Chapter 2
Global Perspective of Kidney Disease

Shuchi Anand, Masuma Akter Khanam, and Fredric O. Finkelstein

Key Points

• The prevalence of CKD in economically developing nations is approaching that of developed nations.
• A large proportion of patients living in economically developed regions who approach end-stage renal disease (ESRD) likely die without accessing therapy. This gap in care is as yet unquantified.
• Most nations offer some form of renal replacement therapy, but its expense and scarcity limit universal access. Expansion of peritoneal dialysis and transplantation may be potential strategies for improving access.
• Traditional risk factors for the development of CKD and ESRD include diabetes and hypertension; these are increasing in prevalence across the world. Moreover relatively novel risk factors including low birth weight and metabolic syndrome are now recognized to play a role. Managing the extremes of nutrition—i.e., malnutrition and obesity—can play an important role in cost-effective prevention of ESRD.

Keywords  Global epidemiology of chronic kidney disease • Global epidemiology of renal replacement therapy • Low birth weight • Metabolic syndrome

Introduction

The demographic shift towards an older population [1] and urbanization with subsequent change in diet and physical activity patterns [2] are resulting in rise of chronic noncommunicable diseases across the world. A majority of patients suffering from diabetes and hypertension—primary risk
factors for development of chronic kidney disease (CKD)—now reside in economically developing nations [3, 4].

In this context, more nations are investigating the burden of CKD, although few are looking at strategies for management. CKD not only multiplies the risk for cardiovascular disease—a leading cause of morbidity and mortality worldwide—but also leads to the development of end-stage renal disease (ESRD). Care for patients with ESRD requires costly dialysis or transplant; even nations with established economies struggle to finance this therapy.

In this chapter we review available data on the prevalence and incidence of CKD and ESRD, with emphasis on studies from economically developing nations. We then detail the challenges in provision of renal replacement therapy (RRT) in low-resource settings. Finally, we examine associated risk factors, highlighting the role of the extremes of nutrition (i.e., both malnutrition and obesity).

**Epidemiology of CKD and ESRD**

In the USA, data on epidemiology of CKD are made available through National Health and Nutrition Examination Survey (NHANES) and periodically updated. The NHANES is a cross-sectional survey sampled to be representative of the overall US population [5]. The latest available estimate of a CKD prevalence of 13% spans 1988–2004, includes 28,721 individuals over 20 years of age, and defines CKD as persistent albuminuria >30 mg/g and/or estimated glomerular filtration rate (eGFR) below 60 mL/min/1.73 m² by the Modification Diet in Renal Disease (MDRD) formula. Restricting to individuals with eGFR below 60 mL/min/1.73 m² yields a prevalence of about 5%. Other population-based studies from established economies also present estimates close to 5% for eGFR below 60 mL/min/1.73 m². In Norway the estimated prevalence using the NHANES definition was 10% among adults over 20 years of age, with a 4.7% prevalence of individuals with eGFR below 60 mL/min/1.73 m² [6]. Another population-based, nationally representative survey from Taiwan detected 7% prevalence for individuals with eGFR below 60 mL/min/1.73 m² [7]. Studies from the UK [8], Japan [9], and Australia [10] confirm similar or higher prevalence. Among economically developing nations, a few nationally representative studies are available. Table 2.1 provides a summary of available research from large population-based studies (note: not all studies use a nationally representative sampling strategy) [11–18].

Studies examining awareness of diagnosis among persons living in economically developing countries reported that fewer than 10% of patients with CKD knew of their disease [12, 13, 18]. We can postulate then few patients are seeking health care for CKD regions. Discerning what proportion of these patients reach ESRD and are able to access RRT is a further challenge. In the USA and other economically developed countries, a centralized agency manages reimbursement of the majority of RRT, e.g., Medicare in the USA and Australia, and the National Health Services in the UK. A majority of eligible and willing patients can access therapy, either through the safety net of the centralized agency or through private insurance. Thus, data on RRT prevalence and incidence is assumed to approximate the prevalence and incidence of ESRD [19].

