Burden of Chronic Kidney Disease: An International Perspective

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CKD is associated with increased cardiovascular mortality and a loss of disability-adjusted life years. Diseases of the genitourinary system were responsible for 928,000 deaths and 14,754,000 disability-adjusted life years in 2004. However, the absence of kidney registries in most of the low- and middle-income countries has made it difficult to ascertain the true burden of CKD in these countries. The global increase in the incidence and prevalence of CKD is being driven by the global increase in the prevalence of diabetes mellitus, hypertension, obesity, and aging. Most patients in low- and middle-income countries die because they cannot access renal replacement therapy because of the exorbitant cost. Community surveys have shown that the number of people with end-stage kidney disease is just the tip of the "CKD iceberg." The preventive strategies to stem the tide of CKD should involve educating the population on how to prevent renal disease; identifying those at risk of developing CKD; raising the awareness of the general public, policy makers, and health care workers; modifying the lifestyle of susceptible individuals; detecting early stage of CKD; arresting or hindering the progression of disease; and creating facilities for global assistance.

Key Words: CKD, Burden, Incidence, Prevalence, International

Chronic kidney disease (CKD) is defined as a glomerular filtration rate (GFR) less than 60 mL/min/1.73 m^2 and/or kidney damage determined by abnormal findings in urine, such as proteinuria, albuminuria, hematuria, abnormal imaging, and/or histology, lasting for 3 months or more.[1] Chronic kidney failure or end-stage kidney disease (ESKD), which represents the end of the continuum of CKD, is a devastating medical, social, and economic problem for the patients, their families, and the country as a whole.[2] The burden of a disease can be quantified by the prevalence of the disease in a given population at a particular point in time, the mortality rate resulting from the disease and the disability-adjusted life years (DALYs). DALYs for a disease is the sum of the years of life lost because of premature mortality in the population and the years lost due to disability for incident cases of the disease.[3] One DALY can be thought of as one lost year of "healthy" life, and the burden of disease can be thought of as a measurement of the gap between current health status and an ideal situation in which everyone lives into old age free of disease and disability.[3]

According to the World Health Organization Global Burden of Disease (GBD) 2004 Update Report, diseases of the genitourinary system (GUS) were responsible for 928,000 (1.6%) deaths out of the total number of global deaths of 58,772,000 and were listed as the 19th leading cause of global death in 2004.[4] Also, diseases of the GUS accounted for 14,754,000 DALYs, which constituted 1% of the global 1,523,259,000 DALYs.[4] However, these values are likely an underestimation of the contribution of CKD to GBD in view of several reasons. First, the articulation of diseases of the GUS in the GBD report in only 2 specific cause groups, namely, "nephrosis and nephritis" and "benign prostatic hypertrophy," does not provide any significant insight into the contribution of specific kidney diseases to the GBD[2] and, second, an unknown proportion of people whose death and disability are attributed to cardiovascular disease have CKD because patients with CKD are 5 to 11 times more likely to suffer premature death than to progress to ESKD.[5] It can, therefore, be argued that a proportion of the 12.9 million deaths attributable to ischemic

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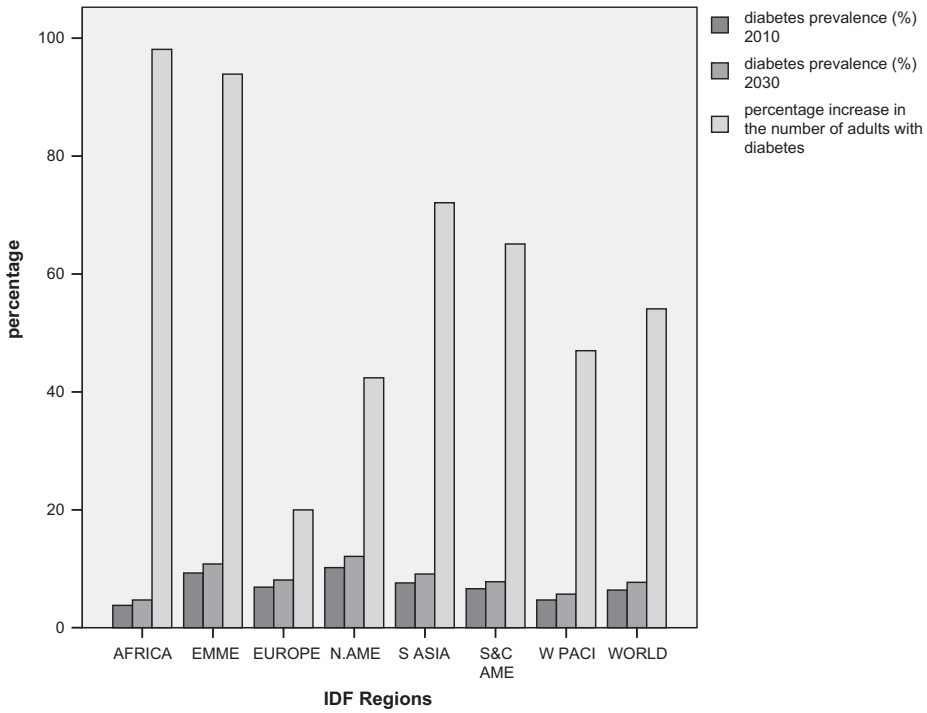

