Burden of Chronic Kidney Disease in Iran
A Screening Program is of Essential Need

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Introduction. The latent nature of chronic kidney disease (CKD) in primary stages precludes early diagnosis. This necessitates plans such as screening, but we should first introduce CKD as a public health problem. This study was designed to define the burden of CKD in Iran.

Materials and Methods. We calculated disability-adjusted life years (DALYs) according to the World Health Organization's practical guidelines for national burden of disease studies. The sum of years of life lost and years lived with disability were estimated for CKD stages 1 to 4 and end-stage renal disease (ESRD) based on the national registry data and the published reports about CKD in Iran in 2004.

Results. Over 700 000 people were estimated to have CKD in Iran in 2004 and 61 000 new cases of CKD were anticipated. The prevalence rate of CKD was estimated to be 1083 and its incidence rate was 173.5 per 100 000 population. Chronic kidney disease was responsible for 1 145 654 DALYs. The highest DALYs for stages 1 to 4 of CKD were due to unknown etiology, diabetes mellitus, and hypertension (382 000 years, 347 400 years, and 311 800 years, respectively). The DALY for ESRD and CKD stages 1 to 4 were 21 490 years and 1 124 164 years, respectively.

Conclusions. The present study provides an estimate of the burden of CKD in Iran. As CKD can be controlled by practical cost-effective plans, we strongly recommend the information given by this study be considered for future action plans.

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INTRODUCTION

Chronic kidney disease (CKD), while taken for granted in most healthcare systems, encompasses a diverse group of conditions that have a major impact on health. Notwithstanding the proven effect of preventive and therapeutic measures in controlling progression of the disease, the latent nature of CKD in its primary stages precludes prompt diagnosis and treatment.[1] This has emerged interventional strategies such as screening programs. However, contradiction exists about the priority of healthcare allocation for controlling the CKD in most national health policies.

Health problems or conditions are considered public health issues when 4 criteria are met[1,2]: first, when the disease burden is high; second, when the problem is distributed unfairly in a community; third, when there is evidence that the upstream preventive strategies can substantially reduce the burden of the condition; and fourth, when evidence

shows that such preventive strategies are not yet in place. There are now more than 24 000 people with end-stage renal disease (ESRD) in Iran, and their number has drastically increased over the recent years.[3] Patients with ESRD constitute the tip of an iceberg of patients with varying degrees of CKD. This can outline the tremendous burden of CKD. However, we lack information to define this burden in Iran and rationalize at least the first of the above criteria.

Information by which we can precisely describe the health problems of a population is the cornerstone for determining public health priorities. Mortality data has traditionally been used to assess the level of disease in a population. Nonetheless, mortality figures do not capture the huge toll of sickness and disability caused by diseases. Chronic kidney disease, for instance, is accompanied by long-term disability and complications that impose a high expenditure to the patient and disfigure years of healthy life, in addition to the high risk of death. In the recent years, considerable international efforts have been put into the development of summary measures of population health that combine information on mortality and non-fatal health outcomes into a single measure.[4,5] In 1992, the World Bank sponsored a study to assess the global burden of disease (GBD) in collaboration with the World Health Organization and the Harvard School of Public Health.[6,7] In an attempt to generate a comprehensive and consistent set of estimates of mortality and morbidity,[6-8] the GBD study also introduced a new metric *the disability-adjusted life year* (DALY) to quantify the burden of a disease. The DALY comprehends both years of life lost (YLL) because of premature death and years of healthy life lost as a result of disability (YLD).[8] Burden of a disease is the gap resulted from that disease between current health status and an ideal situation where everyone lives into old age free of disease and disability, and 1 DALY can be thought of as one lost year of healthy life.[8] In accordance with the practical guidelines for national burden of disease studies,[9] we designed this study to estimate the burden of CKD in Iran, using the DALY.

MATERIALS AND METHODS

Disease Categories

We categorized CKD into 2 groups: CKD stages 1 to 4 and CKD stage 5, namely ESRD. A total of 10 subgroups were assessed: CKD stages 1 to 4 were assessed in 7 subgroups according to the major etiologies[10,11]: diabetes mellitus (DM), hypertension, glomerulonephritis, adult polycystic kidney disease (ADPKD), uronephropathy, genetic disorders, and unknown cause (Table 1). End-stage renal disease was assessed in 3 subgroups based on the treatment options: hemodialysis, peritoneal dialysis, and kidney transplantation. We calculated the DALY for each of the above conditions and for CKD as a whole. Data were also disaggregated into 5 age groups (0 to 20 years, 21 to 40 years, 41 to 60 years, 61 to 80 years, and > 80 years) and into men and women.

Collection of Data on Chronic Kidney Disease in Iran

Review of the Literature. An extensive review of the literature was conducted on the epidemiology of CKD in Iran. The keywords "chronic kidney disease," "chronic renal failure," "end-stage renal disease," and "kidney transplantation" in combination with the word "Iran" were searched. To include articles not listed in the international indexes, an extensive hand searching was done and the authors were requested to provide the researchers of this study with copies of their published manuscripts, where copyright would not be violated.

