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PREVALENCE OF CHRONIC KIDNEY DISEASE IN ADULT DISADVANTAGEOUS POPULATION

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Summary

The prevalence of kidney disease, particularly diabetic and hypertensive kidney disease is increasing rapidly in many disadvantageous populations throughout the world.

This cross sectional survey was carried out at certain selected slum areas of Mirpur in Dhaka City over a period of July 2003 to June 2005 and a total of 1000 adult population ranging from 15 – 65 years were studied. Variables studied were age, sex, marital status, occupation, family income, literary status, body weight, height, body mass index and serum creatinine. Risk factors studied were diabetes mellitus, hypertension, tobacco use, over-weight and obesity and proteinuria detected by multisticks.

The analysis showed that the mean age was 34.39 ± 012.70 . Majority of the participants were female(66.6%), married (84.7%) and illiterate (78.8%) and house-wives(40%). 21% participants were overweight and obese. 4.1% participants were diabetics and 11.6% participants were hypertensive. Approximately 45.7% participants had smoking habit and 7.7% participants had proteinuria. Based on MDRD equation 13.1% participants were detected as having CKD and while with Cockcroft-Gault equation 16% were CKD. Difference between two equations was not significant.

The survey data revealed that CKD and its risk factors like DM and hypertension are alarmingly increasing in disadvantageous population and adding further pressure to the existing burden of CKD.

Key words: CKD (Chronic Kidney Disease) ; DM (Diabetes mellitus) ; HTN (Hypertension); BMI (Body mass index); C-G (Cockcroft-Gault) formula; MDRD (Modification of Diet in Renal Disease) equation.

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Introduction

Chronic Kidney Disease (CKD) is an ailment of fatality. Accordingly, abundant of people are meeting their dooms around the world by the affliction of this disease.

It is miserably factual that we barely perceive any symptom till the collapse takes place. Consequently, most of the times it seems difficult to prevent the renal failure.

End-stage renal disease (ESRD) has reached epidemic proportion with more than 400,000 affected individuals in United States and well over one million worldwide[1] . This staggering numbers represent only the tip of the iceberg, as the incidence of chronic kidney disease (CKD) is at least 30 fold higher than that of ESRD[2].

The incidence of kidney disease, particularly diabetic kidney disease is increasing rapidly in many disadvantageous population throughout the world[3]. Disadvantageous population are socioeconomically disadvantaged and have limited access to health care and Low socioeconomic status related to occupational and educational level.

CKD and the development of ESRD due to type 2 DM and systemic Hypertension are particularly common in minority population in USA like African American, Hispanic, Asian American and native[4,5]. The majority individuals are socioeconomically disadvantageous and may lack health insurance and have limited access to health care [6]. Renal disease is also increasing, with an age adjusted incidence of treated ESRD in Australian Aboriginals approximately 20 times that of non-Aboriginal people and doubling every three to four years [7]. Low socioeconomic status related to occupational and educational level is associated with increased risk of chronic renal failure in Sweden [8].

Staging of CKD is based on estimation of renal function by GFR. GFR is calculated from Serum Creatinine by Cockcroft-Gault and MDRD equation. Some study showed that there were significant number of patients with normal S. Creatinine level had abnormal GFR with Cockcroft-Gault values ≤ 50 ml/min [9]. This group of patients may remain unrecognized by primary care physician who rely on S. Cretinine abnormality to identify renal insufficiency.

With the increase of diabetes and hypertension, the prevalence of Chronic Kidney Disease (CKD) is also alarmingly going up; particularly in disadvantageous population. We conducted this study among the urban disadvantageous population to find the prevalence of CKD and rise of serum creatinine as there were no exact data before this tiny endeavour has been inaugurated in Bangladesh.

Materials & methods

This cross sectional survey was carried out at certain selected slum areas of Mirpur in Dhaka City over a period of July 2003 to June 2005. A multistage clustered sampling design, following a simple random sampling procedure, was done to choose the study area (Mirpur Slums) and a total of 1000 adult population ranging from 15 – 65 years were studied. Sample size was calculated by using formula and my sample size was higher than expected size. Out of 1000 population 666 were female and 334 were male participants.

Inclusion criteria

Age between 15 and 65 years irrespective of sex

Exclusion criteria

1) Age below 15 years and above 65 years.
2) Condition when albumin excretion is increased- exercise, pregnancy and fever
3) people who did not give consent.