This assumption does not hold true in most economically developing countries (Fig. 2.1). First some countries have extremely limited access to RRT. In Africa, 27 countries reported almost no availability of nephrologists, at fewer than one per million population [20]. In a survey returned by 31 of the 53 African countries, 13 reported fewer than 100 patients on dialysis [21]. Only ten countries perform transplantation. This scarcity in care likely reflects competing social and economic national priorities rather than lack of need—particularly given the high rates of malignant hypertension among young Africans [22].

Even in countries which have developed health care strategies related to ESRD, access to therapy is constrained by timely detection of ESRD [23]. The Brazilian Ministry of Health has committed to financing dialysis or transplant therapy via its public insurance; 90% of patients on dialysis receive
public health funding [24]. Despite this, experts from the country speculate that a large proportion of patients with ESRD die without diagnosis due to lack of early detection programs [25].

In South Africa, although wealthier patients have access to private dialysis units, those seeking care through the public hospitals undergo a selection process based on guidelines established by the National Department of Health [26]. From a rare single-center analysis from Cape Town, Moosa and Kidd report that the proportion of patients accepted for RRT actually declined as the number of patients presenting with advanced CKD increased over a 15-year period [26]. Overall, the unit accepted 53% of presenting patients. The authors asserted that “poverty related” factors—such as unemployment or illiteracy—accounted for a majority of the reasons for rejection (Fig. 2.2). Younger patients, patients with nondiabetic kidney disease, and those living closer to the dialysis center were more likely to be accepted. Similarly only about 5–10% of the Indian ESRD population is estimated to be “accepted” for RRT [27].

Complex factors underlie access to RRT in economically developing countries: government commitment to ESRD care, concentration of nephrologists and dialysis or transplant centers, and ability to detect CKD. Not surprisingly, provision of RRT may be divorced from the actual incidence of ESRD and tracks more closely with a country’s income (Fig. 2.3) [28].

### Provision of Renal Replacement Therapy

Not only do we know little about the characteristics of patients with CKD who die with ESRD in economically developing countries, but data on the even smaller proportion of patients who reach ESRD and are able to access RRT are scanty as well. In most developed countries, national registries

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Sample size and methodology</th>
<th>Method of eGFR estimation</th>
<th>Prevalence of eGFR &lt; 60 mL/min/1.73 m² (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen et al.</td>
<td>China</td>
<td>Population-based study representative of China (n = 15,540)</td>
<td>MDRD</td>
<td>2.5</td>
</tr>
<tr>
<td>Zhang et al.</td>
<td>China</td>
<td>Population-based study representative of Beijing residents (n = 13,925)</td>
<td>MDRD</td>
<td>1.7</td>
</tr>
<tr>
<td>Ingsathit et al.</td>
<td>Thailand</td>
<td>Population-based study representative of Thailand (n = 3,459)</td>
<td>MDRD</td>
<td>8.6</td>
</tr>
<tr>
<td>Escobar et al.</td>
<td>Chile</td>
<td>Population-based study representative of Chile (n = 3,619)</td>
<td>Cockcroft-Gault</td>
<td>5.9</td>
</tr>
<tr>
<td>Amato et al.</td>
<td>Mexico</td>
<td>Primary care clinic-based study representative of Morelia (an urban area), Mexico (n = 3,564)</td>
<td>Cockcroft-Gault</td>
<td>8.5</td>
</tr>
<tr>
<td>Sumaili et al.</td>
<td>Congo</td>
<td>Screening in 10 of 35 health zones of Kinhasa, not representative</td>
<td>MDRD</td>
<td>8</td>
</tr>
<tr>
<td>Cepoi et al.</td>
<td>Romania</td>
<td>Voluntary participants of a national health screening program from Iasi county, Romania (n = 60,969)</td>
<td>MDRD</td>
<td>6.7</td>
</tr>
<tr>
<td>Singh et al.</td>
<td>India</td>
<td>Population-based study representative of New Delhi and surrounding areas (n = 6,101)</td>
<td>MDRD</td>
<td>4.2</td>
</tr>
</tbody>
</table>
Fig. 2.1 A schematic of the risk factors (related to both malnutrition and obesity) linked with chronic kidney disease, also highlighting data gaps in morbidity and mortality related to chronic kidney disease and end-stage renal disease in low- and middle-income countries. Dx diagnosis, Rx treatment