Figure 1. The estimated percentage prevalence of diabetes mellitus in 2010 and 2030 and the percentage increase in the number of adults with diabetes in different regions according to the International Diabetes Federation. (Data from Shaw et al.[8]) IDF, International Diabetes Federation; EMME, Eastern Mediterranean and Middle East; N.AME, North America; S Asia, South Asia; S&C AME, South and Central America; W PACI, Western Pacific.

heart disease and cerebrovascular disease,[4] which were the leading causes of global death in 2004, were likely caused by underlying CKD. Third, CKD likely contributed to the 2.04 million and 1.14 million deaths attributed to human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) and diabetes mellitus, respectively, because kidney involvement in these 2 conditions is common and adversely affects survival.

The high disease burden of CKD, its uneven distribution, the high cost of treatment, and the fact that preventive strategies although available are not yet fully in place in many countries and communities qualify CKD as a public health problem.[6] The global increase in the prevalence of CKD and its disproportionate burden on economically developing countries is being driven by an increase in the prevalence of the main risk factors for CKD, namely, diabetes, hypertension, obesity, increasing growth, and aging of the population.[1,7-12] Diabetes remains the leading cause of CKD globally and is estimated to presently affect 285 million adults aged 20 to 79 years.[7,8] This number is expected to rise by 54% to 439 million by 2030 according to the International Diabetes Federation.[8] The developing countries will account for 69%, whereas the expected increase in developed countries is 20%.[8] The biggest percentage increase in the prevalence of diabetes is expected to occur in Africa, Eastern Mediterranean, and Middle East and South Asia (Fig 1). An increase in the prevalence of hypertension from 972 million to 1.56 billion by 2025 is also projected, with 80% of the increase (639 million to 1.15 billion) occurring in economically developing nations.[9] The World Health Organization estimates that more than 1 billion people are overweight, with 300 million of them being clinically obese.[10] Also, the world population is projected to increase from 6.7 billion in 2008 to 8.3 billion in 2030,[11] and the proportion of the population aged ≥60 years has been rising

steadily from 8% in the 1950 to 11% in 2007 and is expected to reach 22% in 2050.[12] These changes in the distribution of risk factors and the populations at risk will all act in concert to drive the CKD epidemic.

Incidence, Prevalence, and Etiology of CKD in Different Parts of the World

The incidence of ESKD, which can be judged by the number of patients starting renal replacement therapy (RRT) in countries with good kidney registries, varies widely among different countries and among different races within the same country.[3] The prevalence of ESKD reflects the incidence and, more importantly, the survival of these patients after RRT (ie, dialysis or transplantation). It is projected that if the size of the ESKD population continues to rise at a rate of 7% per year, it will exceed 3 million patients by the year 2010, and the aggregate cost of treating ESKD will exceed US$1 trillion.[13] The total Medicare spending on ESKD in 2006 in the United States was US$23 billion, representing 6.4% of the entire Medicare budget.[14] The Australian Institute of Health and Welfare estimated that the total recurrent health expenditure on CKD in 2000 to 2001 was $647 million.[15] In Japan, the medical cost of ESKD is approximately 4.1% of the total health care budget, which amounted to more than 1000 billion yen (>10 billion US$).[16] The health care costs for kidney disease was 3.24% of the national expenditure for health services in Korea in 2004.[17]

There is a strong relationship between the prevalence rate of ESKD and gross domestic product per capita of the various countries.[18,19] At the end of 2004, 52% of the global dialysis population was treated in only 4 countries, namely, the United States, Japan, Brazil, and Germany.[19] With the exception of the high-income countries and few middle-income countries, reliable kidney registries are not available in most of the low- and middle-income countries (LMICs) because of poor infrastructural facilities.[2] In addition, an insignificant proportion of these patients report to the hospital, with even fewer numbers reporting to the tertiary centers. This dearth of national kidney registries makes estimation of the burden of ESKD in LMICs difficult. Thus, data from these regions are provided by small observational series or reports from personal experience of renal physicians.