We used a National Research Center,[13] the Medline,[14] and the Science Citation Index.[15] Over 2000 issues of 94 Persian-language medical journals were addressed manually in the Medical College Library of Tehran University, Iran University Reference Medical Library, and the Library of the Urology and Nephrology Research Center. A total of 70 articles were reviewed.

National Databases of Health Status. The database of the Transplantation Management Center of Ministry of Health was used for this

Table 1. Initiating Factors of Chronic Kidney Disease in Iran[12]

Etiology	Percentage
Unknown	27.4
Diabetes Mellitus	23.7
Hypertension	22.1
Glomerulonephritis	9.5
ADPKD*	4.4
Uronephropathy	6.5
Congenital Disorders	0.9
Others	5.5

*ADPKD indicates autosomal dominant polycystic kidney disease.

study. In this database, all patients with ESRD who undergo hemodialysis, peritoneal dialysis, and kidney transplantation are registered. The goal of the analyses of these data was to develop estimates of the prevalence and incidence of CKD stage 5 in Iran. For other stages of the CKD, we used data from some population-based studies,[16,17] hospital-based studies,[18-25] and the mortality data from the Vital Registry System.[26] We also used a study in the United States[27] for estimation of the prevalence of CKD stages 1 to 4.

Assessment and Revision of Estimates

After all analyses were completed, the reliability and validity of the data were assessed. We designed a questionnaire on the epidemiological parameters and sent it to 13 nephrologists in Iran. The comparable data from this survey were used to validate findings from the analyses of the literature and the available databases.

The unweighted cell count for each variable, the overall age distribution of the data set, and the methods used in sampling the population were all considered in selecting the definitive source for CKD data point. We checked data consistency and quality with these methods: internal consistency by using a disease modeling software (DisMod II, a computer software program developed for the GBD)[9]; and adjusting for nonrepresentativeness plausibility with nephrologists' consultation.

Computing National Disability Weights

The term *disability weight* (DW) is used broadly in burden of disease analyses to refer to departures from optimal health in any of the important domains of health.[5] Only the DW of ESRD and acute glomerulonephritis are defined in GBD 2000.[9] We designed a questionnaire to define the DW of CKD by their impact on health. The questionnaire was filled out by 8 nephrologists. The 6 dimensions of health including mobility, self-care, participation in daily activities, pain and discomfort, anxiety and depression, and cognition were used to define the DW of CKD. Each dimension was scored from zero to 10. Zero was considered "no problem" and 10, "severe problems." Accordingly, the DW of each disease category was scored from zero to 60. Then, we recoded these to a proportion between zero and 1. The calculated DWs of CKD are listed in Table 2.

Table 2. Epidemiological Estimations for Chronic Kidney Disease in 2004 in Iran*

Disease Categories	New Cases	Mean Age of Onset, y	Expected Duration, y	Deaths
	Men			
CKD due to DM	14 044	46.6	7.5	10 213
CKD due to hypertension	13 101	46.6	7.5	9524
CKD due to glomerulonephritis	5650	46.7	7.5	0
CKD due to ADPKD	2621	46.7	7.5	1899
CKD due to uronephropathy	3869	46.7	7.5	0
CKD due to congenital diseases	539	46.5	7.5	391
CKD due to unknown cause	16 220	46.6	7.5	11 803
ESRD with hemodialysis	2552	53.6	2.7	396
ESRD with peritoneal dialysis	130	53.4	2.1	32
ESRD with transplantation	1045	40.0	7.5	178
	Women			
CKD due to DM	13 003	46.3	7.6	8189
CKD due to hypertension	10 500	46.3	7.6	7636
CKD due to glomerulonephritis	4526	46.4	7.6	0
CKD due to ADPKD	2099	46.4	7.5	1522
CKD due to uronephropathy	3098	46.4	7.6	0
CKD due to congenital diseases	432	46.2	7.5	314
CKD due to unknown cause	13 003	46.3	7.6	9463
ESRD with hemodialysis	1822	52.4	3.0	317
ESRD with peritoneal dialysis	96	49.6	2.5	27
ESRD with transplantation	694	37.9	7.4	112

*CKD indicates chronic kidney disease; DM, diabetes mellitus; ADPKD, autosomal dominant polycystic kidney disease; and ESRD, end-stage renal disease.