gather data on dialysis and transplant provision and patient outcomes, e.g., the United States Renal Data System (USRDS), the European Renal Association-European Dialysis and Transplant Association (representing more than 20 European countries), and the Australia and New Zealand Dialysis and Transplant Registry. The USRDS has collected data since 1978, with detailed information on etiology of renal disease and patient outcomes including hospitalizations and mortality [29]. Based on its most recent report, about 450,000 (1,738 per million population) people are dialyzing or living with a transplant in the USA, and about 100,000 (355 per million population) people begin therapy annually. Provision of this therapy incurred a cost of $29 billion to Medicare (the primary payer). Cause of ESRD was attributed to diabetes or hypertension in three-fourths of the individuals starting RRT. Japan and Taiwan report the highest prevalence of RRT at more than 2,000 per million population, potentially due to a higher life expectancy allowing older patients with CKD to reach ESRD as well as improved survival while on dialysis therapy [30]. Interestingly, the incidence and prevalence of ESRD in Western European countries is well below that of Caucasians in the USA for reasons that are not clear. Whether this truly reflects a lower incidence of ESRD or the limited provision of ESRD services to selected patients (such as the elderly or those with multiple comorbidities) in Western European countries is not certain.

Very few systems of data collection exist in economically developing regions. Often patients are splintered between public institutions and a vast network of private providers. Registries of RRT are rare. One exception is the Latin American Society of Nephrology and Arterial Hypertension’s Dialysis and Transplant Registry [31]. The registry received data from 18 of the 20 member nations in 2004, noting that 230,901 patients were on therapy (prevalence rate of 447 per million population). As noted by the report authors, member countries have not adopted uniform data collection methods. Typically the registry receives aggregate (not patient level) estimates from a participating country. The ERA-EDTA registry also captures aggregate data from some middle-income countries with burgeoning dialysis practices, including Russia, Romania, Latvia, Croatia, and Poland [32]. Most of these countries report a prevalence of 400–700 per million population, with the exception of Russia where prevalence rate was lowest at 170 per million population. No regional registries exist for South Asia, East Asia, Africa, or the Middle East.

A handful of economically developing countries submit aggregate RRT estimates to the USRDS [29]. The trends reported here offer an interesting perspective. Thailand, for example, reported a prevalence rate of 220 per million population in 2005; this number had doubled to 553 per million population in 2009. Similarly rapid gains were noted in Bangladesh, Mexico, and Romania. China and India have
also likely experienced rapid increases in patients on RRT although data from these two countries are particularly sparse. In 1999, the Chinese Dialysis and Transplantation Registry Group sent out a questionnaire to dialysis centers across China but received responses from less than half. Based on these, the prevalence of patients on dialysis was a rather low 33 per million population with an incidence of 15 per million population [33]. However, more recent estimates from Beijing and Shanghai are more in-line with the Latin American region [34, 35]. The Shanghai Dialysis Registry reported a prevalence of around 200 per million population in 1999 with a rise to 400 per million population by 2005 [34]. This steep difference may reflect a large gradient between dialysis availability in an urban setting, compared with a rural one [36].

