

**COMPARISON OF GLOMERULAR FILTRATION RATE AND CHRONIC KIDNEY DISEASE PREVALENCE USING COCKCROFT-GAULT(C-G) AND MODIFICATION OF DIET IN RENAL DISEASE (MDRD FOR CHINESE FORMULA AMONG BALINESE POPULATION**

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**ABSTRACT**

Some community based study to determine the prevalence of chronic kidney disease has been conducted. It is reported that a reasonable rate of prevalence of CKD if calculated with different formula (either C-G or MDRD). This study is aiming to compare estimated GFR and CKD prevalence determined by either C-G or MDRD and the new Chinese modified MDRD formula

This study analyzed 4528 subjects from 7 areas in Bali Islands including 219(4.8%) subjects in Sembiran, 302 (6.7%), Denpasar 302 (6.7%), Nusa Ceningan 305 (6.7%), Legian 282 (6.2%) Blahbatuh 3038(67.1%), Tenganan, 81(1.8%), and in Ubud 301(6.6%), consisted 2217 (49%) males and 2311 (51%) females. It is found that there were a substantial differences and stepwise increase (79, 83, 86, and 105 mL/min/ 1.73 m<sup>2</sup>), consecutively of mean of estimated-GFR if calculated by C-G, MDRD, MDRD for Chinese (if non-Chinese), and MDRD for Chinese (if Chinese) formula. It was also found that differences of prevalence rate CKD using different formulas. More than twenty percent (20.6%) of CKD defined by estimated-GFR of 59 to 30 ml/min per 1.73m<sup>2</sup> when were calculated by C-G, and 6.9 and 6.8 percent if were calculated by MDRD and MDRD for Chinese (if non-Chinese), consecutively, however, it is much lower (2.2%) using MDRD formula for Chinese (if Chinese).

In conclusion, this study shows difference in mean values of e GFR and prevalence of CKD if calculated using different formulas. A valid formula is needed for specific Indonesian people. [MEDICINA 2014;45:151-155].

**Key words** : - estimated glomerular filtration rate - Cockcroft-Gault - Modification of Diet in Renal Disease – Chinese population – Indonesian population

**PERBANDINGAN LAJU FILTRASI GLOMERULUS DAN PREVALENSI PENYAKIT GINJAL KRONIK MENGGUNAKAN FORMULA COCKROFT-GAULT (C-G) DAN MODIFICATION OF DIET IN RENAL DISEASE (MDRD) FOR CHINESE PADA POPULASI BALI**

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**ABSTRAK**

Beberapa penelitian berbasis masyarakat telah dilakukan untuk mengetahui prevalensi penyakit ginjal kronik (PGK). Laporan penelitian-penelitian ini menunjukkan perbedaan cukup bermakna prevalensi PGK bila dihitung dengan formula berbeda [Cockcroft-Gault (C-G) or MDRD]. Penelitian ini bertujuan untuk membandingkan estimasi laju filtrasi glomerulus eLFG dan prevalensi PGK menggunakan formula C-G, MDRD dan MDRD modifikasi China baru.

Penelitian ini dilakukan dengan melakukan analisis kembali data 4528 subyek dari 7 daerah di Pulau Bali yang terdiri dari 219 (4,8%) subyek di Sembiran, 302 (6,7%), Denpasar 302 (6,7%), Nusa Ceningan 305 (6,7%), Legian 282 (6,2%), Blahbatuh 3038 (67,1%), Tenganan 81 (1,8%), dan di Ubud 301 (6,6%), terdiri dari 2217 (49%) laki-laki dan 2311 (52%) perempuan. Dilaporkan bahwa terdapat perbedaan cukup besar dan peningkatan secara berjenjang, berturut-turut (79, 83, dan 105 ml/min/ 1,73 m<sup>2</sup>) rerata eLFG bila dihitung dengan formula C-G, MDRD, MDRD Cina (bila subyek non-Tionghoa), dan MDRD Cina (bila subyek Tionghoa). Juga dijumpai perbedaan angka prevalensi menggunakan perbedaan formula. Lebih dari dua puluh persen (20,6%), PGK bila PGK yang didefinisikan sebagai eLFG 59 to 30 ml/min per 1,72m<sup>2</sup> bila dihitung dengan formula C-G, dan 6,9 dan 6,8 persen bila dihitung dengan MDRD dan MDRD Cina (bila subyek non-Tionghoa), berturut-turut, namun jauh lebih rendah (2,2%) bila dihitung menggunakan formula MDRD Cina (bila subyek Tionghoa). Disimpulkan bahwa dijumpai perbedaan nilai rerata eLFG dan prevalensi PGK bila dihitung dengan formula berbeda. Diperlukan formula yang valid untuk orang Indonesia. [MEDICINA 2014;45:151-155].

