Assessment of Risk Factors in Chronic Kidney Disease in Adult Rural Population

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Abstract:
Context: CKD is a major public health problem worldwide and a significant cause of morbidity and mortality. With this background the present study was done to find out the exact prevalence of CKD with associated risk factor in rural area. **Method:** A multistage sampling following simple random sampling procedure was done to choose the study area and a total 1265 adult population ranging from 15-65 years of both sexes were studied. Multisticks test for urine demonstrated a total 76(6.0%) participants were proteinuric and among this 2.5% had isolated proteinuria. Proteinuria and MDRD equation depicted 238 (18.8%) were having CKD. **Results:** Study population was categorized by BMI where 789(62.3%) as normal, 278 (22%) as underweight, 165(13.0%) as overweight, 31(2.5%) as obese 2(0.2%) as morbidly obese. This study revealed 47(3.7%) participants were diabetic of them 23(49%) were self reported and 24(51%) were diagnosed during the survey. A total 243 (19.2%) were hypertensive. Among them 84 (34.6%) were established hypertensive and the rest 159 (65.4%) were unaware of their disease. **Conclusions:** Association of risk factors like obesity, diabetes, hypertension was significantly higher. Increasing number of risk factors multiply the chance of development of CKD.

Indexing words: Chronic kidney disease, Body mass index, Hypertension, Diabetes mellitus

Introduction:
According to National Kidney Foundation, Chronic Kidney Disease (CKD) is defined according to the presence or absence of kidney damage and level of kidney function- irrespective of the type of kidney disease. So, CKD is defined as either kidney damage and /or GFR< 60 ml/min/1.73m^2 for $\geq$ 3 month. Kidney damage is defined as pathological abnormalities or markers of damage, including abnormalities in blood or urine tests or imaging studies.[1]

Chronic kidney disease (CKD) is a major public health problem worldwide and emerging as an epidemic proportion. In the terminal stage of CKD, when life is incompatible without renal replacement therapy either by dialysis or transplantation named as end stage renal failure (ESRD).[2]

Staging of CKD is based on estimation of renal function by GFR. GFR is calculated from serum Creatinine by Cockcroft-Gault and MDRD (Modification of Diet in Renal Disease) equation. Some study showed that there were significant number of patients with normal serum Creatinine level had abnormal GFR with Cockcroft-Gault values <50 mi/mm.[3] This group of patients may remain unrecognized by primary care physician who rely on serum creatinine abnormality to identify renal insufficiency. In our country the most common causes of ESRD are chronic glomerulonephritis (47%), diabetes mellitus (24%) and hypertension (13%).[4] The incidence of increase of DM was 2% in 1986 and increased to 6% in 2001. A survey in the community level has shown that about 10-12% has been suffering from hypertension in our country. Many of them will be presenting with advanced kidney failure either to physician or with hospital. The majority of these patients are younger in age which is the most productive age of life. But this unexpected presentation with end stage kidney disease-very little can be offered except dialysis which also beyond the ability due to poverty. As a result these patients are becoming burden for themselves and for the whole family. In most of the cases the affected family bears the financial burden years after years even after the death of the patient.

Proper intervention of risk factors in early stage of CKD will slow the progression and reduce the rate of ESRD. So, country like us it is very

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important to know the prevalence of CKD which emphasis the early detection and prevention.
So, the present study was aimed at to assess the prevalence of risk factors of Chronic Kidney Disease (CKD) in adult rural population.

Methods:
This was a cross sectional study carried out in Nephrology department, Bangabandhu Seikh Mujib Medical University and Kidney Foundation from July 2003 to June 2005. The study area was selected named Bongaon Union, a rural area of Savar thana 30 k.m. away from centre of Dhaka city. A total fifteen thousand population of both sex, age between 15 and 65 years were included in this study. Age <15 year and above >65 years, Fever at the time of screening, recent history of fluid loss such as diarrhea, vomiting, trauma etc. and pregnant women were excluded from the study.

Duration of study: Sampling procedure:
A multistage clustered sampling design was utilized by following simple random sampling procedure. First of all a Thana of Dhaka district was selected named Savar. This thana comprises with 12 Unions. Out of these 12 Union Bongaon Union was selected. According to local Union porishod authority there were about 15 thousand adult populations who met the inclusion criteria. Among them 1265 participated in the study within mentioned period. Local authority, Public leaders, Imam, social workers motivated people to participate in this program. Leaflet distribution, miking, postering was done to create awareness about this program regularly.