Grassmann et al. have attempted a worldwide estimate of RRT (Table 2.2) [37]. Their data are gathered through questionnaires distributed to in-county experts—with assistance from Fresenius Medical Care, one of the largest suppliers of dialysis equipment worldwide. According to their analysis, Asia and Africa have some of the lowest prevalence of RRT. More than half of the patients on RRT reside in North America or Europe. Thus, from the limited data that are available from economically developing countries, we can conclude that the prevalence of RRT in ears about a quarter or less of the USA. Africa in particular lags behind in provision of RRT overall. Most middle-income countries have experienced a steep rise in RRT prevalence over the past 5 years but its provision may be concentrated around urban centers.

### Table 2.2 Estimated prevalence of renal replacement therapy worldwide

<table>
<thead>
<tr>
<th></th>
<th>Prevalence values (p.m.p.)</th>
<th>ESRD</th>
<th>Dialysis (HD+PD)</th>
<th>Transplant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>280</td>
<td>215</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>North America</td>
<td>1,505</td>
<td>1,030</td>
<td>470</td>
<td></td>
</tr>
<tr>
<td>Europe (thereof EU)</td>
<td>585 (850)</td>
<td>400 (550)</td>
<td>185 (295)</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>2,045</td>
<td>1,945</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Asia (excluding Japan)</td>
<td>70</td>
<td>60</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Latin America</td>
<td>380</td>
<td>320</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Africa</td>
<td>70</td>
<td>65</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Middle East</td>
<td>190</td>
<td>140</td>
<td>55</td>
<td></td>
</tr>
</tbody>
</table>


### Modality Use

Hemodialysis is the primary modality used worldwide, even in economically developing regions. Based on the estimate by Grassmann et al., 77 % of patients on RRT are on dialysis with 89 % of this subgroup undergoing hemodialysis [37]. Use of peritoneal dialysis is proportionally greater in economically developing regions however (Fig. 2.4).

Specific countries within Latin America—Mexico, Guatemala, El Salvador, Nicaragua, and Dominican Republic—and Hong Kong are rare regions that rely more heavily on peritoneal dialysis than on hemodialysis [31]. The extent of peritoneal dialysis use is often influenced by government policy and relative costs of obtaining supplies. Nearly a quarter of the world’s peritoneal dialysis population resides in Mexico [38]. After its relatively early introduction to Mexican physicians in the 1970s, the widespread use of peritoneal dialysis has also been encouraged by local manufacturing of required solutions, dissemination of simple techniques to primary care physicians, and government reimbursement policy [38]. In Hong Kong, nephrologists first initiate peritoneal dialysis in patients
with ESRD and use hemodialysis only in patients who experience modality failure, resulting in the use of peritoneal dialysis in more than half of patients with ESRD [39]. In Thailand, the government has instituted a similar policy as in Hong Kong, and there has been a recent, rapid growth of peritoneal dialysis. Economic evaluations carried out in the developed economy context have confirmed lower payer costs of peritoneal dialysis with no difference in survival, compared with hemodialysis [40]. Large studies from Brazil and Mexico have shown low rates of peritonitis (e.g., one episode every 24–30 months [41, 42]). Acceptable rates of peritonitis have also been reported from African countries such as Sudan [21].

Despite the expectation that peritoneal dialysis should be the favored modality—it is a low technology and infrastructure modality, and published data to date indicate acceptable outcomes and low rates of peritonitis—hemodialysis remains the predominant modality used in most economically developing countries. Paradoxically, one reason may be the cheaper labor costs involved in having nurses perform dialysis, compared with the more expensive use of imported solutions and supplies [43]. As well, nephrologists working in economically developing countries perceive several barriers to peritoneal dialysis and sometimes do not discuss the modality as an option. For example, in a single center from an Indian state-run hospital, only 30% of patients on chronic hemodialysis were aware of peritoneal dialysis as a modality [44]. The nephrologists identified lack of an organized program and doubtful patient compliance as some of the barriers to peritoneal dialysis therapy [44]. Similarly in a survey of 68 Filipino nephrologists—another country with low peritoneal dialysis utilization rates—about 40% of nephrologists surveyed stated that they would preferentially recommend hemodialysis over peritoneal dialysis [45]. They cited poor patient hygiene, visual impairment, and lack of manual dexterity as potential reasons for hemodialysis preference.