**Kata kunci** : estimated glomerular filtration rate - Cockcroft-Gault - Modification of Diet in Renal Disease – Chinese population – Indonesian population

## INTRODUCTION

**D**etection and Prevention of Chronic Kidney Disease Program study in Indonesia sponsored by Indonesian society of Nephrology has screened CKD in the community in 2004 has conducted in Indonesia. The screening covered 12.000 subjects in 4 provinces in Indonesia including Bali. This survey shows that among 9412 analyzed, those who are high risk subjects (who have high blood pressure, proteinuria and diabetes mellitus) has prevalence of CKD varies from 12,5% if calculated using Cockcroft-Gault (C-G) formula to 8,6% using MDRD (Modification of Diet in Renal Disease) formula, and 7,5% using Chinese modified MDRD formula<sup>1</sup>. A similar result of a discrepancy in rate of CKD prevalence if calculated by different formulas showed by recent epidemiologic study in Bali. This study shows that prevalence chronic kidney disease (CKD) is high using C-G and reasonably lower than using MDRD formula. Among more than 800 subject in population, prevalence of CKD was 56% using C-G formula and 6.0% using MDRD formula.<sup>2</sup> This discrepancy was also revealed by Inter-Asia study in Thailand, that prevalence of moderate reduced kidney function is 17.3% using C-G and 8.8% using MDRD formula.<sup>3</sup>

A Chinese modified MDRD formula which was targeted for Chinese population has been developed using 4 variables known as abbreviated MDRD for western population. This formula was using plasma creatinine concentrations, age, gender and race to estimate GFR. In this formula, race is an important determinant of GFR estimation.<sup>4</sup> In MDRD formula, a coefficient should be used when applied to either White or Black individuals. However, in Chinese modified MDRD formula, a different coefficient is used for either Chinese or non-Chinese. It was

reported that modification of MDRD formula for Chinese people precisely predict measured GFR (Rs<sup>2</sup>=0.86) measured by 99mTc-DTPA plasma clearance method used as a reference for GFR measurement.

Since Chinese people is considered more similar to Indonesian we conducted a study was to compare the prevalence of CKD using C-G, MDRD and Modification of MDRD for Chinese patients in Balinese community in seven sub-districts in Bali Islands. This study may be important because a more reliable and accurate formula for the estimation of GFR and prevalence of CKD in the community is needed. Therefore, a more accurate estimation of burden of illness in kidney disease using a particular formula can be used.

## MATERIAL AND METHODS

An epidemiologic community based study was carried out in some area of Bali, including: 1) in a high terrain resided by indigenous people Sembiran village located in northern part of Bali island using cluster random samples; 2) in a costal area indigenous people in eastern part of Bali island Tenganan village using cluster random samples; 3) in urban Denpasar city using stratified random samples; 4) in semi-urban Blahbatuh sub-district using stratified random samples; 5) in a small isolated Nusa Ceningan island using consecutive cluster random samples; 6) in new-urban tourist destination Legian village using consecutive cluster random, and 6) in a new-urban tourist destination Ubud sub-district using consecutive cluster random. GFR was calculated by C-G, abbreviated (a) MDRD (Abbreviated MDRD using 4 variables) and MDRD-C (Chinese modified abbreviated MDRD formula). Subjects were asked to gather at the village hall at 10.00 am. A series of interview were undertaken by cadres of medical

