

Kidney Disease in Oman

A View of the Current and Future Landscapes

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Oman is located in the southeast of Arabian Peninsula with a relatively young population of about 3 831 553 people. The Ministry of Health, which is the healthcare provider, is facing a challenge with the increased levels of noncommunicable diseases including chronic kidney disease. A growing number of patients progress to end-stage kidney disease (ESKD), demanding renal replacement therapy. In 2014, there were 1339 of ESKD patients receiving dialysis and almost 1400 patients received kidney transplants. The estimated annual incidence of ESKD is 120 patients per million population. Diabetes mellitus and hypertensive nephropathy are the commonly identified causes of ESKD. Many patients with glomerulonephritis, systemic lupus erythematosus, nephrolithiasis, and inherited kidney disease present with advanced chronic kidney disease. This article reviews the current status of kidney disease in Oman and addresses the present and future needs, through a systematic-review of all related papers.

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INTRODUCTION

Oman is the second largest country in the South East of Arabian Peninsula with a surface area of 309 500 square kilometers and a total population of 3 831 553 people.¹ It has a considerably high growth rate with a natural annual increase of approximately 24 per 1000 population.² Oman has a relatively young population, where about 35.1% of the population is under 15 years of age, while only 5.9% are in the 6th decade and over.² The population had a sex ratio of 102 males for every 100 females and the life expectancy at birth has increased by 19.1 years since 1980 to the current figure of 76.6 years.²

Over the past few decades, Oman has experienced speedy social and economic growth along with demographic tendencies that has been clearly reflected on all segments, including the health services. Examples include an increase in life expectancy at birth and a drop in the incidence of infectious ailments.

Currently, Oman is encountering a fast transformation in the disease profile from first generation diseases such as infectious diseases to the encumbrance of noncommunicable diseases. The burden of noncommunicable diseases has been a worldwide public health challenge, as chronic diseases compose 61% of global deaths and 49% of the global burden of diseases.³ In Oman, the outpatient morbidity rate due to communicable diseases had been decreased by 10.4% in 2014 compared to 1996 (from 43.2% to 32.8%), while the morbidity of noncommunicable diseases showed an increase by 3.5% during the same period (from 42.5% to 46.0%).² The Ministry of Health (MOH) annual reports indicated that 75% of the registered hospital deaths were ascribed to chronic diseases and cardiovascular disease was the first leading cause of hospital death (32.5%).² In addition, the results of national noncommunicable diseases screening program of people aged 40 years and greater, performed in 2009, showed that 70.9% of

Omani population was overweight or obese, 14.4% had hypertension, 8% had diabetes mellitus (DM), and 9.9% had chronic kidney disease (CKD) with an estimated glomerular filtration rate of 60 mL/min/1.73 m² or less (unpublished data; personal communication).

Chronic kidney disease is increasingly recognized as a global public health challenge as 10% of the global population is affected.⁴ Through the last 3 decades, a sharp progression in the prevalence of people progressing to end-stage kidney disease (ESKD) and demanding renal replacement therapy (RRT) has been noticed in Oman.⁵ The World Health Organization ranked Oman on the 51st position of the top world countries where CKD is the most important causes of death and reported that CKD was the 6th major cause of death accounting for 2.97% of total deaths (18.1 per 100 000 population).⁶

Considering these substantial changes in CKD in Oman, it is important to review the current landscape of kidney disease to determine and characterize the present and future needs of this population.

NEPHROLOGY CARE IN OMAN

Treatment of patients with ESKD is one of the major health care challenges in Oman, as the number of ESKD patients is continuously increasing. The prevalence of patients receiving

RRT at the end of 2013 was 2382 with an incidence of 120 per million population,⁷ and it was more frequent in young patients, as 86% of them were of 64 years and below.⁴ Table 1 summarizes the prevalence and incidence of treated ESKD patients reported in 2013 in different Asian and Middle East countries with some similarities in the geographic and socioeconomic patterns as in Oman. These countries have prevalence rates of treated ESKD patients ranging between 200 and 3000 patients per million population.⁷

As well as an increase in ESKD prevalence, as expected, a gradual increase in the outpatient morbidity caused by CKD has been observed. In 2014, for example, a total of 1280 males and 3150 females per 100 000 population had evidence of kidney or urinary tract disease (Table 2).² Additionally, surgical procedures related to the kidney and urinary tract constitutes a considerable economic burden. In 2014, a total of 2265 operations were performed that included removal of calculus (n = 340), kidney transplants (n = 8), and other kidney and urinary tract surgeries (n = 1917).²

COMMON KIDNEY PROBLEMS

Hypertensive Kidney Disease

From a public health perspective, hypertension is one of the major health problems in Oman, where the prevalence among both sexes aged 20

Table 1. Prevalence and Incidence of End-stage Kidney Disease Commencing Renal Replacement Therapy and Using Dialysis in 2013^{8*}

Country	Prevalence, PMP	Incidence, PMP	Prevalence of dialysis, PMP	Percentage of Using Dialysis		
				In-center Hemodialysis	In-center Peritoneal Dialysis	In-home Hemodialysis
Taiwan	3138	458	3021	90.8	9.2	NA
Malaysia	1140	236	1078	90.3	8.8	0.8
Oman	656	120	359	92.9	7.1	0
Qatar	649	100	317	77	23	0
Iran	603	75	316	93.7	6.3	0
Saudi Arabia	486	127	NA	NA	NA	NA
Philippines	224	136	221	96.1	3.9	NA

*PMP indicates per million population and NA, not available.