To overcome some of these obstacles to wider adaptation of peritoneal dialysis, governments would need to prioritize infrastructure building for peritoneal dialysis, ensure a steady supply of the low-cost dialysate solution, and organize physician training. Only then would patient volumes reach a level large enough to sustain a successful peritoneal dialysis strategy (Table 2.3).

Of the three modalities, transplant offers the best survival [40]. In developed countries, rates are limited by availability of organs. Approximately 30% of patients with ESRD are living with a transplant in the USA, with a majority (>60%) having received deceased donor transplants [29]. Somewhat higher proportions of prevalent transplant patients (between 40 and 50%) are reported in European countries including France, the UK, Norway, and Sweden [32], but deceased donor
transplantation predominates here as well. Japan is one exception; overall rates of transplantation are lower and living donation predominates, partly due to a societal and organizational reluctance to accept organs from brain-dead donors [46]. Although the cost of therapy is high for the first year, costs drop off steeply after this time, resulting in an overall favorable cost-benefit ratio in comparison with dialysis therapy [40].

The provision of transplants varies widely in economically developing countries. Some countries report a thriving and successful transplantation program. For example, Iran reports that with government support and regulation of a paid-donation program, the number of transplantation centers rose from 2 to 25 over a 2 decade period [47, 48]. Living unrelated donation predominates, both donors and patients were young (under 40 years of age on average), and 3-year graft survival rates were over 85%. Similarly the Brazilian government helps coordinate transplantation, particularly procurement of deceased organs and supply of immunosuppressive medications [49]. There are 138 transplant centers in Brazil, resulting in a prevalence of 123 per million population (comparable number in the USA: 528 per million population) [29, 31]. The proportion of patients receiving deceased donor transplantation is increasing.

In other regions, particularly East and South Asia, transplantation activity is harder to track. In China, a practice of organ procurement from deceased prisoners has been widely denounced [50]. After the government announced its intention to prohibit such procurement, a steep rise in the black market sale of organs was expected. India is widely known to have a thriving black market, with an estimated 2,000 kidneys sold each year [47]. Pakistan’s Sindh Institute—a large, partially governmentally funded hospital—reported that foreigners received up to two-thirds of the renal transplants performed. Thus, although the reported number of renal transplants is around 3,000 per year in India, the number of native Indian patients who are able to access this therapy is likely much lower [51]. Similar practices have been reported in the Philippines.

The expense of therapy not only deters widespread use of RRT, it also forces nephrologists in economically developing countries to modify dialysis and transplantation practice. Although data on outcomes are rare, single-center studies have reported significant reliance on two times per week hemodialysis as well as reuse of older cellulosic membranes. In a report of 259 patients on hemodialysis at an Indian tertiary care center, 14% were not able to adhere to the prescribed thrice weekly schedule [52]. Single-pool $KT/V$—a marker of dialysis adequacy—was less than 1 in half of the patients. A majority of patients who started dialysis discontinued therapy when financial resources ran out within the first year; and early mortality due to uremic complications was high. Twenty-eight percent of registered Beijing patients were undergoing two times per hemodialysis in 2002 [35]. To save on costs, the number of peritoneal dialysis exchanges performed may be suboptimal as well, and immunosuppressive medication use may be tapered quickly for patients with transplants. Programs rely more on older medications such as cyclosporine and azathioprine (as compared with tacrolimus and

### Table 2.3 Key ingredients for establishing a successful peritoneal dialysis (PD) program in a developing country

| 1. Developing a chronic kidney disease identification and education program |
| 2. Developing a healthcare policy addressing the problems of end-stage renal disease therapy |
| 3. Integrating PD into the program |
| 4. Developing a viable financial model to support the program |
| 5. Having appropriate individuals (nurses, physicians, etc.) trained in the details of PD therapy |
| 6. Developing strategies to monitor the outcomes of the therapy to permit adjustments and modifications to be made to ensure the success of the program |
| 7. Maintaining communication with groups/individuals outside the country to provide support as needed for focused problems |


S. Anand et al.
mycophenolate mofetil). The Sindh Institute in Pakistan ascribes to an aggressive tapering of immunosuppression, for example, discontinuing cyclosporine altogether in individuals with fully matched kidneys who are rejection-free at 1 year post-transplant [53].