The well-recognized risk factors for CKD include diabetes mellitus, hypertension, increasing age, family history of kidney disease, cigarette smoking, and dyslipidemia.[1,7,20] Others include exposure to heavy metals such as lead, low birth weight with a reduction in the number of nephrons, and the use of herbal remedies, particularly in Africa.[1,7] There have been reports of cortical necrosis with subsequent development of CKD after a snake bite.[21] The relative contribution of these factors to the etiologic burden of CKD varies from country to country.

Africa

According to the United Nations' Human Development Report of 2008 (which represents the statistical value for the year 2006), 25 of the 26 nations classified as having low human development using the Human Development Index were in Africa.[22] However, the economic and social transformation occurring in Africa is making most of the countries experience a polarized and protracted double burden of communicable and noncommunicable diseases (NCDs).[23]

The availability of RRT in sub-Saharan Africa (SSA) is limited by absent or restricted government funding or subsidy and health insurance to cover high costs of dialysis, paucity of dialysis units, restriction of these units to urban areas, and manpower shortage.[2] Most of the patients with chronic kidney failure in SSA cannot access RRT because of the cost. For example, the cost of a session of hemodialysis in Nigeria is US$100, which is twice the minimum wage paid to federal government workers. The estimated annual cost of dialysis in Africa varies between US$8000 to 12,000, which far exceeds the gross domestic product per capita of most of the African countries.[24,25] Funding for RRT is primarily private in much of Africa, with the government of only a few countries (eg, Mali, Mauritius, and South Africa) providing therapy for a small number of patients.[26] In many African countries, chronic dialysis is not sustainable, with patients unable to afford dialysis beyond the

first 2 to 3 months. In a cohort of Nigerian patients with ESKD, less than 2% were still on dialysis 12 months later.[27]

The current dialysis treatment rate ranges from 70 per million population (pmp) in South Africa to less than 20 pmp in most of SSA. Dialysis rates are 45 pmp for hemodialysis (HD) and 25 pmp for chronic ambulatory peritoneal dialysis (CAPD) for South Africa, 46 pmp for HD and 85 pmp for CAPD in Sudan, 7.5 pmp for HD and 1.2 pmp for CAPD in Kenya, 421 pmp for HD and 0.3 pmp for CAPD in Egypt, and 650 pmp for HD and 20 pmp for CAPD in Tunisia. The transplant rate in Africa averages 4 pmp and is 9.2 pmp in South Africa.[26]

The etiologies of ESKD vary in different parts of Africa. In tropical and East Africa, the commonest causes of ESKD are hypertension, glomerulonephritis, diabetes mellitus, and obstructive uropathy.[26,28] In a 6-year study of 3632 patients with ESKD based on the South African Dialysis and Transplant Registry statistics, hypertension was reported to be the cause of ESKD in 4.3% of whites, 34.6% of blacks, 20.9% of a mixed race group, and 13.8% of Indians.[26] A single-center review of 2442 patients over a 15-year period in South Africa showed that chronic glomerulonephritis accounted for 41% of all-cause ESKD followed by hypertension (15.8%) and diabetes mellitus (15.1%).[24] Glomerular disease is more prevalent in Africa than the Western countries and is characterized by a poor response to treatment and a progression to kidney failure.[26]

SSA bears a heavy burden of HIV/AIDS. Two thirds of the global total of 33 million people with HIV and almost 90% of the 2 million children younger than 15 years living with HIV live in SSA.[29] A variety of renal syndromes, which can be acute or chronic, are associated with HIV infection, of which HIV-associated nephropathy (HIVAN) is the commonest form of CKD reported in the published data.[30] Although the true prevalence of HIVAN in Africa and worldwide is unknown,[31,32] it is estimated that 3.5% to 12% of black Africans with HIV are at risk for developing HIVAN. The implication is that 1 to 3.5 million black Africans are likely to develop ESKD from HIVAN, an epidemic with which continent is ill equipped to deal.[31] However, with improvement in access to medical care, timely institution and sustenance of highly active antiretroviral therapy, and better nutrition, the catastrophic burden of HIVAN in SSA may be averted.[33]