students, exploring demographic data. Venous spot blood samples were taken for the examination of serum creatinine concentrations. Creatinine concentrations were measured using Jaffe's methods. A group of were trained to undertake interview and measure body weight and height. Estimated-GFR were calculated using different formula as follow: 1) C-G: e-GFR (ml/min per 1.73m<sup>2</sup>) =  $\frac{[(140-\text{age}) \text{ body weight}]}{[72 \times \text{kreatinin serum (mg/dl)}]}$  if males and 0,85 of the e-GFR, if female; 2) abbreviated MDRD (4 variables): e-GFR (ml/min per 1.73m<sup>2</sup>) =  $186,3 \times (\text{Pcr})^{-1.154} \times (\text{age})^{-0,203} \times (0,742 \text{ if female}) \times 1.212$  (if black); 3) Chinese modified abbreviated MDRD formula: e-GFR (ml/min per 1.73m<sup>2</sup>) =  $186 \times \text{Pcr}^{-1.154} \times \text{age}^{-0.203} \times 0.742$  (if female)  $\times 1.233$  (if Chinese). Estimated (e) GFR using the four calculations were compared. CKD was defined based on KDOQI classification, namely eGFR less than 60 ml/mnt.

Descriptive statistics were used to express distribution of demographic characteristics and prevalence of disorders. Estimated-GFR were tested using normal distribution and determined for their mean and SD values. Prevalence of CKD is defined of total CKD cases among total population

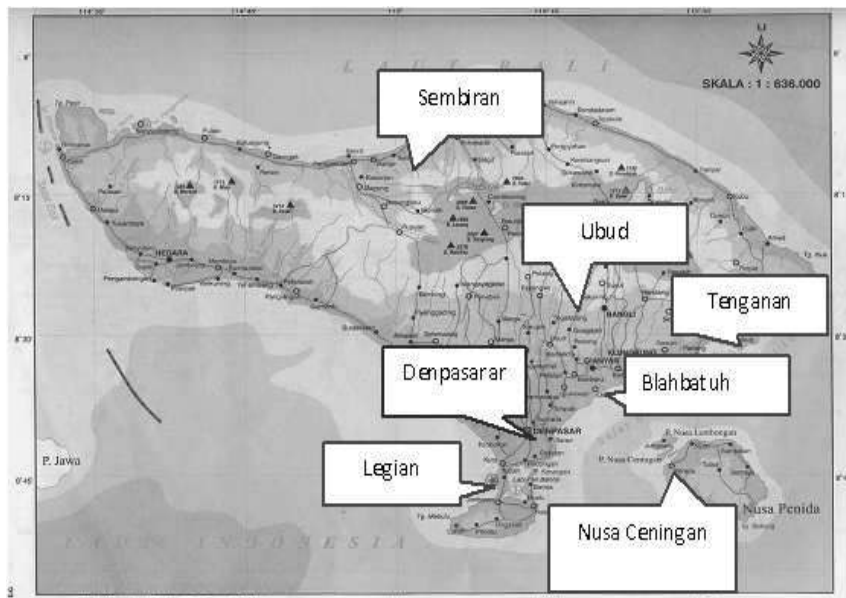
## RESULTS

We recruited 4528 subjects from areas including 219 (4.8%) in Sembiran, 302 (6.7%) in Denpasar, 305 (6.7%) in Nusa Ceningan, 282 (6.2%) in Legian, 3038 (67.1%) in Blahbatuh, 81 (1.8%) in Tenganan, and 301 (6.6%) in Ubud (see **Figure 1**), consisted 2217 (49%) males and 2311 (51%) females, aged 42(12) years, heighted 159(12) cm, body weight 58(15) kg, body surface area 1.59 m<sup>2</sup>, and serum creatinine concentrations 0.96(0.53) mg/dL, 699 (16.8%) were illiterate, 205 (4.9%) partial illiterate, 1477 (35.6%) elementary school, 476 (11.5%) junior high

school), 1054 (25,4%) senior high school, 237 (5.7%) university graduates. Among subjects 1554 (43%) were farmers, 846 (23.4%) self-employment, 390 (10.8%) jobless, 252 (7.0%) private

employee, 179 (5%) civil servant, 11 (0.3%) household, 382 (10.6%) unemployed. Among subjects, 3085 (78.3%) were married, 812 (20.6%) unmarried, and 41(1%) were widow or widower. Among

those subjects only 1979 were examined for plasma creatinine concentrations, consisted 168 (8.5%) in Sembiran, 302 (15.3%) in Denpasar, 305 (15.4%) in Nusa Ceningan, 282 (14.2%) in Legian, 540 (27.3%) in Blahbatuh, 81(4.1%) in Tenganan, and 301 (15.2%) in Ubud