Variables studied were age, sex, marital status, occupation, family income, literary status, body weight(in kilogram) , height (in centimeter) , Body mass index (BMI)= weight in kg/height in m^2

Risk factors studied were diabetes mellitus, hypertension, tobacco use, over-weight and obesity and proteinuria detected by multisticks.

Population were categorized by BMI as per WHO criteria into Normal (BMI 18.5-24.9), Under weight (<18.5), Over-weight (25.0-29.9), Obese (30.0-39.9), Morbid obese (≥40.00).

Participants were considered to have diabetes mellitus if, previously they were being recognized by the doctor about having DM or any documents in favour of DM or they reported taking insulin or a diabetes pill or random plasma glucose ≥ 11.1 mmol/l. Hypertension was defined as systolic BP >140 mmHg or diastolic BP ≥ 90mmHg or use of medication for hypertension irrespective of the BP.

A random urine sample of MSU (Mid stream urine) was obtained from each participants using a clean catch technique and sterile container. Urinary excretion of protein and sugar were detected by Multi-sticks named Uripath 5 made by UK.

Serum creatinine was determined by auto analyzer as µmmol/l which then converted to mg/dl by convertion factor 88.4[10]. CCR (creatinine clearance rate) and Estimated GFR (glomeruler filtration rate) were calculated from S. creatinine (mg/dl) by using equation eg Cockcroft-Gault and MDRD (modification of diet in renal disease) equation.

Equations developed to predict GFR in adult based on serum creatinine:

(i) Cockcroft-Gault equation (1976)

$$\text{Ccr (ml/min)} = \frac{(140\text{-age}) \times \text{Weight (kg)}}{72 \times \text{S. creatinine (mg/dl)}} \times 0.85 \text{ if female}$$

Estimated GFR 2= Correction factor (0.85) x Ccr

(ii) Original MDRD equations (2000) estimated GFR = 186.3 x (S creatinine)$^{-1.154}$ x (age)$^{-0.203}$ x 0.742 (if female).

Normalization of Ccr or GFR for Body Surface Area (BSA).

Normalization of Ccr for BSA allows more accurate evaluation of renal function. Traditionally, 1.73 m^2 is used as standard BSA. As in our population average BSA is low, it needs to be corrected by 1.73 / BSA [11].

$$\text{Ccr corrected by BSA} = \frac{\text{Ccr (ml/min)} \times 1.73\ m^2}{\text{BSA } (m^2)}$$

Body surface area can be determined from height and weight using a monogram found in standard references

$$\text{BSA } (m^2) = \sqrt{\frac{\text{Height(cm)} \times \text{weight (kg)}}{3600}}$$

All the CKDs screened at the 1st visit were advised to have their serum checked for creatinine and urine for protein 3 months after the first check up.

Data were collected using structured questionnaire which was finalized after field testing. Data were processed and analyzed using software SPSS and EpiInfo 2000. Test statistics used to analyze the data was Chi-square test and Fisher's exact test and p values less than 0.05 were considered significant. There was no incentive for slum population and ethical clearance was taken from departmental committee.

Observations & results

The analysis showed that 55% of the participants were young and early middle aged (from 15-40 years of age), while the mean age was 34.39 ± 012.70 years(Table I). A female preponderance was observed among the participants (66.6%). Majority of the participants was married (84.7%) and illiterate (78.8%)(Fig 1).

In terms of occupation, the house-wives comprised the main bulk (39.9%), followed by garment-workers 17.4%, small-business 9.4%, service 9%, day labour 5.4%, rickshaw-puller 4.3%, and other jobs 10.6%(Table II). The rest 4% were unemployed. BMI study categorized 575(57.5%) participants as normal, 218(21.8%) as underweight, 174(17.4%) as overweight, 30(3%) as obese and 3(0.3%) as morbidly obese. A total of 41(4.1%) participants were diabetics. Likewise a total of 116(11.6%) participants were hypertensive. Approximately 22% participants had smoking habit and nearly one quarter (23.7%) informed about the habit of chewing tobacco. Urine albumin analysis using multi-sticks demonstrated that 77(7.7%) participants had proteinuria ,of them 57(5.7%) had '+' protenuria, 16(1.6%) had '++' and 4(0.4%) had '+++' proteinuria. Based on MDRD equation 131(13.1%) participants were detected as having CKD (stage 1- 2.7%, stage 2- 3.9%, stage 3- 6.3%, stage 4-0.1%, stage 5-0.1%) and while with Cockcroft-Gault (C-G)equation 160 (16%) (stage 1-1.3%, stage 2- 3.4%, stage 3- 10.9%, stage 4-0.3%, stage 5-0.1%), were CKD(Table III). Difference between two equations was not significant.