Data Collection:
(a) Data were collected from all participants by direct interview and using structured questionnaire. Informed consent was obtained from all participants.
(b) In order to collect data and sample, there was a fixed centre where study subjects would come every Friday from 9:00 AM to 2:00PM.
(c) Age, occupation, marital status, addresses were recorded as per statement of the participants at the time of interview.
(d) Height, weight and blood pressure was measured according to standard procedure. BMI was calculated.

Blood samples were collected on the spot for estimation of blood glucose and serum creatinine.

Spot urine sample was collected in test tubes labeled with individual's registration no. for each participants and dipstick test was done. Positive test was labeled as + (30mg/dl), ++ (100mg/dl), +++(300mg/dl), ++++(1000mg/dl) depending on amount of proteinuria. At the same time urinary sugar was also detected and was labeled as ±(100mg/dl),+(250mg/dl), ++(500mg/dl), +++(1000mg/dl) depending on the amount of glycosuria.

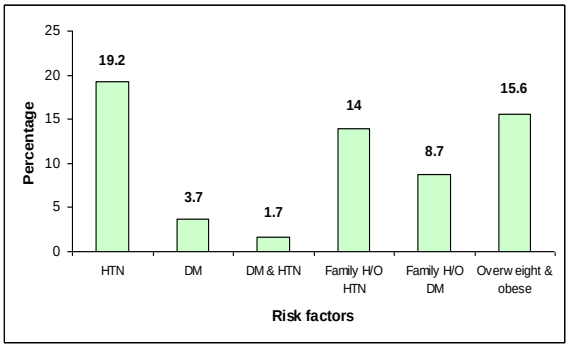
Body mass Index (BMI):
BMI was calculated taking weight in kg divided by height in meter squared.

- Normal : BMI 18.5 – 24.9 kg/m^2
- Overweight : BMI 25 – 29.9 kg/m^2
- Obese : BMI 30 – 39.9 kg/m^2
- Extremely obese : BMI ≥ 40kg/m^2
- Underweight : BMI <18.5

Data processing and analysis:
Data were analyzed through SPSS program. Continuous data were presented as mean and standard deviation from the mean. Chi-square, fishers exact test, Students t- test and Spearman scorrelation test was used for statistical analysis. Results were presented in tabulated form, charts and diagrams along with statistical interpretation**.**

Results:
Out of 1265 participants proteinuria and MDRD equation depicted 238 (18.8%) were having CKD, on the other hand, C-G equation revealed 226 (17.9%) having CKD.[5]

Prevalence of risk factors for CKD:
Out of 1265 participants, 19.2% were hypertensive, 3.7% diabetic, 1.7% combined hypertensive and diabetic. Family history of hypertension, and family history of diabetes mellitus were 14% and 8.7% respectively. Overweight and obese were 15.6% (Fig 1).



M = Diabetes mellitus, HTN = hypertension

Fig. 1: Prevalence of risk factors of CKD (n = 1265)

Body Mass Index (BMI):
Majority (62.3%) of the participants' Body Mass Index (BMI) was within normal range, 22% underweight, 13% overweight and 2.5% obese. Only 2(0.2%) participants had morbid obesity (Table 1).

Table 1: Distribution of the participants by Body Mass Index (n= 1265)

BMI (kg/M^2)	**No**	**%**
Normal (18.5 – 24.9)	789	62.3
Underweight (< 18.5)	278	22.0
Over-weight (25.0 – 29.9)	165	13.0
Obese (30.0 – 39.9)	31	2.5
Morbid (≥ 40.0)	02	0.2

***Mean BMI =** (21.34 ± 3.67) kg/M^2; **range:** (11.47 – 40.66) kg/M^2

Distribution of diabetes:
Out of 1265 participants 47 (3.7%) were diabetics (Fig. 2). Of them 24(51%) were newly diagnosed (unaware) (Fig. 3).