In summary, despite data on the improved cost-effectiveness and survival of transplantation (compared with any dialysis) and the very valid hypothesis that peritoneal dialysis carries several advantages in resource-constrained settings, hemodialysis dominates these modalities. A concerted governmental effort is likely required to prioritize the use of peritoneal dialysis and transplantation; example programs exist in Mexico and Brazil, respectively. Data on outcomes of therapy are sparse, but its collection is particularly important since a majority of individuals are likely receiving suboptimal care and/or withdraw from therapy upon exhaustion of personal resources.

### Nutrition as a Risk Factor and Key Intervention

With these challenges in provision of RRT, economically developing countries should focus on prevention of CKD and ESRD. Thus tackling risk factors for CKD is a key area of intervention. Nutrition in particular can play an important role.

Obesity and subsequent development of metabolic syndrome or frank diabetes and hypertension likely drove the largest part of the rise in ESRD rates we have seen in the USA and other developed nations. A similar pattern is repeating now in economically developing regions. As previously noted, the prevalence of diabetes and hypertension will rise proportionally more in economically developing countries. Increasing obesity and declining physical activity, corresponding to the rapid urbanization and aging of the population, are felt to underlie this accelerating rate of metabolic syndrome, diabetes, and hypertension.

Obesity has skyrocketed worldwide, tripling in prevalence in economically developing nations where the Western lifestyle has come into vogue [54]. Using data gathered from the United Nations Food and Agriculture Organization and the Chinese Health and Nutrition Survey, Popkin and Drewnowski have documented a “nutrition transition” [55]. With the advent technological efficient manufacturing of edible oils, a greater proportion of households living in developing countries can access this cheaper version of fat, even at low household incomes (Fig. 2.5). The same survey in China demonstrated a shift away from vegetable and grain intake and towards animal protein intake,

![Fig. 2.5](image_url)  
**Fig. 2.5** Fats have become a larger portion of diets around the world over time. Data from the China Health and Nutrition Survey. From Drewnowski A, Popkin BM. The nutrition transition: new trends in the global diet. Nutr Rev. 1997 Feb;55(2):31–43. Reprinted with permission from John Wiley and Sons
resulting over time in a higher energy content per gram of food consumed in both urban and rural areas—although the shift was more dramatic for urban areas. Urban diets rely more on caloric sweeteners than previously [56].

Food retail has changed substantially as well. Animal meat prices have declined over time, allowing for its greater consumption. Supermarket retailers—who have an advantage in prices when selling dry processed goods or frozen prepared foods—now dominate the landscape in many economically developing countries. For example, Reardon et al. describe that over the 2-decade period spanning 1980–2000, supermarkets have grown from occupying a 10–20 % share to 50–60 % share of the food retail market in Latin America [57]. Foreign direct investment in developing country economies is felt to be driving this phenomenon. Similarly, in Indonesia the fast food chain industry has boomed, going from fewer than 10 chains in 1980s to over 70 chains in the 1990s [58]. Potentially due to influx of women into the labor force, the average Indonesian spends 30 % more on prepared foods each year.

The outlined dietary changes, coupled with decline in strenuous physical activity as the service sector employs a greater proportion of the rapidly growing urban population, have led to an increase in the average body mass index in many economically developing countries. Initially this change was felt to be confined to individuals with higher socioeconomic status, but newer data demonstrates that as a country’s overall income increases, individuals of lower socioeconomic status experience a higher burden of obesity, than their “richer” counterparts [59].