Data Analysis With DisMod II

Since information on the age of onset and duration of the disease were not available directly from disease registers or epidemiological studies (only prevalence or incidence data were available), the DisMod-II software was used to model the average age of onset and expected duration of disease from estimates of prevalence, incidence, remission, and mortality.[9] The estimated population and overall mortality rate in Iran by age and sex groups were used in the DisMod II analyses. The total Iranian population was 66 518 224 (33 621 920 men and 32 896 304 women) in 2004, and the mortality rate was 5.29 per 1000 in men and 4.03 per 1000 in women.[28]

Computing the Disability-Adjusted Life Year

The DALYs were calculated as the sum of the YLL in the population and the YLD for incident cases of the CKD.[5] Where remission rates and/or case fatality rates were not known, they were estimated from the available evidence. We also used the estimated life table of the Iranian population.[29] The life expectancy was 70 year for men and 68 year for women.[29]

Statistical Methods

The collected data were analyzed with DisMod II, and the output of DisMod II was sent to the Microsoft Excel software for computing the DALY. The following formulas were used to calculate this indicator[5]:

DALY = YLD + YLL

YLD = number of incident cases × average duration (years) × DW

$$YLL(r,K)=\frac{KCe^{ra}}{(r+\beta)^2}e^{-2}\left[[-z-1]-e^{-(r+\beta)}[-(r+\beta)a-1]\right]+\frac{1-K}{r}(1-e^{rL})$$

The DALY's assumptions were β (Standard age weights) = 0.04, r (standard discount rate) = 0.03, C (standard age weights) = 0.1658, and K (full age weights) = 1.

RESULTS

It was estimated that over 700 000 people had CKD in Iran in 2004 and 61 000 new cases of CKD were developed. The prevalence rate of CKD was estimated to be 1197 and 980 per 100 000 men and women population, respectively, and its incidence rate was 190 and 157 per 100 000 men and women population, respectively (Tables 2, 3, and 4). Overall, the prevalence rate of CKD was estimated to be 1083 and its incidence rate was 173.5 per 100 000 population.

The DWs for stages 1 to 4 of CKD in each etiologic group and ESRD in each treatment group were estimated. The DWs of CKD in stages 1 to 4 were determined between 0.064 and 0.153. The DW for ESRD with hemodialysis and peritoneal dialysis was 0.155 and 0.118, respectively, and it was 0.047 for ESRD with transplantation (Table 5).

The YLD, YLL, and DALY were calculated according to the above estimations (Table 6). Chronic kidney disease was responsible for 1 145 654 DALYs (life years lost due to CKD in 2004 in Iran). The highest DALYs for stages 1 to 4 of CKD were due to unknown etiology, DM, and hypertension (382 000 years, 347 400 years, and 311 800 years, respectively). The DALY for ESRD and stages 1 to 4 of CKD were 21 490 years and 1 124 164 years, respectively.

DISCUSSION

In the present study, the total burden of CKD in 2004 was estimated to be over 1 145 600 years in Iran. It means more than 1 million healthy lives are lost every year due to CKD. The total DALY per 1000 population was 17.22 years. This indicator is smaller for most major cancers.[30,31] For example, the DALY for breast cancer in a European population was 6.07 years per 1000 population.[31] Information on the burden of diseases in Iran are limited. The reported DALY for osteoporosis in Iran is 0.5 years per 1000 population.[32] Also, in another recent report, the DALYs for diabetes and its complications were 3.5 and 4.7 years.[33]

We had to estimate the incidence and prevalence rates of CKD stages 1 to 4. Also, lack of data did not let us estimate factors such as the average onset age for CKD caused by each known underlying disease. The estimates by the DisMod-II software, although not realistic in some cases, can be an acceptable base for calculation of DALY. Another challenge was the local DWs. Only the DWs of ESRD and acute glomerulonephritis are defined in GBD 2000.[9] We used a zero-to-10 scoring system instead of a 3-level conventional method. However, there was a relatively great diversity between the nephrologists' opinions. Estimation of DWs needs a more accurate

Table 3. Estimation of Prevalence and Incidence Rates of Chronic Kidney Disease Stages 1 to 4 in Iran per 100 000 People in 2004 Categorized by Age*