**Figure 1:** Map of Bali Island and locations of the surveys

**Table 1** showed e-GFR value (mean ± SD) and its distribution cokolated by defferent formulas. **Table 2** showed e-GFR distribution with G-G formula among subjects, 556 (28.2%) had e-GFR 90 mL/min/ 1.73 m<sup>2</sup> or more, 988 (50.1%) had e-GFR 60-89, 406 (20.6%) had e-GFR 30-59 mL/min/ 1.73 m<sup>2</sup>, 12 (0.6%) had e-GFR 15-29 mL/min/ 1.73 m<sup>2</sup>, and 9 (0.5%) had e-GFR less than 15 mL/min/ 1.73 m<sup>2</sup>. Using modified MDRD showed by table 606 (30.7 %) of subjects had e-GFR of 90 mL/min/ 1.73 m<sup>2</sup> or more , 1220 (61.7%) of subjects had e-GFR of 60-89 mL/min/ 1.73 m<sup>2</sup>, 136 (6.9%) of subjects had e-GFR of 30-59 mL/min/ 1.73 m<sup>2</sup>, 9(0.5 %) of subjects had e-GFR of 15-29 mL/min/ 1.73 m<sup>2</sup>, and 6 (0.3 %) of subjects had e-GFR of less than 15 mL/min/ 1.73 m<sup>2</sup>. Using modified MDRD for Chinese (if non-Chinese) formula 739 (37.4%) of subjects had e-GFR of 90 mL/min/ 1.73 m<sup>2</sup> or more, 1088 (55.0%) of subjects had e-GFR of 60-89 mL/min/ 1.73 m<sup>2</sup>, 134 (6.8%) of subjects had e-GFR of 30-59 mL/min/ 1.73 m<sup>2</sup>, 9 (0.5 %) of subjects had e-GFR of 15-29 mL/

**Table 1.** Distribution of e-GFR value (mean, SD) according formulas

e-GFR formulas	N	Mean (ml/mnt/1.73 m <sup>2</sup> )	SD
Cockcroft-Gault	1971	79	25
MDRD*	1977	83	19
MDRDforChinesepopulation (if non-Chinese)	1977	86	23
MDRDfor Chinesepopulation (if Chinese)	1977	105	28

\*Modification of Diet in Renal Disease

**Table 2.** Distribution of estimated GFR according K/DOQI classification using different formulas

e-GFR (ml/mnt/1.73 m <sup>2</sup> )	C-G*		MDRD **		C-MDRD (non-C)#		C-MDRD (C)\$	
	N	%	N	%	N	%	N	%
≥ 90	556	28.2	606	30.7	739	37.4	1442	72.9
60 - 89.	988	50.1	1220	61.7	1088	55.0	479	24.2
30 - 59.	406	20.6	136	6.9	134	6.8	44	2.2
15 - 29	12	0.6	9	0.5	9	0.5	6	0.3
<15	9	0.5	6	0.3	7	0.4	6	0.3
Total	1971	100.0	1977	100.0	1977	100.0	1977	100.0

\*Cockcroft- Gault

\*\*Modification of diet in renal disease using 4 variables

# Modification of diet in renal disease for Chinese population, if non Chinese

\$ Modification of diet in renal disease for Chinese population, if Chinese

¶Estimated glomerular filtration rate

min/ 1.73 m<sup>2</sup>, and 7 (0.4 %) of subjects had e-GFR of less than 15 mL/min/ 1.73 m<sup>2</sup>. Using modified MDRD for Chinese (if Chinese) formula showed by **Table 2**, 1422 (72.9%) of subjects had e-GFR of 90 mL/min/ 1.73 m<sup>2</sup> or more, 479 (24.2%) of subjects had e-GFR of 60-89 mL/min/ 1.73 m<sup>2</sup>, 44 (2.2%) of subjects had e-GFR of 30-59 mL/min/ 1.73 m<sup>2</sup>, 6 (0.3 %) of subjects had e-GFR of 15-29 mL/min/ 1.73 m<sup>2</sup>, and 6 (0.3 %) of subjects had e-GFR of less than 15 mL/min/ 1.73 m<sup>2</sup>.

