular filtration rate (ml/min/1.73 m2) was found to be 118 ± 43.0, whereas the C-G formula yielded an average of 92 ± 31.1. According to the MDRD formula, 10.3% of the patients exhibited mild kidney insufficiency (eGFR 60-89.9 ml/min/1.73 m2), while 3.6% had moderate kidney insufficiency (eGFR 30-59.9 ml/min/1.73 m2). The Cockcroft-Gault (C-G) formula indicated that among individuals with normal S. Cr, 18.3% had mild kidney insufficiency and 8.1% had substantial kidney insufficiency. Multivariate analysis based on the employed GFR determination method revealed a correlation between prevalent renal insufficiency and factors such as advanced age, female gender, high systolic blood pressure, and a family history of kidney disease or other chronic conditions.

Conclusion: This study demonstrates that poor kidney function is more prevalent among adult patients with normal S. Cr. The inclusion of estimated GFR in routine laboratory reporting can facilitate the identification of individuals with renal insufficiency and enable them to receive optimal care.

Keywords: Estimated glomerular filtration rate, serum creatinine level, kidney function.

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Introduction:

In patients with high risk, as well as the general population, kidney illness is a known risk factor for cardiovascular and all-cause mortality, even in cases where kidney function is only slightly or moderately

compromised [1-4]. Several problems, including anaemia and disorders related to the metabolism of bone minerals, as well as unfavourable outcomes, such as cardiovascular events and the development of renal failure that necessitates renal replacement treatment, are also linked to impaired renal function [5-7]. Therefore, it is essential to detect renal impairment as soon as possible to make it possible to employ therapies that can halt or reduce the disease's course and reduce the likelihood of negative effects [8]. The most accurate measure of kidney function in healthy and disease is generally agreed to be the glomerular filtration rate or GFR. Direct measurements of GFR can be obtained using clearance studies with suitable exogenous markers, like inulin.

Nevertheless, kidney function has traditionally been estimated by measuring blood levels of endogenous filtration indicators; until now, none of these methods is essential or cost-effective for routine usage [9].

The most popular endogenous filtration measure for evaluating the function of the kidney in clinical practice is serum creatinine (S. Cr). It is more challenging to identify and, thus, provide the best care for renal impairment at an earlier stage when S. Cr is in-sensitive to early kidney illness, and values may stay with-in the standard range even when kidney functions are severely compromised [10, 11]. Therefore, to aid in the detection of kidney illness, current guidelines advise applying equations of prediction, such as the Cockcroft – Gault equation [12] and the Modification of Diet in Renal illness (MDRD) equation [13], to determine GFR (e GFR) when-ever the S. Cr determined [14, 15]. Depending on these recommendations, several studies have demonstrated that using eGFR in renal impairment screening can enhance patient outcomes and delay the course of renal disease, allowing for the early identification of patients early in the course of the illness and the prompt start of treatment [16-18].

When S. Cr is tested, the majority of outpatient labs. do not routinely publish the e GFR; instead, kidney function is often assessed by looking at S. Cr values in primary care settings. Despite this, no information has been released about the underestimation of reduced kidney function among adult outpatient Iraqis with standard S. Cr. These data will help determine the clinical significance and need for the nation's programmed e GFR reporting system for adult outpatients. The purpose of this paper was to use estimated-GFR (e GFR) among adult patients in the out-patient department with-in standard S. Cr at the Al-Sadder Teaching Hospital in Baghdad to ascertain the prevalence of kidney insufficiency.

Methods:

The study design:

A cross- sectional study was carried out at the Al-Sadder Teaching Hospital's outpatient clinic in Iraq's capital city of Baghdad. The research comprised patients in the outpatient department aged 18 years and older whom their doctors referred for SCr assessments between June and December 2022. Individuals who had dialysis treatment were hospitalised, had fever, or had abnormal serum creatinine levels (men more than 1.5 mg / dl and women more than 1.3 mg / dl) were not accepted. Following the application of exclusion criteria, 200 consecutive patients with standard S. Cr met the study's eligibility requirements.

Sample size calculation:

The final sample size of 200 individuals was determined using a single proportion formula, taking into account several assumptions. These assumptions included a 95% confidence level, a 5% margin of error, a predicted prevalence of renal impairment at 50%, and an additional 10% non-response rate. It is important to note that three respondents who opted out of participating in the examination component were excluded from the analysis, resulting in a sample size of 200 for the final analysis.