Asia and Oceania

Many of the Asian countries are also undergoing epidemiologic transition, and communicable diseases are rapidly being replaced by chronic NCDs such as hypertension, diabetes, ischemic heart disease, cancers, and renal disease in parallel with a changing lifestyle, increasing urbanization, and socioeconomic changes.[34] RRT is not universally available in many countries, and there is a high rate of discontinuation of treatment with associated excess mortality. For example, less than 10% of patients with ESKD receive any form of RRT in India.[34]

With the exception of countries such as Japan, Taiwan, and Malaysia, the true incidence and prevalence of CKD in Asia is not known because of a lack of kidney registries in most of the countries. In 2007, the incidence and prevalence rates of ESKD in Taiwan, Japan, and Malaysia were 415, 361, and 143 and 2288, 2154, and 690 pmp, respectively.[35,36] In China, the incidence of ESKD is estimated to be 102 pmp.[37] A recent population-based study in Bhopal, India, put the crude and age-adjusted incidence rate of ESRD at 151 and 232 pmp, respectively.[38] The incidence of ESKD in Bangladesh varies between 100 and 200 pmp.[39]

The leading causes of ESKD in Asia are chronic glomerulonephritis, diabetic nephropathy, chronic interstitial nephritis, and nephrolithiasis.[39] However, there is a changing trend in the etiology of ESKD in Asia. Diabetic nephropathy is now the leading cause of incident ESKD in Japan (43.4% in 2007) and Malaysia (52% in 2005).[39] A reduction in the prevalence of glomerulonephritis and nephrolithiasis has been noticed in Malaysia although the latter remains an important cause of CKD in Macau.[39]

In Sri Lanka, a high prevalence of CKD of unknown etiology has been described in the North Central and North Western Provinces.[39] This entity is characterized by a high prevalence in farmers, an early onset of disease in adolescents, nonspecific symptoms, moderate anemia, mild hypertension chronic interstitial

changes on kidney biopsy, and progression to ESKD over time. Speculation as to the etiology remains largely unknown, but contamination of food commodities by ochratoxin A, a naturally occurring mycotoxin with nephrotoxic properties, high water fluorides, exposure to agro-chemicals, possible exposure to contaminated aluminum, and excessive alcohol consumption could all be playing important roles.[39] However, the levels of ochratoxin A levels in food commodities in these regions were below the recommended statutory maximum limit, raising doubts about the etiologic role of this mycotoxin.[40]

The incidence rate of ESKD in Australia and New Zealand in 2006 was 115 and 117 pmp,[41] respectively. Diabetic nephropathy was responsible for 32% and 42% of incident cases of ESKD in Australia and New Zealand, respectively.[41] Glomerulonephritis and hypertension were the second and third commonest causes of ESKD in both Australia and New Zealand.[41] CKD disproportionately affects nonwhite and indigenous population.[42,43] In 2004, Indigenous Aboriginal and Torres Strait Islander population of Australia accounted for approximately 10% of all new RRT patients, despite comprising only 2.4% of the total Australian population.[42] The rates of ESKD incidence in the Aboriginal and Torres Strait Islander population of Australia are, on average, 8 times the rates observed for the nonindigenous population.[43]

Europe

The overall incidence rate of RRT among all registries reporting to the ERA-EDTA registry was 118 pmp/y in 2006.[44] The highest incidence rates were reported by Germany (213 pmp), Israel (204 pmp), and Greece (196 pmp), whereas incidence rates below 100 pmp were reported by Ukraine (18 pmp), Russia (28 pmp), Montenegro (56 pmp), Iceland (69 pmp), Romania (75 pmp), Finland (84 pmp), Latvia (88 pmp), and the former Yugoslav Republic of Macedonia (98 pmp).[44] The highest prevalence rates of RRT for ESKD were from Cantabria, Spain (1234 pmp), Germany, (1114 pmp), and Valencian region of Spain (1080 pmp), whereas the lowest reported rates were from Ukraine (73 pmp) and Russia (130 pmp).[44] The overall incidence and prevalence of ESKD in United Kingdom (England, Wales, Scotland, and Northern Ireland) in 2007 was 109 pmp and 746 pmp, respectively.[45]

Diabetes remains the leading cause of ESKD in Europe.[44,45] In 2006, diabetes nephropathy accounted for more than 20% of incident cases of ESKD in Spain, France, Germany, Belgium, and Sweden. The contribution of hypertension as a cause of ESKD in United Kingdom is relatively small, accounting for less than 6% of all cases. One quarter of ESKD in the United Kingdom in 2007 was of unknown etiology.[45] These represented patients who presented quite late to the nephrologists, ascertaining that the etiology of ESKD was difficult.