## DISCUSSION

Our study had shown that there some differences in prevalence distribution of e-GFR value according different formula. We compared estimates of mean, SD of e-GFR which were calculated by C-G, MDRD, MDRD for Chinese population (if non-Chinese), and MDRD for Chinese population (if Chinese) formula. There are a substantial differences among mean values if calculated using those formulas 79, 83, 86, and 105 mL/min/ 1.73 m<sup>2</sup>, consecutively. They are stepwise increase, which the lowest if C-G formula is used and the highest if MDRD for Chinese population (if non-Chinese) formula is used. It is also shown that standard deviation (SD) is the widest if C-G formula is used and the narrowest if MDRD for Chinese population (if non-Chinese) formula is used. It may be interpreted that using normal distribution of data, means values among samples can be more representatives of population if it is calculated using MDRD for Chinese population (if non-Chinese) formula than the others.

This study also had shown that differences of prevalence value of categories of e-GFR if calculated using different formula. More than twenty percent of e-GFR in a category less than 60 to 30 percent when were calculated by C-G, and

around seven percent if were calculated by MDRD and MDRD for Chinese population (if non-Chinese). However the prevalence much lower that is 2.2% if calculated using formula of MDRD for Chinese population (if Chinese). A validation study among patients in different stages of chronic kidney disease using renal dynamic imaging method (modified Gate's method) with <sup>99m</sup>Tc-diethylene triaminepentaacetic acid (99mTc-DTPA) as a reference method was done in Beijing, PR China. It is reported that modified MDRD e-GFR in Chinese patients were correlated well with reference GFR (r = 0.90; P < 0.001).<sup>4</sup>

National Health and Nutrition Examination Survey (NHANES) III and IV a population based study using MDRD formula has reported that prevalence of moderate reduced kidney function (GFR 15-59 ml/minute/1.73 m<sup>2</sup>) is 4.2% in NHANES III and 3.7% in NHANES, consecutively. In Inter-Asia study, prevalence of moderate reduced kidney function is 17.3% using C-G and 8.8% using MDRD formula.<sup>3</sup> In Ausdiab study, the prevalence moderate kidney insufficiency (GFR 30-59 ml/minute/1.73 m<sup>2</sup> calculated by C-G is 11%. In Framingham Offspring Study, the incidence chronic kidney disease is 9.4% during 18.5 years (5). In a study conducted in the community in Shanghai Chinese in more than twenty five hundreds to investigate prevalence, awareness and the risk factors CKD. The study reported that prevalence of CKD in population of Shanghai is 11.8%. Subjects with e-GFR under 60 mL/min/1.73 m<sup>2</sup>, is defined as having decreased kidney function<sup>6</sup>. Validated modified MDRD equation for GFR estimation for Chinese population was used to estimate GFR. In Korea, prevalence of CKD among more

than five thousands Korean subjects age more than 20 years of age was 6.8%. CKD was defined as an estimated glomerular filtration rate less than 60 ml/min/1.73 m<sup>2</sup>.<sup>7</sup> An epidemiologic cohort on chronic kidney disease in Southeast Asian populations was conducted over a period of 12 yr (1985 to 1997) among almost thirty five hundreds subjects in Thailand, to determine the prevalence of reduced kidney function with future development of decreased kidney function. The prevalence of reduced kidney function defined as GFR less than 60 ml/min, calculated by MDRD formula was increased from 1.7% in 1985 to 6.8% in 1997, and the prevalence of elevated serum creatinine was 6.1% and 16.9% in 1985 and 1997 surveys, respectively.<sup>8</sup> PREVENT study in Groningen has reported the incidence moderate renal insufficiency of 4.2% within 4 years.<sup>9</sup>

## SUMMARY

In summary, a differences value mean e-GFR and prevalence of CKD if calculated using different formulas. Since results have shown that means and standard deviation of e-GFR calculated by modified MDRD for Chinese (if Chinese) formulas considered more normally distributed and prevalence rate of CKD is more similar to those found in other Asian population and on the other hand, Chinese people is ethnically considered are more similar to Indonesian people, we assume that at present modified MDRD for Chinese (if Chinese) formula be more suitable for the estimation of GFR and prevalence of CKD in Indonesian people. A valid formula is needed for specific Indonesian population in order to produce more accurate estimation of burden of illness in kidney disease.

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