The mean CCr by Cockcroft-Gault equation was 85.1 ml/minute in males and 99.2 ml/minute in females, While the mean eGFR by MDRD equation was 100.8 ml/minute in males and 133 ml/minute in females. Out of total population, 13(1.3%) males had serum creatinine > 1.5mg/dl and 27(2.7%) females had serum creatinine > 1.3 mg/dl, comprising 40(4%) participants with raised serum creatinine (Fig 2).

Table I : Age distribution of the participants

Age (yrs)*	No	%
< 20	102	10.2
20 – 30	284	28.4
30 – 40	267	26.7
40 – 50	188	18.8
≥ 50	159	15.9
Total	**1000**	**100.0**

* **Mean age** = (34.39 ± 12.70) yrs; **range:** (15 – 65) yrs

Table II : Distribution of participants by occupation

Occupation	No	%
House-wife	399	39.9
Small-business	94	9.4
Service	90	9.0
Day-labour	54	5.4
Riksaw- puller	43	4.3
Garments' worker	174	17.4
Others	106	10.6
Unemployed	40	4.0
Total	**1000**	**100.0**

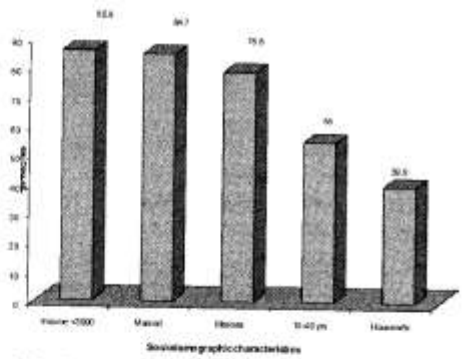

Fig 1: dominant sociodemographic characteristics of the participants

Table III: CKD staging by different equations (N = 1000)

Staging of CKD	Equation		
	Cockcroft-Gault	MDRD	Cockcroft-Gault X Correction factor (0.85)
Total CKD	160 (16.0)*	131(13.1)	287(28.7)
Stage 1	13(1.3)	27(2.7)	6(0.6)
Stage 2	34(3.4)	39(3.9)	40(4.0)
Stage 3	109(10.9)	63(6.3)	234(23.4)
Stage 4	3(0.3)	1(0.1)	6(0.6)
Stage 5	1(0.1)	1(0.1)	1(0.1)
Normal	840(84.0)	869(86.9)	713(71.3)

* Figures in the parentheses denote corresponding %

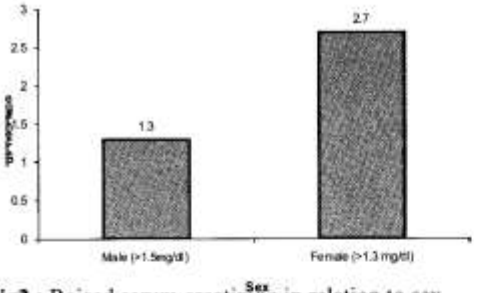

Fig2 : Raised serum creatinine in relation to sex

Discussion

Present study conducted for 'detection of chronic kidney disease in adult disadvantageous population' is the first ever study done in the slum area of Dhaka i.e. urban disadvantageous population.

The prevalence study was done to examine the prevalence of diabetes mellitus, hypertension, chronic kidney disease (based on proteinuria and low GFR), and to find the association of CKD with sociodemographic and other putative risk factors.

A total of 41(4.1%) participants were diabetic in my study of them 20 (about 50%) were self reported diabetics and 21 (about 50%) were diagnosed during survey.

The crude prevalence of type-2 DM in different community in Bangladesh is 4.3% in rural population[12], 7.9% in urban population [13] and 8.1% in urban slums of Dhaka [14].

A total of 116 (11.6%) participants of my study population were hypertensive. Of them 50 (43.1%) were established hypertensives and the rest 66 (56.9%) were discovered so from the collected data.

The prevalence of hypertension in rural population of Bangladesh with systolic blood pressure (SBP) $\geq$ 140mmHg was 10.5% and with diastolic blood pressure (DBP)$\geq$ 90 mmHg was 9% [15] and in urban slum of Dhaka was 15% and 16.7% respectively[14].