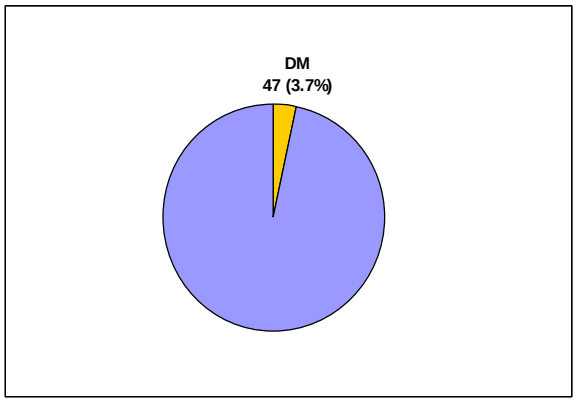


Fig. 2: Distribution of diabetes mellitus (DM) (n = 1265)

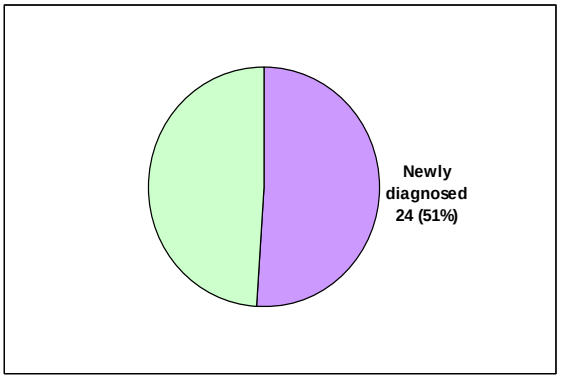


Fig. 3: Awareness about diabetes mellitus (n = 47)

Distribution of hypertension:
Out of 1265 participants 243 (19.2%) were hypertensive (Fig. 4). Of them 159(65%) were detected firs time during survey (unaware) (Fig. 5).

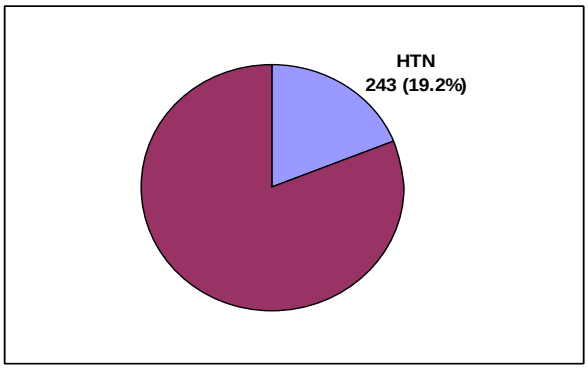


Fig. 4: Distribution of hypertension (HTN) (n = 1265)

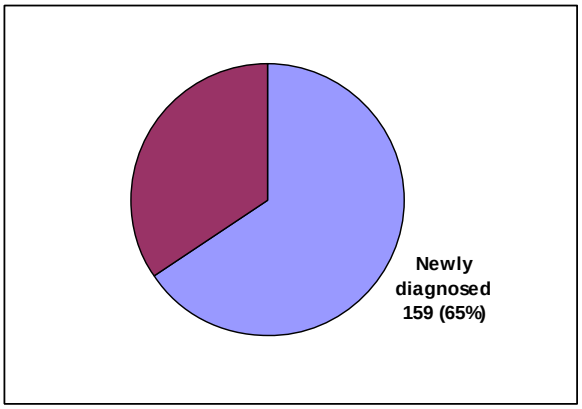


Fig. 5: Awareness about hypertension (n = 243)

Distribution of proteinuria:
Out of 1265 participants 21(1.66%) had DM with proteinuria, 33(2.6%) had HTN with proteinuria, while 3192.5%) had isolated proteinuria. A total of 76(6%) were proteinuric (Fig. 6).

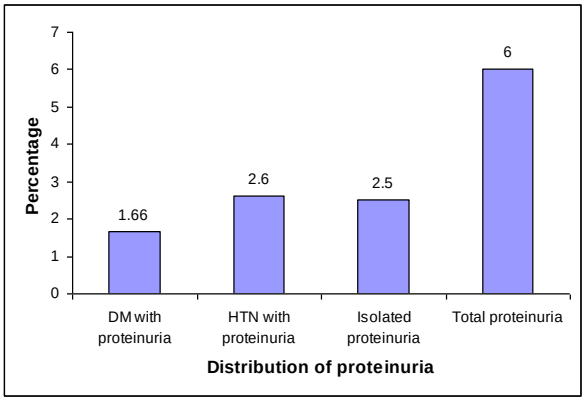


Fig. 6: Distribution of proteinuria among participants (n = 1265)

Distribution of CKD:
Distribution of CKD among risk groups demonstrates that around 25% of the hypertensives had CKD (28.8% by C-G equation and 28.8% by MDRD equation). Among diabetics the presence of CKD was much higher (46.8% by C-G equation and 51.1% by MDRD) than those among hypertensives. However, in case of combined HTN & DM the prevalence of CKD was found to be even higher 68.2% and 68.2% by C-G and MDRD equations respectively) (Fig. 11).