Age Groups, y	Prevalence Rate			Incidence Rate		
	Men	Women	Total	Men	Women	Total
CKD Due to DM						
0 to 20	57.5	54.7	56.1	8.9	8.5	8.7
21 to 40	244.6	174.9	209.7	37.9	27.1	32.5
41 to 60	686.1	559.0	622.6	106.3	86.6	96.5
61 to 80	1330.3	1107.0	1222.0	206.2	171.6	189.4
> 80	226.2	197.6	211.7	35.1	30.6	32.8
All ages	293.2	236.0	264.9	45.4	36.6	41.1
CKD Due to Hypertension						
0 to 20	53.6	51.0	52.3	8.3	7.9	8.1
21 to 40	228.0	163.1	195.5	35.3	25.3	30.3
41 to 60	639.8	521.3	580.6	99.2	80.8	90.0
61 to 80	1240.5	1032.3	1139.5	192.3	160.0	176.6
> 80	210.9	184.2	197.4	32.7	28.6	30.6
All ages	273.4	220.1	247.0	42.4	34.1	38.3
CKD Due to Glomerulonephritis						
0 to 20	23.0	21.9	22.5	3.6	3.4	3.5
21 to 40	98.0	70.1	84.1	15.2	10.9	13.0
41 to 60	275.0	224.1	249.6	42.6	34.7	38.7
61 to 80	533.2	443.7	489.8	82.6	68.8	75.9
> 80	90.7	79.2	84.8	14.1	12.3	13.2
All ages	117.5	94.6	106.2	18.2	14.7	16.5
CKD Due to ADPKD						
0 to 20	10.7	10.2	10.4	1.7	1.6	1.6
21 to 40	45.4	32.5	38.9	7.0	5.0	6.0
41 to 60	127.4	103.8	115.6	19.7	16.1	17.9
61 to 80	247.0	205.5	226.9	38.3	31.9	35.2
> 80	42.0	36.7	39.3	6.5	5.7	6.1
All ages	54.4	43.8	49.2	8.4	6.8	7.6
CKD Due to Uronephropathy						
0 to 20	15.8	15.0	15.4	2.4	2.3	2.4
21 to 40	67.1	48.0	57.5	10.4	7.4	8.9
41 to 60	188.2	153.3	170.8	29.2	23.8	26.5
61 to 80	364.8	303.6	335.1	56.5	47.1	51.9
> 80	62.0	54.2	58.1	9.6	8.4	9.0
All ages	80.4	64.7	72.7	12.5	10.0	11.3
CKD Due to Congenital Diseases						
0 to 20	2.2	2.1	2.1	0.3	0.3	0.3
21 to 40	9.3	6.6	8.0	1.4	1.0	1.2
41 to 60	26.1	21.2	23.6	4.0	3.3	3.7
61 to 80	50.5	42.0	46.4	7.8	6.5	7.2
> 80	8.6	7.5	8.0	1.3	1.2	1.2
All ages	11.1	9.0	10.1	1.7	1.4	1.6
CKD Due to Unknown Cause						
0 to 20	2.2	2.1	2.1	0.3	0.3	0.3
21 to 40	9.3	6.6	8.0	1.4	1.0	1.2
41 to 60	26.1	21.2	23.6	4.0	3.3	3.7
61 to 80	50.5	42.0	46.4	7.8	6.5	7.2
> 80	8.6	7.5	8.0	1.3	1.2	1.2
All ages	11.1	9.0	10.1	1.7	1.4	1.6
CKD Stages 1 to 4						
Total	1169	941	1056	181	146	164

*CKD indicates chronic kidney disease; DM, diabetes mellitus; and ADPKD, autosomal dominant polycystic kidney disease.

Table 4. Estimation of Prevalence and Incidence Rates of End-Stage Renal Disease in Iran per 100 000 People in 2004 Categorized by Age*

Age Groups, y	Prevalence Rate			Incidence Rate		
	Men	Women	Total	Men	Women	Total
ESRD With Hemodialysis						
0 to 14	0.8	1.0	0.9	0.5	0.6	0.5
15 to 24	4.0	5.4	4.7	1.7	2.6	2.2
25 to 44	11.9	16.4	14.1	4.1	6.4	5.2
45 to 64	52.3	59.2	55.7	19.4	24.3	21.8
65 to 74	99.9	122.5	111.7	37.2	45.8	41.7
≥ 75	73.4	127.3	100.3	21.9	49.4	35.6
All ages	15.0	18.8	16.9	5.5	7.6	6.6
ESRD With Peritoneal Dialysis						
0 to 14	0.0	0.0	0.1	0.0	0.0	0.0
15 to 24	0.0	0.0	0.1	0.1	0.1	0.1
25 to 44	0.1	0.1	0.2	0.3	0.3	0.3
45 to 64	0.2	0.2	0.4	1.0	1.4	1.2
65 to 74	0.1	0.1	0.2	1.4	1.8	1.6
≥ 75	0.0	0.0	0.1	1.1	2.6	1.9
All ages	0.5	0.5	1.0	0.3	0.4	0.3
ESRD With Transplantation						
0 to 14	0.9	1.1	0.6	0.3	0.2	0.3
15 to 24	7.3	9.9	5.0	1.7	2.0	1.8
25 to 44	20.1	33.3	16.6	3.3	5.3	4.3
45 to 64	37.1	57.7	28.8	5.4	8.5	7.0
65 to 74	10.3	21.5	11.3	1.1	2.9	2.0
≥ 75	2.4	2.6	1.3	0.9	0.0	0.4
All ages	12.5	19.4	9.8	2.1	3.1	2.6
ESRD						
Total	28.2	39.0	27.4	7.9	11.1	9.5

*The age groups in the database of *the Transplantation Management Center of Ministry of Health* were different from our classification.

Table 5. Disability Weight of Chronic Kidney Disease (CKD)

CKD Categories	Disability Weight*
CKD due to diabetes mellitus	0.153 ± 0.046
CKD due to hypertension	0.085 ± 0.145
CKD due to glomerulonephropathy	0.064 ± 0.001
CKD due to ADPKD	0.068 ± 0.050
CKD due to uronephropathy	0.068 ± 0.001
CKD due to congenital disease	0.072 ± 0.084
CKD due to unknown cause	0.066 ± 0.046
ESRD with hemodialysis	0.155 ± 0.153
ESRD with peritoneal dialysis	0.118 ± 0.019
ESRD with kidney transplantation	0.047 ± 0.050

*Values are demonstrated as mean ± standard deviation. ADPKD indicates autosomal dominant polycystic kidney disease.

scale and further national and international studies on the DWs of nephrological diseases are warranted. The results in this study can provide the basis of the future investigations in this regard.