Urine protein analysis using multi-sticks demonstrated that 77 (7.7%) participants had proteinuria, of them 57(5.7%) had '+' proteinuria; 16(1.6%) had '++' and 4(0.4%) had '+++' proteinuria. Two previous population based studies had examined the prevalence of proteinuria in adults. Iseki et al, [16] detected proteinuria, as defined by a dipstick result of trace or greater in 4 to 6% of men and 2.5 to 7% of women in a study of 1,07,192 Japanese volunteers. A similar prevalence, ranging from 1% in 34-44 years old to 6% in 55-64 years men, was found in US volunteers in framingham study [17]. Though dipstick detection of proteinuria has better sensitivity than specificity.

Measurement of renal function is important in the diagnosis of renal disease and glomerular filtration rate (GFR) is believed to the best overall index of renal function in health and disease. Renal function in our study was assessed by estimated GFR (MDRD equation) and CCR (Cockcroft-Gault equation). Both the equations were based on serum creatinine and correcrted for body surface area (BSA). Creatinine clearance usually exceeds GFR because of tubular excretion of creatinine. It is generally agreed that tubular excretion of creatinine is responsible for 10-15% of creatinine excretion. Therefore in general a correction factor of 0.8-0.9 seems to be appropriate for routine use [18]. Here we use correction factor 0.85. So estimated GFR from C-G equation was CCRX0.85. In Icelandic study, they used correction factor 0.84 to calculate estimated GFR (eGFR) from CCR of C-G equation[19].

Prevalence of CKD in my survey was 131 (13.1%) when MDRD equation was used. Out of which stage 1 (Proteinuria +GFR $\geq$ 90 mg/min) was 27 (2.7%), stage 2 (proteinuria + GFR 60-89 ml/min) was 39(3.9%), stage 3 (GFR 30-59 ml/min) was 1(0.1%) stage 5(GFR < 15 ml/min) was 1 (0.1%). Prevalence of CKD using MDRD in USA adult population was 11%, out of which stage 1 was 3.3%, stage 2 (3%), stage 3 (4.3%), stage 4 (0.2%) and stage 5 (0.2%)[10].

Prevalence of CKD in my survey was 160 (16%) when Cockcroft-Gault equation was used. Out of which stage 1 was 13(1.3%), stage 2 was 34(3.4%), stage 3 was 109(10.9%) stage 4 was 3(0.3%), stage 5 was 1 (0.1%). Prevalence of CKD using C-G equation in AusDiab kidney study was also 16% [20]. The prevalence of individuals with CCR < 60 ml/min/1.73 m^2 (using C-G equation) was greater then those of estimated GFR < 60 ml/min/1.73m^2 using MDRD equation (7% versus 4.5%)[10].

In my study when i multiply C-G equation by correction factor (0.85) total CKD was found 28.7%, mostly belonging to stage 3 (23.4%). This equation was used in Iceland study to calculate estimated GFR from CCR of C-G equation. In Iceland study among CKD, proportion of stage 1 was higher in MDRD than C-G with correction factor but proportion of stage 3 much higher in C-G with correction factor than MDRD which is consistent with my study.

In AusDiab kidney study, they used C-G equation and explained that C-G estimates of creatinine clearance when corrected for body surface area have been found to correlate well with gold-standard measures of GFR.

In US prevalence study, they used MDRD and C-G equation without correction factor. I did not find any significant difference in the proportion of CKD whether C-G or MDRD equation was used. Similar report also shown in NHANES III data when age of the population less than 65-70 years. Thus the study data suggest that detection of CKD is independent of method of CKD staging.

We also showed raised serum creatinine in terms of sex. About 1.3% of males had serum creatinine >1.5 mg/dl and 2.7% females had s. creatinine >1.3 mg/dl giving a total of 4% of my study population with raised serum creatinine. Kidney early evaluation program (KEEP) demonstrated, a total of 5% of entire KEEP population had raised serum creatinine (>1.5 mg/dl in male and > 1.3 mg/dl in female[21]. NHANES III survey showed the prevalence estimates of an elevated s. creatinine level had been reported as 3.3% of adult men with s. creatinine ≥ 1.6 mg/dl and 2.7% of adult women with s. creatinine ≥ 1.4 mg/dl[10].

Conclusion

The survey data revealed that CKD is no less than 13% and raise serum creatinine is 4% in the urban disadvantageous population. The commonest risk factors for CKD like DM and hypertension are also alarmingly increasing, thus adding to the existing burden of CKD.