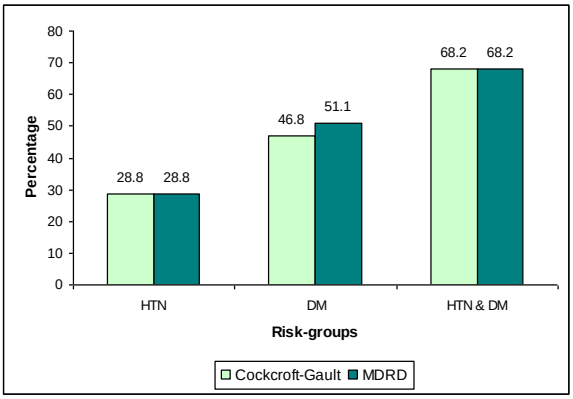


Fig. 7: CKD among risk groups by different equations (n = 1265)

Association of CKD (C-G) with nutritional and systemic diseases:
The associations of CKD with nutritional and systemic diseases were evaluated. The variables that were selected to be studied were BMI, DM, HTN and combined DM & HTN association Apart from BMI. Apart from BMI all other variables demonstrated their significant presence in the CKD population compared to normal ones ($p < 0.001$) (Table 2).

Table 2: Association of CKD (C-G) with nutritional & systemic diseases

Nutritional & systemic diseases	Group		χ^2	*p-values
	CKD (n=226)	Normal (n=1039)		
Over-wt & obese (BMI ≥ 25 Kg/M²)	27(11.9)	171(16.5)	2.86	0.091
DM (self-reported + RBS ≥11.1 mg/dl)	22(9.7)	25(2.4)	27.86	<0.001
TN (self-reported + newly-diagnosed)	70(31.0)	173(16.7)	24.53	<0.001
Combined DM & HTN	15(6.6)	7(0.7)	38.62	<0.001

*Data were analysed using **Chi-squared (χ^2) Test** and **df = 1** in each case**.**

Association of CKD (MDRD) with nutritional and systemic diseases
The associations of CKD (MDRD) with nutritional and systemic diseases were studied. All the variables, except BMI, demonstrated their significant predilection with the CKD population compared to normal ones ($p < 0.001$) (Table 3).

Table 3: Association of CKD (MDRD) with nutritional & systemic diseases

Nutritional & systemic diseases	Group		χ^2	*p-values
	CKD (n=238)	Normal (n=1027)		
Over-wt & obese (BMI ≥ 25 Kg/M²)	36(15.1)	162(15.8)	0.061	0.804
DM (self-reported + RBS ≥11.1 mg/dl)	24(10.1)	23(2.2)	33.23	<0.001
HTN (self-reported + newly-diagnosed)	70(29.4)	173(16.8)	19.66	<0.001
Combined DM & HTN	15(6.3)	7(0.7)	35.72	<0.001

* Data were analyzed using **Chi-squared (χ^2) Test** and **df = 1** in each case**.**

Comparison of risk factors between CKD (C-G) and CKD (MDRD)
The distribution pattern BMI and certain systemic diseases like HTN and DM in CKD population are almost similar whether CKD (C-G) or CKD (MDRD) equations are used for staging of CKD ($p > 0.05$) (Table 4).

Table 4: Comparison of risk factors between CKD(C-G) & CKD(MDRD)

Nutritional & Systemic disease	Group		χ^2	*p-values
	CKD(C-G) (n=226)	CKD(MDRD) (n=238)		
Over-wt & obese	11.9%	15.1%	0.17	0.678
DM	9.7%	10.1%	0.06	0.809
HTN	31.0%	29.4%	0.02	0.877
Combined DM & HTN	6.6%	6.3%	0.08	0.774

*Data were analyzed using **Chi-squared (χ^2) Test** and **df = 1** in each case**.**

Discussion:
Among adults in rural population of Bangladesh the prevalence study was done to examine the prevalence of diabetes, hypertension, and chronic kidney disease (based on proteinuria and/or low GFR, estimated GFR was calculated from Cockcroft-Gault and MDRD equation) and to find out the association of CKD with risk factors like hypertension, diabetes mellitus.
Of the 1265 population studied total 47 (3.7%) participant were diabetic in the study; of them 23 (about 49%) were self reported and 24 (about 51%) were newly diagnosed during survey.