The main burden was due to the CKD stages 1 to 4; they caused over 1 124 000 years lost annually. The main causal factors of CKD in Iran are DM and hypertension regardless of the unknown causes.[20] These two are associated with a series of complications that involve a significant portion of the healthcare system. However, CKD is usually neglected in the therapeutic protocols of these diseases, while it needs a more comprehensive treatment. It has been shown that in the United States, urine protein is checked for only 59% of hypertensive patients and 62% of diabetic ones.[34] On the other hand, CKD with unknown cause is a matter of concern. According to our findings, it constitutes nearly one-third of the burden of CKD, and unfortunately, it is mostly diagnosed in the higher stages, when symptoms are present. We speculate that these CKD cases might be due to glomerulonephritis that have yielded atrophic and sclerosing kidneys (high stages) when detected. We cannot provide enough evidence for it, but it is rational to conclude that the main burden is related to stages 3 and 4, but not 1 and 2.

Patients with CKD are at the risk of many complications such as cardiovascular disease (CVD) that is 10 to 30 times more than that for

Table 6. Years Lost as a Result of Disability (YLD), Years of Life Lost (YLL), and Disability-Adjusted Life Year (DALY) of Chronic Kidney Disease in Iran*

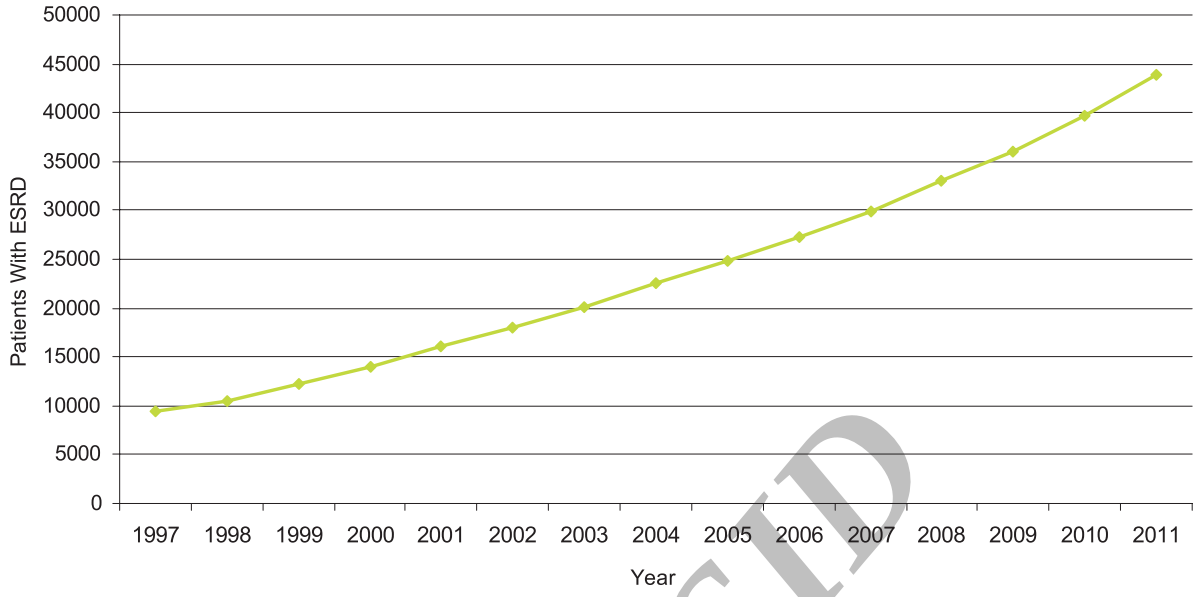
CKD Categories	YLD			YLL			DALY			DALY Per Case			DALY Per 100 000 Population		
	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
CKD stages 1 to 4															
CKD due to diabetes mellitus	16 225	13 013	29 238	172 956	145 160	318 117	189 182	158 173	347 355	13	14	14	563	481	522
CKD due to hypertension	8405	6742	15 147	161 297	135 409	296 706	169 701	142 151	311 853	13	14	13	505	432	469
CKD due to glomerulonephritis	2767	2219	4986	0	0	0	2767	2219	4986	1	1	1	8	7	8
CKD due to ADPKD	1338	1074	2412	32 131	26 990	59 120	33 469	28 063	61 532	13	13	13	99	85	93
CKD due to uronephropathy	1981	1588	3569	0	0	0	1981	1588	3569	1	1	1	6	5	5
CKD due to genetic	287	229	516	6645	5610	12 255	6931	5839	12 771	13	14	13	21	18	19
CKD due to unknown cause	7970	6392	14 362	199 937	167 799	367 735	207 907	174 190	382 097	13	13	13	618	529	574
CKD stage 5															
ESRD with hemodialysis	1099	861	1960	6297	5153	11 449	7396	6013	13 409	3	3	3	22	18	20
ESRD with peritoneal dialysis	35	28	63	549	534	1083	583	562	1146	5	6	5	2	2	2
ESRD with transplantation	436	282	718	3757	2460	6218	4193	2743	6935	4	4	4	12	8	10
Total	40 542	32 428	72 970	583 568	489 115	1 072 683	624 110	521 543	1 145 654	...	...	...	1856	1585	1722