Data Collection:

To obtain information about participant demographics and other risk factors, interviews were conducted. Measurements of tallness, weight, and B. P. (blood pressure) were taken throughout the clinical examination. Weight squared (kg) times the height (meters) yielded the body mass index (BMI), which

was used to categories individuals into three groups: regular (BMI less than 25 kg/m2), overweight (BMI = 25 – 29.9 kg / m2), and obese (BMI more than 30 kg/ m2).

After a five-minute break, the right upper arm was used to monitor blood pressure (B. P.), and the average of three measurements was taken. A blood pressure reading of 140 mmHg or above on a diastolic basis, along with the usage of antihypertensive medication, were considered hypertension. By using a modified Jaffe technique, blood samples were obtained for the measurement of SCr in mg/ dl, includes standardization traceable to NIST SRM 909B level 2 IDMS reference material.

Kidney functions measurement:

A four- variable Modification of Diet in Renal Disease (MDRD) research formula was used to measure kidney function, and the formula was eGFR = 186 × S. Cr (mg / dl)−1.154 × age (years) − 0.203 × 0.742 (if female) × 1.210 (if black) [12] and the body surface area (BSA) was normalised using the Cockcroft – Gault (C – G) method [13]: (140 – age) * Weight (kg) * 0.86 (if female) * 1.73/ 72 * S. Cr (mg/dl) * BSA (m2). When the e GFR was > 90 ml/ min/ 1.73 m2, patients were classified as having standard kidney function; when it was 60 – 89.9, 30 – 59.9, and 15 – 29.9 ml/ min/ 1.73 m2, respectively, patients were classified as having a mild severity, moderate, and severe Kidney insufficiency [14-19]. The two further classifications for moderate renal insufficiency were G3a (e GFR 45 – 59.9 ml/ min/ 1.73 m2) and G3b (e GFR 30 - 44.9 ml/ min/ 1.73 m2) [19].

Statistical Analysis:

The statistical program SPSS version 20.0 (SPSS Inc., Chicago, IL, USA) was applied for the analyses. The data were presented as either a percentage or as mean ± standard deviation (S.D.). When necessary, the t-test or the Chi-square (x2) test were used to compare the groups. The study employed multivariate logistic regression to find characteristics independently associated with renal insufficiency. The resulting adjusted odds ratios (A. O. R.) and 95 % confidence intervals (C.I.) were then analysed. P less than 0.05 was considered statistically significant.

Results

The kidney function of 200 adult samples was tested in this short study. The median age was 40 ± 7,648 years, with 103 (51.5) males and 97 (48.5) females, with a non-high educational level of 140 (70). Among this study, 40 (20.0) had diabetes, 43 (21.5) had high blood pressure, 15 (7.5) had cardiovascular disease, 14 (7.0) had HIV, and 11 (5.5) were smokers. Most of the participants in this study 80 (90) did not have family history of kidney disease (FH - KD). The mean BMI were 22.7 ± 2.43 kg / m2 . Mean systolic and diastolic B.P. (mmHg) was 128 ± 10 and 82 ± 11, respectively. Mean SCr was 0.9 ± 0.21, while the mean eGFR (ml/min/1.73m^2) of the participator was 118 ± 43.0 and 92 ± 31.1 as stated by the M. D. R. D. and C – G equations, respectively (Table 1).

Table 1: Descriptive and clinical features of 200 research participants within standard s. creatinine levels (n=200)

Characteristics	Variables
Age (year), mean ± S. D. Participants	40 ± 7.648
Age group, n (%)	
18– 30	53 (26.5)
31– 40	35 (17.5)
41– 50	34 (17)
51– 60	38 (19)
> 60	40 (20)
Sex, n (%)	
Male	103 (51.5)

Female	97 (48.5)
Level of education, n (%)	
<High school	140 (70)
≥High school	60 (30)
Family history (FH), n (%)	
Kidney disease	20 (10)
Hypertension (HTN), diabetes (DM) or CVD	43 (21.5)
Medical history (MH), n (%)	
Diabetes (DM)	40 (20.0)
Hypertension (HTN)	43 (21.5)
Cardiovascular disease (CVD)	15 (7.5)
HIV	14 (7.0)
Current smoker, n (%)	11(5.5)
Body mass index BMI (Kg / m^2), mean ± SD	22.7± 2.43
Systolic BP (mmHg), mean±SD	128 ± 10
Diastolic BP (mmHg), mean±SD	82 ± 11
S. creatinine (mg/dl), mean±SD	0.9 ± 0.21
e GFR MDRD (ml/min/1.73m^2), (mean±SD)	118 ± 43.0
e GFR C–G (ml/min/1.73 m^2), (mean±SD)	92 ± 31.1

*B. P. is blood pressure, C. V. D. is cardiovascular disease, e GFR is estimated glomerular filtration rate.