Previously studied prevalence of type- 2 DM in Bangladesh in rural area was 4.3%,[6] in sub urban population it was 4.1% and in urban population it was 7.9%.[7] Rahim et al showed the prevalence of type 2 diabetes in urban slum of Dhaka was 8.5%.[8] A similar type of study was done in urban disadvantageous population in Mirpur slum area and found 4.1% of population with DM, of them 50% was newly diagnosed. The global prevalence of DM in the year 1995 showed 4%; developed countries 5.9%, developing countries 3.3%.[9] In this study only random plasma glucose was measured. Fasting plasma glucose and 2 hours after plasma glucose can reveal the more accurate prevalence of DM.

A total of 243(19.2%) among 1265 of our study population were hypertensive. Of them 84 (34.6%) were self reported and the rest 159 (65.4%) diagnosed during the survey. In a small community based study Sayeed et al showed that in native Bangladeshi overall prevalence rates of systolic hypertension 14.4% and diastolic hypertension 9.1%.[10] The prevalence of systolic hypertension was significantly higher in rural than urban participants (p<0.001). Compared with the poor the rich class had significantly higher prevalence of both systolic (p=0.002) and diastolic (p=0.041). In a recent study among urban slum population in Dhaka showed that 11.6% had hypertension.

Proteinuria is the cardinal manifestation of overt diabetic nephropathy, hypertensive renal damage and glomerulonephritis. Out of 1265 participants urine protein analysis using multisticks demonstrated that 21(1.66%) participants had DM with proteinuria, 33(2.6%) had HTN with proteinuria, while 31(2.5%) had isolated proteinuria.

In this study 11.9% of the CKD population were overweight and obese compare to 16.5% without CKD, although the difference between the two groups did not reach the level of significance (P=0.091) when using C-G equation. Also 15.1% of the CKD population were detected as overweight and obese compared to 15.8% of those without CKD and show no difference between the two groups (p=0.804) when using MDRD equation.

In our study, diabetes mellitus was present in significant proportion in CKD group than those in the normal population (p< 0.001). When using C-G equation CKD was four times higher in comparison to normal that is CKD was 9.7% in DM patient and 2.4% in normal population (p<0.001). Based on MDRD equation CKD was 10.1% in diabetic patient and 2.2% in normal population (p<0.001). The prevalence of a reduced GFR <60 ml/min (CKD stage 3 to 5) was three fold higher in those with DM compared with those without (27.6%; 95%CI: 22.0%, 33.1% VS 9.8%; 95% CI: 7.6%, 12.1%) (P<0.00l).[11] The association of DM and low GFR (<60 ml/min) was not significant in Iceland male (Low GFR 65% vs. control 6%) but it was significant in female (low GFR 6.6% vs. control 4.4%) (p<0.05).

In the survey, association of CKD with risk factor revealed significant relation. Those heaving CKD, 31.0% of them had hypertension (HTN) compared to 16.7% of normal population, showing statistically significant association of CKD with HTN (p<0.001) based on C-G equation. The association of HTN and CKD also significant when MDRD equation was used (CKD was 29.4% in hypertensive's and 16.8% in normal population, p< 0.001).

The AusDiab kidney study demonstrated hypertension (odds ratio: 5.4, 95% CI: 4.3, 6.9) were strongly predictive of proteinuria on univariate analysis and hypertension also predictive of renal impairment. The prevalence of reduced GFR <60ml/min/l.73 m^2 was five-fold more prevalent in those with hypertension compared to those without (p<0.00l).

NHANES III data of US adult population also showed significant prevalence of CKD among hypertensive and diabetics.[12] Along with past population based study some of which mentioned above and the present study revealed that hypertension and diabetes is established cause of CKD.

Among high risk group having hypertension and diabetes was studied in community health clinic by Patel et al[13] and found the prevalence of CKD was 68.9%. In the United States 70% of patient who are getting renal replacement therapy are having diabetes or hypertension or both. Blood pressure systolic or diastolic is significantly higher in low GFR group compared with normal in Iceland study.[14]

From this study we found those having the combination of risk factors like diabetes and hypertension, CKD was nine times higher compared with normal population when C-G or MDRD equation used (P<0.001).

The present study revealed the increase number of risk factor multiplying the probability of developing of

CKD. As we found hypertensive or diabetic patient was 2 or 4 times prone to develop CKD compared with normal (P< 0.001). But already mentioned both the factor together can raise the probability of CKD nine times (p<0.001).