Americas

The adjusted incident and prevalent rate of ESKD in the United States of America in 2006 was 360 pmp and 1626 pmp, respectively.[35] By race, the incident rate for African Americans and Native Americans in 2006 reached 1010 and 489 pmp, respectively, 3.6 and 1.8 times greater than the rate for white patients (279 pmp).[35] The prevalent rate of ESKD in African Americans is 4.2 times that of the white population.[35] Some of the observed high rate of ESKD in African Americans can be explained by the presence of potentially modifiable factors, such as lower socioeconomic status, suboptimal health behaviors, suboptimal control of glucose, and blood pressure.[46] The incident rate of ESKD in Cuba in 2006 was 194 pmp.[47] The age-adjusted prevalence rate of ESKD in Brazil as of January 2007 was 540 pmp.[48] Diabetes was the commonest cause of ESKD in the United States, accounting for 44.3% of incident cases.[35] In Cuba, the incidence of primary renal disease was 23% for diabetes mellitus, 23% for vascular nephropathy, and 14% for glomerulopathy.[47] Figure 2 shows the relative contribution of diabetes to the incident rate of ESKD in selected countries.

Early Detection of CKD in the Community

Kidney registry data only provide information about the last stage of CKD and in so doing

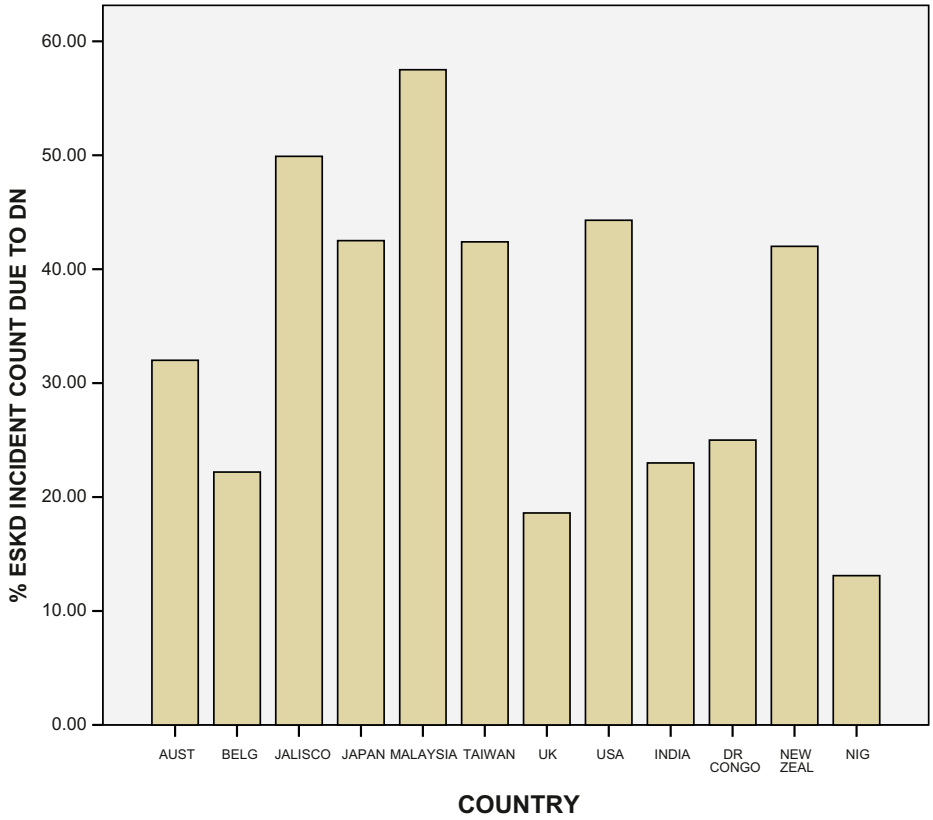

Figure 2. The percentage of the incident count of ESKD because of diabetic nephropathy in different countries. Data from the USRDS,[36] Alebiosu et al,[28] and Krzesinski et al.[66] Aust, Australia; Belg, Belgium–Dutch speaking; UK, United Kingdom (England, Wales, and Northern Ireland); USA, United States of America; DR Congo, Democratic Republic of Congo; New Zeal, New Zealand; Nig, Nigeria.