Table 2: The simplified M. D. R. D. and Cockcroft - Gault formulas were used to estimate kidney functions in patients within normal serum creatinine.

GFR (ml/min/1.73m^2)	**Description**	**MDRD n(%)**	**Cockcroft-Gault n (%)**
≥90	Normal or high GFR	141(33.9)	89 (21.5)
60–89.9	Mildly ↓GFR	43 (10.3)	76 (18.3)
30–59.9	Moderate ↓GFR	15 (3.6)	34 (8.1)
45–59.9	Mild to moderate ↓GFR	15 (3.6)	18 (4.4)
30–44.9	Moderate to severe ↓GFR	–	15 (3.6)

*GFR glomerular filtration rate.

In Table No. 2, by applying the (M. D. R. D.) and (C - G) Cockcroft –Gault formulas to estimate kidney function in patients with standard S. Cr, by M. D. R. D. formula, mild kidney insufficiency (e GFR) 18.3 % of the patients and moderate kidney insufficiency (e GFR 30– 44.9 ml/ min/ 1.73 m2) was found in 8.1% of the patients with average S. Cr. 15 (3.6%) and 18 (4.4%) of patients with standard S. Cr with mild to moderately impaired renal function (e GFR 45– 59.9 ml/ min /1.73 m2) according to the M. D. R. D. and C – G equations, respectively. moreover, 15 (3.6 %) patients had moderate to severely impaired kidney function (e GFR 30– 44.9 ml/min /1.73 m2) despite normal S. Cr when renal function was evaluated by using the C– G formula (Table 2).

According to the MDRD formula to calculate GFR, Table 3 shows the personalities of patients with and without clinically significant kidney failure (e GFR<60 ml/ min /1.73 m^2). In this study, older people (females) suffered from kidney failure significantly, as did those who had a low level of educational status and a history of renal illnesses in the family. The same was true for those who had chronic diseases represented by diabetes, high blood pressure, or cardiovascular disease, as well as for patients who had a medical history of high blood pressure and high systolic and diastolic blood pressure—regarding the comparison of BMI and S. Cr in patients had glomerular filtration rate ≥60 ml/min/1.73 m^2. The same trends were found when using the Cockcroft– Gault (C -G) equation except for sex and BMI.

Multivariate analysis revealed that 21.5% of the patients had a family history of 60–89.9 ml/min/1.73 m^2, 7.7% had moderate kidney insufficiency (eGFR 30-59.9 ml/min/1.73 m2), and older age (An adjusted odds ratio in statistic (A. O. R.) = 10.81, 95 per cent confidence interval (C. I.) 4.05 –28.83, P < 0.001, female sex (A. O. R.) = 32.00, per cent confidence interval (C. I.) 7.99 – 128.13 ; P<0.001, and 21.5 % of the patients had a family history of (60 – 89.9 ml/ min /1.73 m^2). The MDRD equation showed that high systolic blood pressure (AOR=1.07, 95% CI 1.03 –1.12, P = 0.002) was shown to be independently linked to a higher incidence of insufficient kidney function and the C -G formula indicated that mild kidney insufficiency was found in other chronic diseases (A. O. R. = 3.06, 95 % CI 1.19 – 7.86, P = 0.020). Using the Cockcroft – Gault (C -G) formula, the only factors that were independently linked to prevalent renal insufficiency were older age (A. O. R. = 14.06, 95 % CI 7.39 – 26.77; P < 0.001) and family history- of kidney disease (FH - KD) (A. O. R. = 2.80, 95 percent CI 1.21 – 6.48, P = 0.017).

Table 3: The features of patients who have and do not have kidney failure (e GFR $_{MDRD}$ <60 ml/min/1.73 m2).

Characteristics	**e GFR< 60 ml/min/1.73m^2**	**e GFR≥60 ml/ min/1.73m^2**
Age above 60 years*, %	33. 0	11.2
Female sex*, %	43.5	21.2
Education< High school*,%	42	33.2
Family history, %		
Kidney disease*	13.5	4.0
HTN, DM or CVD*	24	9.3
Medical history, n (%)		
Hypertension*	21.0	9.4
Diabetes mellitus	15.0	9.2
Cardiovascular disease	4.5	3.6
HIV	2.9	3.4
Current smoker	4.5	2.5
Antihypertensive drug intake* , %	19.5	6.5
Systolic BP (mm Hg)*	135.3±12.0	121.4±10.78
Diastolic BP (mm Hg)*	86.o±9.1	77.8±9.8
Hypertension* , n (%)	31.5	13.2
BMI (kg / m^2)*	23.2±2.7	20.8±3.1
Serum creatinine (mg/ dl)*	1.45±0.08	0.9±0.31
eGFR (ml /min / 1.73 m^2)*	52.5±3.1	123.11±41.2

*HTN is hypertension, DM is diabetes mellitus, CVD is cardiovascular disease, BP is blood pressure, BMI is body mass index, and e GFR is estimated glomerular filtration rate.