Disclosure

All the authors declared no competing interestes.

References

1. Scott GS, Barry IF, Shahriar M. Genetic factors in end-stage renal disease. Kidney Int 2005;67:S1-S4

2. Jones CA et al. Serum creatinine levels in the US population: Third National Health and Nutritional Examination Survey(NHANES III). Am J Kidney Dis 1998;32:992-999

3. Robert GN. Intrauterine determinant of diabetic kidney disease in disadvantaged populations. Kidney Int 2003;63:S13-S16

4. Lopes AAS, Hornbuckle K, James SA, Port FK. The joint effects of race and age on the risk of end-stage renal disease attributed on hypertension. Am J Kidney Dis 1994;24:554-560

5. Cowie CC,Pork FK,Wolfe RE et al. Disparities in incidence of diabetic end-stage renal disease according to race and type of diabetes. N Engl J Med 1989; 321:1074-1079

6. Fiscella K, Franks P, Gold MR, Clancy CM. Inequality in quality: Addressing socioeconomic, racial and ethnic disparities in health care. JAMA 2000; 283:2579-2584

7. Wendy EH, Megan R, Kile E, Mathews JD, Zhiqiang W. A new dimension to the Barker hypothesis: Low birth weight and susceptibility to renal disease. Kidney Int 1999;56:1072-1077

8. Fored CM, Ejerblad E, Fryzek JP et al. Socio-economic status and chronic renal failure: a population-based case-control study in Sweden. Nephrol Dial Tansplant 2003;18:82-85

9. Lynda D, John H, Ognjendka, Djurdjev and Adeera L. Screening for renal disease using serum creatinine: who are we missing ? Nephrol Dial Transplan 2001;16:1042-1046

10. Josef C, Brad CA, Tom G, Garabed E, Andrew SL. Prevalence of chronic kidney disease and decreased kidney function in the adult US population: third National Health and Nutrition Examination Survey. Am J Kidney Dis 2003;41: 1-12

11. Jacobien CV , Gansevoort RT, Hillege HL et al. Drawbacks of the use of Indirect estimates of renal function to evaluate the effect of risk factors on renal function. J Am Soc Nephrol 2004;15:1316-1332

12. Sayeed MA, Mahtab H, Khanam PA, Latif ZA, Khan AKA. Diabetes and impaired fasting glycemia in a Rural Population of Bangladesh. Diabetes Care 2003; 26: 1034-1039

13. Sayeed MA, Ali L, Hussain MZ, Rumi MAK, Khan AKA. Effect of socioeconomic risk factors on the difference in prevalence of diabetes between rural and urban population in Bangladesh. Diabetes Care 1997;20:551-555

14. Rahim MA, Vaaler S, Ali SMK, Khan AKA, Hossain A. Prevalence of type 2 diabetes in Urban Slums of Dhaka, Bangladesh. Bangladesh Med Res Counc Bull 2004; 30:60-70

15. Sayeed MA, Banu A, Khan AR, Hussain MZ. Prevalence of diabetes and hypertension in a rural population of Bangladesh.Diabetes Care 1995;18:555-558

16. Iseki K, Iseki C, Tkemitya Y, Fukiyama K. Risk of developing end-stage renal disease in a cohort of mass screening. Kidney Int 1996;49:800-805

17. Kannel WB, Stam MJ, Castelli WP, Verter J. The prognostic significance of poteinuria: the framingham study. Am Heart J 1984; 108:1347-1352

18. Gerald Vervoort, Hans L, Willems, Wetezls Jack FM. Assessment of glomerular filtration rate in healthy subjects and normoalbuminuric diabetic patients: validity of a new (MDRD) prediction equation. Nephrol Dial Transplant 2002;17:1909-1913

19. Viktorsdottir O, Runolfur P, Margret B, Vilmundur G, Olafur S. Prevalence of chronic kidney disease based on estimated glomerular filtration rate and proteinuria in icelandic adults. Neprhol Dial Transplant 2005;20:1799-1807

20. Steven JC et al. Prevalence of Kidney Damage in Australian Adults: the AusDiab Kidney Study. J Am Soc Nephrol 2003; 14:S131-S138

21. Wendy WB, Peters RM, Qhmit SE, Collins A, Shu-Chen Chen. Early detection of kidney disease in community settings: the kidney early evaluation program (KEEP). Am J Kidney Dis 2003;42:22-35