cannot help in ascertaining the "true" burden of CKD. Early stages of CKD are usually asymptomatic and often go undetected and undiagnosed. Community surveys are necessary to determine the prevalence of early stages of CKD. The definition and classification of CKD by the National Kidney Foundation Kidney Disease Outcome Quality Initiative in 2002,[1] its subsequent modification by the Kidney Disease Improving Global Outcomes in 2004,[20] and its widespread acceptance have made it possible for the medical community to determine the prevalence of CKD and its associated risk factors. Also, the classification permits international comparison of the prevalence of CKD and the assessment of strategies used to delay or halt the progression of CKD.[49] The new staging system recommended the use of estimated GFR using the Modification of Diet in Renal Disease or Cockcroft Gault formula in adults to determine the level of kidney function.[1,20] Although the present classification has some shortcomings such as an arbitrary selection of the cutoff point, nonvalidation of the Modification of Diet in Renal Disease formula in a heterogeneous population, nonstandardization of serum creatinine assays, and mislabeling of people with low GFR as having a "disease," further research, refinement, and validation of the formula in different countries will help in defining whether CKD has assumed an epidemic proportion.[49-51]

The various community surveys on CKD have shown that the population of patients with ESKD is the tip of the CKD iceberg.[17,52-64] The prevalence of CKD varies from 3% to 21.8% (Table 1).[17,52-64] The National Health and Nutrition Evaluation Survey III found that among US adults surveyed between 1988 and 1994, 11%, corresponding to 19.2 million people, have CKD.[52] A repeat survey between 1999 and 2004 estimated an even higher

Table 1. The Prevalence of CKD From Community-Based and Medical Screening in Various Countries

Ref	Country	Sampling Strategy	Study Population (n)	Age Range (mean) (y)	eGFR Estimation	Urine	Stage of CKD							CKD Awareness (%)
							1	2	3	4	5	All stages	CKD 3+	
[52]	USA	Population survey (NHANES 1988-1994)	15,600	≥20	MDRD	MAL	3.3	3.0	4.3	0.2	0.2	11.0	4.7	–
[53]	USA	Population survey (NHANES 1999-2004)	13,323	≥20	MDRD	MAL	1.78	3.24	7.69	0.35	NA	13.07	8.04	11.6% (Males CKD3), 5.5% (females CKD3)
[54]	Taiwan	Medical screening program	462,293	≥20	MDRD	Dipstick	1.0	3.8	6.8	0.2	0.1	11.9	7.1	3.54
[55]	Norway	Population survey	65181	≥20	MDRD	MAL	2.7	3.2	4.2	0.16	—	10.26	4.36	—
[56]	Australia	Population survey	10,949	≥25	MDRD	MAL	0.9	2.0	10.9	0.3	0.003	14.103	11.203	—
[57]	Shanghai, China	Population survey	2554	18-104 (58.4)	MDRD	MAL, hema pyuria, USS	2.4	3.6	5.5	0.3	0.04	11.84	5.84	8.2
[58]	Beijing, China	Population survey	13,925	≥18	MDRD	MAL, hema, pyuria	7.4	4.7	1.8	—	—	14.0	1.8	7.9
[59]	Japan	Health check	574,024	≥20	MDRD	≥1+ prot	0.6	1.7	10.4	0.2		12.9	10.6	—
[17]	Korea	Population survey	2356	≥35 (50.5)	MDRD	MAL	2.0	6.7	4.8	0.2	—	13.7	11.7	—
[60]	North India	Population survey	5252	≥20	MDRD	≥1+ prot	NA	NA	3.8	0.2	0.2	—	4.2	—
[61]	Spain	Population survey	239	≥20	MDRD	MAL	3.5	3.5	5.3	0.4	—	12.7	5.7	—
[62]	Iran	Population survey	16,354	15–79 (51)	MDRD	MAL, hema, pyuria, kidney biopsy	2.2	2.1	7.8	0.3	0.2	12.6	8.3	7.8
[63]	Mexico	Population survey	3564	≥18	CG-BSA	—	NA	NA	8.1	0.3	0.1	—	8.5	11
[64]	DR Congo	Population survey	500	20-79 (38.6)	MDRD	≥300 mg/day	2.0	2.4	7.8	0.0	0.2	12.4	8.0	3.2
[65]	Zuni Indians, USA	Population survey	1196	≥20	MDRD-AI	MAL	11.8	4.6	3.2	0.6	1.6	21.8	5.4	—
[39]	Singapore	Medical screening	3432	2112	MDRD	—	—	—	4.1	0.3	0.08	—	4.5	—