According to NKF: K/DOQI guideline: CKD should be labeled if kidney damage with or without decreased GFR persist for ≥3 months. In the follow up programme out of 226 CKD patient only 72 (32%) attended and complying to the advise. Out of these 72 person 57 (79%) met the CKD criteria after reevaluation. In other studies 18% of the participants showed compliance in KEEP study.[15]

Conclusion:

The survey data revealed that CKD is not less common (18%) in the rural population. A similar survey conducted recently in the urban disadvantageous population also demonstrated a significant percentage of CKD. The commonest risk factors for CKD like diabetes and hypertension are also highly prevalent in adult rural population and majority of the population were unaware of their disease. The combined effect would increase the burden of CKD. So to prevent or slow the progression of CKD, early detection and therapeutic intervention of risk factors is the best way.

So, a nationwide screening programme is necessary to develop awareness of entire population, to find exact prevalence of CKD and its associated risk factors. As a result a cost effective preventive strategy could be adopted.

References:

1. Rocco MV, Buckalew VM Jr, Moore LC, Shihabi SK. Measurement of glomerular filtration rate using nonradionctive iohexol: comparison of two one compartment models. Am J Nephrol 1996; 16:138-143.
2. Grassmann A, Gioberge S, Moeller S, and Brown G. ESRD patient in 2004: global overview of patient numbers, treatment modalities and associated trends. Nephrol Dial transplant 2005; 20:2587-2593.
3. Duncan L, Heatheote J, Djurdjev O and Levin A. Screening for renal disease using serum creatinine: who are we missing? Nephrol Dial Transplant 2001; 16: 1042-1046.
4. Rashid HU. 1986-1996: Bangladesh renal registry report. Bangladesh Renal J 2002; 21(1): 25-28.
5. Muqeet MA, Rashid S, Anwar S. Detection of Chronic Kidney Disease in Adult Rural Population. Journal of Rangpur Medical College 2019; 4(2):40-45.
6. Sayeed MA, Mahtab H, Khanam PA, Latif ZA, Kermat SM, Khan AKA et al. Diabetes and impaired fasting glycemia in a rural population of Bangladesh. Diab Care 2003**;** 26(4):1034-1039.
7. Sayeed MA, Hussain MZ, Rumi MAK, Banu A, Khan AKA. prevalence of diabetes in a suburban population of Bangladesh. Diabetes Res Clin Pract 1997; 34:149-155.
8. Rahim MA, Vaaler S, Ali SMK, Khan AKA, Hussain A, Nahar Q. Prevalence of type 2 diabetes in urban slums of Dhaka, Bangladesh. Bangladesh Med Res Counc Bull 2004; 30(2): 60-70.
9. King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025. Prevalence, numerical estimates, and projections. Diabetes care 1998; 21:1414-1431.
10. Sayeed MA. Banu A, Haq JA, Khanam PA, Mahtab H, Khan AKA. Prevalence of hypertension in Bangladesh; effect of socioeconomic risk factors on difference between rural and urban community. Bangladesh Med Res Counc Bull 2002; 28(1)**:** 7-18.
11. Chadban SJ, Briganti EM, Kerr PG, Dunstan DW, Welborn TA, Zimmet PZ and Atkins RC. Prevalence of kidney Damage in Australian Adults: The AusDiab Kidney Study. J Am Soc Nephrol 2003; 14:S131-S138.
12. Coresh J, Brad CA, Astro, Greene T, Eknoyan G, Levy AS. Prevalence of chronic kidney disease and decreased kidney function in the adult US population: The Third National Health and Nutrition Examination Survey. Am J kidney Dis 2003; 41(1):1-12.
13. Patel HR, Pruchnicki MC, Hall LE. Assessment for chronic kidney disease service in high-risk patient at community health clinics. Ann Pharmacother 2005; 39: 22-27.
14. Viktorsdottir O, Palson R, Andresdottir MB, Aspelund T, Gudnason V, Indridason OS. Prevalence of chronic kidney disease based on estimated glomerular filtration rate and proteinuria in icelandic adults. Neprhol Dial Transplant 2005; 20: 1799-1807.
15. Brown WW, Collins A, Chen SC, King K, Molony D, Gannon MR, Politoski G and Keane WF. Identification of persons at high risk for kidney disease via targeted screening: The NKF Kidney Early Evaluation Program. Kidney Int 2003; 83: S-50-55.