*CKD indicates chronic kidney disease; ADPKD, autosomal dominant polycystic kidney disease; and ESRD, end-stage renal disease. Ellipses indicate not applicable.

people without kidney disease.[35] In 2001, the total expenditures (Medicare plus private payers) exceeded US $ 22 billion in the United States. In addition, recent data from the United States Renal Data System (USRDS) indicate that the total healthcare resources used for patients with CKD are 1.6 to 2.4 times (or more) larger than those used by the ESRD population.[36] The increase in the incidence of ESRD could have resulted from increases in the pool of patients with CKD, increases in the rate of their disease progression, decreases in competing mortality, and/or increasing treatment availability. We did not estimate the DWs, and subsequently, the DALYs for each stage of CKD; however, CKD stages 1 and 2 must be responsible for a very small portion of the burden of CKD stages 1 to 4, as they are usually asymptomatic and the patient appears to be healthy. Thus, efforts to stop or at least slow down the progression of CKD in its lower stages can reduce the overall burden of CKD to a great extent.

Our estimation of the burden of ESRD was about 21 500 years. In Iran, there were 17 000 patients with ESRD in 2002 and we have witnessed an average 15% increasing rate every year.[3] It is anticipated that the total number of patients affected by ESRD will reach more than 43 000 by the end of 2011 (Figure). Also in the United States, the annual new cases of ESRD increased from approximately 14 500 in 1978 to 100 359 in 2002; during the same period, the number of individuals on dialysis or with kidney transplant increased from 42 000 to 431 000.[37,38] On the other hand, ESRD is the final stage of a usually prolonged disease. Thus, we should note that the smaller DALY estimated does not contain the previous stages of the disease. Each patient experiences CKD stages 1 to 4, and then ESRD and transplantation. Even they may return to the CKD stages and impose a considerable DALY. Hence, a patient with ESRD has lost considerable years of healthy living in addition to those as a result of ESRD per se.

Total accumulative number of kidney transplantations up to the end of 2004 in Iran has been 17 718, from which 1739 have been performed in year 2004 (694 women and 1045 men).[3] It seems that despite a successful transplant program in Iran, this replacement therapy cannot keep up with the accelerating incidence of ESRD in the upcoming years. Kidney transplantation provides a much



Trend and estimation of the number of patients with end-stage renal disease (ESRD) in Iran from 1997 to 2011 (with permission from the Transplantation Management Center of Ministry of Health, unpublished data).

better quality of life for the patient. However, the burden of disease is not reduced overall. The DW for ESRD with kidney transplant is much less than that of ESRD with dialysis, but the patients' survival rate after transplantation increases[18,21]; thus, the longer duration of the situation leads to a considerable DALY. This has been reflected in our findings. The expected duration of life was over 7 years in transplanted patients but 2 to 3 years in those under long-term dialysis.

International data suggest that CKD is a worldwide public health problem.[1,10] We believe that also in Iran, it meets the first criterion for consideration as a public health issue. Even a more threatening situation is on the way if we do not act immediately. The Iranian population is one of the youngest in the world. By decreasing of the growth rate, it is anticipated that in the next decades, the main age groups will shift to the higher ones. We will face a large population of the elderly in whom DM, hypertension, and CKD are frequent. Thus, even if our figures are overestimated now, in the near future, the burden of CKD will be much more than this. Age alone is a key predictor of CKD.[39] The highest incidence and prevalence rates of CKD were among the 40- to 60-year-old groups. A drastic increase can be predicted when the young population of Iran reaches these age groups.