Abbreviations: eGFR, estimated glomerular filtration rate; MDRD, modification of diet in renal disease formula; MAL, microalbuminuria; hema, hematuria; prot, proteinuria; USS, ultrasonography.

prevalence of 13%.[53] Hallan and colleagues[55] documented that the total prevalence of CKD in Norway was 10.2%, which was comparable to the US CKD prevalence of 11% (1988-1994). However, the relative risk for progression from CKD stages 3 or 4 to ESKD in US white patients as compared with Norwegian whites was 2.5.[55] Late referral to a nephrologist and suboptimal predialysis care were partly responsible for the higher risk of progression of CKD in US whites when compared with Norwegian whites. Predictors of CKD in the various studies include increasing age, increasing prevalence of obesity, hypertension, diabetes, and cigarette smoking.[17,52-64]

Prevention of CKD

The magnitude of the existing burden of ESKD, the projections for the increasing incidence of CKD, the high cost of RRT, and the lack of resources for RRT in most LMICs with its attendant high mortality call for the prevention of CKD using an approach based on awareness, early detection, and effective treatment. According to the Bellagio Declaration of the International Society of Nephrology, such preventive strategies should involve educating the population on how to prevent renal disease; identifying those at risk of developing CKD; raising the awareness of the general public, policy makers, and health care workers; modifying the lifestyle of susceptible individuals; detecting early stage of CKD; arresting or hindering the progression of disease; and creating facilities for global assistance.[65]

To raise awareness among general physicians, primary care professionals, and the general public of the role of the kidney as a source of chronic disease and to emphasize the need for the early detection of renal damage, the International Society of Nephrology and the International Federation of Kidney Foundations launched World Kidney Day in March 2006. The celebration of World Kidney Day in many countries has allowed the nephrology community to raise awareness on the need to detect and treat kidney disease early and also to screen for CKD and its risk factors such as hypertension and diabetes.

The screening and preventive strategies to be used must be well suited to the particular environment taking into consideration factors such as health awareness and the availability of human and material resources. Considering the complex interrelationship between CKD and other chronic NCDs, a screening program for hypertension, diabetes, obesity, and proteinuria must occur at the primary care level and preferably be incorporated into the Millennium Development Goals. Although targeted screening has been advocated in high-income countries in view of its cost-effectiveness, whole population screening may be more suitable for less sophisticated health systems because this will increase awareness and detection and treatment rates of other NCDs.[66] The cost-effectiveness and improved detection and treatment rates of the latter approach has been proven in the Chennai project in Southern India.

Reducing the prevalence of the risk factors of CKD, such as hypertension and diabetes and its attendant cardiovascular disease, will involve lifestyle modifications such as maintaining a healthy weight, eating adequate amount of fruits and vegetables, exercising regularly, and quitting smoking.[1,7,66] Also, the detection and elimination of harmful herbal remedies will be important in Africa and many LMICs.

A direct and continuous relationship exists between blood pressure and cardiovascular and kidney disease. In patients with CKD, target blood pressure levels should be less than 130/80 mmHg in the absence of diabetes or proteinuria, less than 125/75 mm Hg in patients with diabetes, and those with proteinuria greater than 1 g/24 h.[1,7,66] Preferably, renoprotective agents such as angiotensin converting enzyme inhibitors (ACEIs) or angiotensin receptor blockers should be used in the control of hypertension. Adequate glycemic control (glycated Hb1c $<7\%$) must be targeted in patients with diabetes mellitus.[1,7,66]

To start and sustain these preventive measures, there will be a need for capacity building in most of the LMICs. Such capacity building should involve training of nephrologists and sustained education of generalist physicians and nonphysician health care workers. Also, sustained collaboration must be encouraged among governmental agencies, pharmaceutical industry, international societies, and philanthropic bodies.

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