The adverse impact of this obesity—i.e., the end organ damage in the form of development of coronary heart disease or CKD—may be more powerful among certain populations. A tendency towards central adiposity and insulin resistance explains this phenomenon among South Asians, who are widely recognized to be at increased risk for coronary heart disease. In a case–control study of healthy Canadians, South Asians carried a significantly higher percentage of their total body fat in the visceral fat compartment [60]. Another study demonstrated an increased insulin resistance among South Asians, even after adjusting for abdominal and generalized obesity [61]. Studies within India have demonstrated a high prevalence of metabolic syndrome, affecting up to one-third of the urban population (compared with about a quarter of the population in the USA) [62, 63]. A cross-sectional evaluation in the UK identified South Asian migrants as having the highest prevalence for metabolic syndrome, compared with Caucasians and African Caribbeans [64]. The association of coronary heart disease with metabolic syndrome was strongest among the South Asians.

Thus, not only is obesity rising at a rapid pace due to the consumption of high-energy, processed foods, its impact on chronic diseases including CKD may be proportionally more among select ethnicities. A change in the demographics of patients on dialysis in part reflects the increasing burden of obesity. For example, Brazil reports that 8 % of its patients on dialysis were considered to have diabetic nephropathy in the 1980s, but among patients more recently begun on dialysis, 18 % were considered to have diabetic nephropathy [65].

The other side of the coin—protein-energy wasting—may carry its own detrimental consequences for CKD. Children with oligonephronia with bilateral renal hypoplasia develop proteinuria and ESRD by adolescence [66]. Several large-scale epidemiology studies in the USA have demonstrated a 1.5–2.5-fold increase in odds for CKD among individuals with low birth weight [67, 68]. Biological plausibility is suggested by the hypothesis that growth and development of the kidneys is sacrificed in favor of heart and brain development in the child with low birth weight [69]. Decreased glomerular number at birth leads to an increase in glomerular size in compensation, with resulting intraglomerular hypertension predisposing to glomerulosclerosis. This link between low glomerular number and low birth weight has been confirmed in autopsy series. Another proposed mechanism emphasizes rapid weight gain post-delivery as a critical bell weather for weight gain in adulthood [70]. Researchers also invoke the “thrifty gene” hypothesis—in which the fetus creates adaptations to conserve energy when developing in an undernourished environment [71].
For countries with a large burden of food-insecure mothers as well as vulnerability to natural disasters including famine, this correlation between low birth weight and CKD as well as other chronic diseases carries important policy implications. It is no surprise then that both the United Nations and the World Health Organization have been developing strategies to correct this “nutrition paradox” of undernutrition and obesity facing economically developing countries [72]. They promote consumption of home prepared, fruits- and vegetable-rich, and low-sodium diet [72]. A focus on maternal nutrition and exclusive breast-feeding may help correct the undernutrition of infants in particular.

Summary

In summary, we are seeing that prevalence of CKD in economically developing regions is approaching that of developed ones. More and more persons living in these resource-constrained settings will likely be affected by CKD with the rise of metabolic syndrome, diabetes, and hypertension—risk factors tied chiefly to obesity and a nutrition transition. Currently a large proportion of patients with CKD in economically developing countries who approach ESRD likely die without accessing therapy; the limited few who are able to access therapy are potentially receiving suboptimal care. Emphasizing peritoneal dialysis and transplantation over hemodialysis as modalities of choice for treatment of ESRD may make provision of RRT more sustainable.

References

32. ERA-EDTA Registry. ERA-EDTA registry annual report 2009. Amsterdam: Academic Medical Center, Department of Medical Informatics; 2011.
Nutrition in Kidney Disease
Byham-Gray, L.D.; Burrowes, J.D.; Chertow, G.M. (Eds.)
2014, XXXV, 478 p. 30 illus., 14 illus. in color., Hardcover
A product of Humana Press