For the second criterion of public health issues (see the introduction section of this article), we do not have enough information, but it has been noted that CKD is associated with racial and ethnic minorities.[1] In addition, the high costs of the disease for a long period affects the economy of the families, while healthcare strategies are not yet enough supportive for these patients. It seems that the other two criteria are satisfied by CKD[1]; planning for practical nationwide strategies for reduction of the burden of CKD is now feasible, but has not been implemented as an upstream preventive strategy. Therapeutic measures can delay progression of the disease. As well as the treatment of the underlying diseases, prevention and treatment of the complications can be of essential effect.[10] A meticulous control of blood glucose and blood pressure and administration of angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers are the main components of treatment practices.[1,10] The considerable effects of these measures is documented in many studies.[10,40] However, patients with CKD still receive suboptimal care, emerging a comprehensive plan for the promotion of the patients and the physicians' awareness.[1]

It has been shown that investment on the treatment of CKD can be very cost-effective. In 2000, Trivedi and colleagues estimated that a 30% reduction in the decreasing rate of glomerular filtration rate in the United States can save up to US $ 60 billion by 2010 for this country.[41] A

prerequisite for preventive care practices—a key element—is the early diagnosis of CKD, before the referral of symptomatic patients in the end stages of the disease. Individuals at the risk of CKD must be evaluated for decreased glomerular filtration rate, proteinuria, and hematuria. Accordingly, screening programs, their cost-effectiveness, and their target groups are recently considered.[40,42,43] Determination of serum creatinine level and testing a spot urine sample for albumin-creatinine ratio can easily detect most cases of CKD. Patients with DM and hypertension should be diagnosed as soon as possible and followed up for their kidney function. Furthermore, we can prevent the progression of CKD stages 1 and 2 in patients with the *unknown cause* who are nearly one-forth of the 700 000 population of patients with CKD. This needs an extended target group for screening program and it is of course worth. The tremendous burden of CKD can be minimized, thus preventing from encountering the disastrous perspective.

CONCLUSIONS

The present study provides a rough estimate of the burden of CKD in Iran. Lack of corroborative evidence has postponed effectual action to prevent and treat CKD. We acknowledge that more precise information is still required, but our rough estimate of the burden of the disease is significant enough to accelerate national measures against CKD. Fortunately, CKD can be prevented, treated, and controlled by practical cost-effective plans. Thus, we strongly recommend the information given by this study be considered for future action plans. Iran has still a young population and the prevalence rates of diseases such as DM and hypertension are relatively lower than those of developed countries. As a consequence, we feel that the need for strategies such as screening programs in the at risk populations should be considered before encountering a tremendous burden caused by the aged Iranian population with hypertension and DM in the near future.

CONFLICT OF INTEREST

None declared.

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REFERENCES

1. Schoolwerth AC, Engelgau MM, Hostetter TH, et al. Chronic kidney disease: a public health problem that needs a public health action plan. Prev Chronic Dis. 2006;3:A57.
2. Vinicor F. Is diabetes a public-health disorder? Diabetes Care. 1994;17 Suppl 1:22-7.
3. Ghods AJ. Governed financial incentives as an alternative to altruistic organ donation. Exp Clin Transplant. 2004;2:221-8.
4. Field MJ, Gold GM. Summarizing population health: directions for the development and application of population metrics. Washington DC: National Academy Press; 1998.
5. Salomon JA, Murray CJL. Estimating health state valuations using a multiple-method protocol. In: Murray CJL, Salomon JA, Mathers CD, Lopez AD, editors. Summary measures of population health: concepts, ethics, measurement and applications. Geneva: World Health Organization; 2002. p. 487-98.
6. World Bank. World Development Report 1993. Investing in health. New York: Oxford University Press for the World Bank; 1993.
7. Murray CJ, Lopez AD, Jamison DT. The global burden of disease in 1990: summary results, sensitivity analysis and future directions. Bull World Health Organ. 1994;72:495-509.
8. Murray CJ, Lopez AD. Evidence-based health policy--lessons from the Global Burden of Disease Study. Science. 1996;274:740-3.
9. Mathers CD, Vos T, Lopez AD, Salomon J, Ezatti M. National burden of disease studies: a practical guide. 2nd ed. Geneva: World Health Organization; 2001.
10. National Kidney Foundation. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification and stratification. Am J Kidney Dis. 2002;39:S1-266.
11. Einollahi B, Nafar M, Khatami MR, Lesan Pezeshki M, Bakhtiari P, Aghighi M. One year outcome of hemodialysis patient in Iran. Iran J Urol. 2000;26:11-6.
12. Haghighi AN, Broumand B, D'Amico M, Locatelli F, Ritz E. The epidemiology of end-stage renal disease in Iran in an international perspective. Nephrol Dial Transplant. 2002;17:28-32.
13. Iranian Research Institute for Scientific Information and Documentation [cited April 2006]. IRANDOC. Available