*Differences or associations significant at P less than 0.005.

Discussion:

Based on eGFR, we discovered that impaired renal function was highly prevalent in this research in adult outpatients with standard SCr. 3.6–4.4 % of the research participants had clinically severe renal insufficiency, which was determined as an e GFR of less than 60 ml / min/1.73 m2, depending on the GFR estimation algorithm. In earlier investigations, a sizeable portion of out-patients (e GFR 60 ml / min / 1.73 m2) with average S. Cr were shown to have considerably compromised renal function [20–23].

These results imply that many individuals with renal insufficiency may be missed if SCr measures renal function rather than eGFR.

This study demonstrates that if doctors exclusively use normal S. Cr reads as proof of normal kidney function, a significant percentage of female gender and elderly people with compromised kidney function will go undiagnosed. The findings of comparable research and the fact that S. Cr production depends on lean body weight suggest that this might not be a reliable indicator of G. F. R., particularly in elderly individuals and females who have lower muscle mass [23 –27]. The aforementioned research has also shown that including e GFR determined using formulas that account for variables influencing muscle mass size, such as age, sex, and body size, may make it easier to identify and treat this subgroup of patients with renal impairment early on.

The fact that renal insufficiency is significantly more common in people with a family history (FH) of hypertension, diabetes, or cardiovascular disease (CVD), as well as high systolic blood pressure, raises the possibility that a sizable portion of patients at risk for cardiovascular disease whose S.Cr levels are with-in the normal range would not have been identified as having abnormal kidney function if the G. F. R. formulas had not been used to estimate renal function. This aligns with earlier research that showed eGFR should be used instead of SCr alone to evaluate renal function to identify high-risk individuals with renal insufficiency and provide prompt treatment to prevent disease progression and enhance outcomes [28- 29]. The NKF K/DOQI recommendations also corroborated this, advising against depending on SCr in at-risk groups and instead using GFR estimating equations to calculate GFR from S. Cr (eGFR) [30].

When it comes to the clinical evaluation of kidney function, estimates of G. F. R. derived from prediction equations provide significant advantages over measuring S. Cr alone [31]. Although several creatinine - based GFR prediction equations have been established in the past to estimate kidney function, the M. D. R. D. [12- 32] and the C –G equations [13] are the most often employed. The most often utilised formula in clinical experiments today is the MDRD equation, created using data from patients with documented renal insufficiency as determined by 125I- iothalamate clearance corrected for B. S. A. This equation is quick and simple to compute for all patients using the data usually supplied when obtaining an S. Cr measurement because it only depends on the age of patient, sex, race, and S.Cr. Compared to the C - G equation or creatinine clearance, it has typically been demonstrated to offer more accurate estimations of GFR [12- 33]. The C–G equation is a straightforward and advised method of evaluating renal function as it predicts creatinine clearance [13]. It is less convenient for regular usage than the M. D. R. D. equation since it needs a height measurement and the BSA to be calculated. When evaluating renal function, however, e GFR obtained from the C-G equation is preferable to S.Cr alone [33].

Conclusion:

To sum up, our study shows that among Iraqi outpatient patients with normal S. Cr values, there is a significant prevalence of kidney impairment. If doctors depend on standard S.Cr as evidence of normal kidney function, a significant fraction of the elderly people, women, and patients at risk for cardiovascular disease would not be recognised as having compromised renal function. Regular laboratory reporting that includes estimated estimates of GFR may make it easier to identify individuals with renal impairment early and provide them with the best care possible.

Limitations of the study:

1. There was no standardisation in the measurement of serum creatinine, which might have an impact on the accuracy of eGFR calculations, especially at higher levels. This also prevented us from following the KDIGO recommendations to use the widely applied Chronic Kidney Disease Epidemiology (CKD – EPI) equation.
2. The estimation of renal function using estimated GFR rather than actual GFR, which is not the gold standard.
3. We employed the M. D. R. D. study equation, which has not been validated in Iraqi patients.

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