from: http://www.irandoc.ac.ir

14. Pubmed. A service of the National Library of Medicine and the National Institutes of Health [cited June 2005]. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi
15. Scientific citation index [cited June 2005]. Available from: http://scientific.thomson.com/products/sci/
16. Einlollahi B, Nafar M, Bakhtiari S, Hajarizadeh B, Aghighi M. Screening of chronic renal failure in Tehran province. Kousar Med J. 2003;2:139-43.
17. Madani K, Otoukesh H, Rastegar A, Van Why S. Chronic renal failure in Iranian children. Pediatr Nephrol. 2001;16:140-4.
18. Simforoosh N, Basiri A, Fattahi MR, et al. Living unrelated versus living related kidney transplantation: 20 years' experience with 2155 cases. Transplant Proc. 2006;38:422-5.
19. Rezaei M, Kazemnegad A, Reisei D, Bardideh A. Survival analysis of renal transplantation in Kermanshah (1989-2001). Behbood. 2003;7:27-41.
20. Kazemeini SM, Nafar M, Aghighi M, Heidari AR. The status of renal replacement therapy in Iran. Hakim. 2003;6:7-10.
21. Einollahi B. Iranian experience with the non-related renal transplantation. Saudi J Kidney Dis Transpl. 2004;15:421-8.
22. Pour-Reza-Gholi F, Nafar M, Saeedinia A, et al. Kidney retransplantation in comparison with first kidney transplantation. Transplant Proc. 2005;37:2962-4.
23. Makhtoomi KH, Taheri SH, Abdi E, et al. Impact of non-medical factors on patient survival on continuous ambulatory peritoneal dialysis: a multicenter study. Abstract book, 9th Annual Iranian Congress of Nephrology, Dialysis, and Transplantation; 15-19 April 2005, Tehran, Iran: 78.
24. Firoozan A, Hosseini Moghaddam SM, Einollahi B, et al. Outcome of Kaposi's sarcoma and graft following discontinuation of immunosuppressive drugs in renal transplant recipients. Transplant Proc. 2005;37:3061-4.
25. Nafar M, Einollahi B, Hemati K, Gholi FP, Firouzan A. Development of malignancy following living donor kidney transplantation. Transplant Proc. 2005;37:3065-7.
26. Naghavi M. Mortality views in 18 provinces in Iran-2001. Research and Development Office. Health Network Development and Health Promotion Center. Ministry of Health and Medical Education; 2003. p. 102-20.
27. Coresh J, Byrd-Holt D, Astor BC, et al. Chronic kidney disease awareness, prevalence, and trends among U.S. adults, 1999 to 2000. J Am Soc Nephrol. 2005;16:180-8.
28. Statistical Centre of Iran. Iran Statistical Year Book 1383 [cited April 2006]. Available from: http://amar.sci.org.ir/index_e.aspx
29. United Nations Development Programme. Human Development Report 2003. Human development indicators [cited April 2006]. Available from: http://hdr.undp.org/reports/global/2003/pdf/hdr03_HDI.pdf
30. Yoon SJ, Lee H, Shin Y, Kim YI, Kim CY, Chang H. Estimation of the burden of major cancers in Korea. J Korean Med Sci. 2002;17:604-10.
31. Vlajinac H, Sipetic-Grujicic S, Jankovic S, et al. Burden of cancer in Serbia. Croat Med J. 2006;47:134-41.
32. Abolhassani F, Mohammadi M, Soltani A. Burden of Osteoporosis in Iran. Iran J Public Health. 2004;Suppl:18-28.
33. Abolhasani F, Mohagerie Tehrani MR, Tabatabaei O, Larijani B. Burden of diabetes and its complications in Iran in year 2000. Iran J Diabetes Lipid. 2005;5:35-48.
34. McClellan WM, Knight DF, Karp H, Brown WW. Early detection and treatment of renal disease in hospitalized diabetic and hypertensive patients: important differences between practice and published guidelines. Am J Kidney Dis. 1997;29:368-75.
35. Sarnak MJ, Levey AS, Schoolwerth AC, et al. Kidney disease as a risk factor for development of cardiovascular disease: a statement from the American Heart Association Councils on Kidney in Cardiovascular Disease, High Blood Pressure Research, Clinical Cardiology, and Epidemiology and Prevention. Circulation. 2003;108:2154-69.
36. Hunsicker LG. The consequences and costs of chronic kidney disease before ESRD. J Am Soc Nephrol. 2004;15:1363-4.
37. US Renal Data System. USRDS 2004 Annual Data Report. Atlas of end-stage renal disease in the United States [cited April 2006]. Bethesda (MD): National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 2004. Available from: http://www.usrds.org/atlas_2004.htm
38. US Renal Data System. USRDS 2003 Annual Data Report. Atlas of end-stage renal disease in the United States [cited April 2006]. Bethesda (MD): National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 2003. Available from: http://www.usrds.org/atlas_2003.htm
39. Coresh J, Astor BC, Greene T, Eknoyan G, Levey AS. 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.
40. Rossert JA, Wauters JP. Recommendations for the screening and management of patients with chronic kidney disease. Nephrol Dial Transplant. 2002;17 Suppl 1:19-28.
41. Trivedi HS, Pang MM, Campbell A, Saab P. Slowing the progression of chronic renal failure: economic benefits and patients' perspectives. Am J Kidney Dis. 2002;39:721-9.
42. Boulware LE, Jaar BG, Tarver-Carr ME, Brancati FL, Powe NR. Screening for proteinuria in US adults: a costeffectiveness analysis. JAMA. 2003;290:3101-14.
43. de Jong PE, Brenner BM. From secondary to primary prevention of progressive renal disease: the case for screening for albuminuria. Kidney Int. 2004;66:2109-18.

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