Table 2. Outpatients Morbidity Caused by Kidney and Urinary System Diseases at Ministry of Health Institutions in 2014

Type of Morbidity	Rate, per 100 000 population		
	Males	Females	Total
Glomerulonephritis, nephritis, nephrotic syndrome, and kidney failure	100	120	220
Renal, renal pelvis, and ureters infections, cystitis, and urethritis	30	80	110
Calculus of the kidneys, ureters, and lower urinary tract	630	740	1370
Other disorders and symptoms of the urinary system	520	2210	2730

years and greater has increased significantly from 27% in 1995 to 32% in 2000.^{8,9} A cross-sectional survey was performed in Oman to examine the distribution and the associations of hypertension.⁹ A total of 7011 participants were interviewed and demographic data collection, measurement of blood pressure, and fasting blood glucose, serum cholesterol, weight, height, and waist and hip measurements were performed. Of those examined, the age-dependent prevalence of hypertension was found to be 38.3%.⁹ Respondents aged 60 years and greater were at a 5.4-time higher risk of hypertension than those younger than 40 years.⁹ Similarly, another cross-sectional study was carried out on those aged 40 years and above (n = 1498) from Sohar city, Northern coastal part of Oman.¹⁰ Prehypertension was observed in 45% of the total study population and 34% of the examined population was hypertensive.¹⁰ Such studies support the importance of applying cost-effective health system strategies for the management of prehypertension in order to reduce its complications.

Diabetes Mellitus

Data from the Middle East, like most Western countries, has shown that DM is a common cause of ESKD. The highest prevalence of DM in the Middle East and North Africa region is reported in the Gulf Council Countries.¹¹ Oman is ranked 8th among the top 10 countries of the Middle East and North Africa for high prevalence of DM.¹¹ Furthermore, in 2012, the reported incident of ESKD patients with DM as the primary ESKD cause in Oman was 48%.⁷

In 1991, the MOH in collaboration with the World Health Organization conducted a national survey to evaluate the impact of DM. The results showed that 10.7% of the Omani (aged 20 years and greater) had DM, and further, 10.3% had impaired glucose tolerance.¹² Later in 2000, a follow-up cross-sectional survey was conducted and found that over 11% of the population had type 2 DM.¹³ Recently, data from 6 surveys performed in the past 2 decades showed that the prevalence of type 2 DM among the adult Omani population was as high as 21% in the region of Sur, in the Eastern part of the country.¹³

Obesity is known to contribute to insulin resistance and DM. The reported prevalence of obesity has increased in males from 10.5% in

1991 to 22.0% in 2008,^{8,12} whereas in women, the prevalence has remained stable during the same period (25.1% in 1991 and 23.8% in 2000).^{8,12} Similar rates of obesity are found in other Arab countries; for example, in Riyadh, Saudi Arabia, the prevalence of obesity in school children is reaching 18%.¹⁴

In a single-center study from Sultan Qaboos University Hospital, it was found that 51% of diabetic patients were obese, 20% had coronary artery disease, 66% had hypertension, 10% had retinopathy, 15% had microalbuminuria, 31% had nephropathy, and 9% had neuropathy.¹⁵ Therefore, there is a great demand for comprehensive countrywide studies to detect the incidence, prevalence, and contribution of DM and obesity at all stages of CKD.

Glomerular Diseases

Kidney biopsy provides an accurate diagnosis and classification of glomerular diseases. The spectrum of glomerular diseases by kidney biopsy in Omani patients is consistent with reports from the Middle East and other regions. It has been shown that primary glomerular diseases were far more common (69.1%) than secondary glomerular diseases (30.9%), and lupus glomerulonephritis was the most prevalent pathology accounting for 30.4%.¹⁶ Focal segmental glomerulosclerosis was the most common primary glomerular disease followed by minimal change disease.^{16,17} Lupus glomerulonephritis and minimal change disease were the most prevalent glomerular diseases in children younger than 14 years, and lupus glomerulonephritis was the common lesion found in adults (from 15 to 25 years), whereas membranous glomerulonephritis was more frequent in patients of older age (25 years and older).¹⁶ It is not surprising that lupus glomerulonephritis was more predominant in females than males with a 4.6:1 ratio^{16,17}; however, this ratio is lower than that in general systemic lupus erythematosus (SLE) of 9-to-1 female-male ratio. Similar to the nearby countries, a low instance of immunoglobulin A nephropathy cases was found among patients with renal biopsy.¹⁶ However, these studies are of small number and from a single center with no countrywide data being available.

Urolithiasis

Kidney and urinary calculi are common reasons

for seeking medical consultation in Oman. A recent study from the Sultan Qaboos University Hospital was carried out on the components of urinary calculi of 255 patients using a Fourier transform infrared spectrophotometer.¹⁸ The investigators collected the biochemical, metabolic, and radiological data of the examined patients and calculi. It was found that hypertension, DM, benign prostate hyperplasia, urinary tract infection, obesity, and atrophic kidney are frequent comorbidities related with stone formation.¹⁸ The common clinical features present in 96% of studied patients were renal colic and flank pain and calcium oxalate were the most frequent composition of urinary calculi analyses. Generally, the overall probability of forming stones is considered high in the Middle East countries, including Oman, where environmental and sociocultural factors play major role in such disorders.

The Annual Health Report of the MOH in 2014 detailed 137 outpatients per 10 000 population suffered from calculi of the kidneys, ureters, and lower urinary tract. Usually, kidney calculus disease was more frequent in females than males, with 74 per 10 000 female population compared to 63 per 10 000 male population (Table 2).² In contrast, data from Sohar Hospital, evaluating the prevalence and management of kidney calculus found that the calculi were more frequent in the age group of 30 to 39 years old and that the risk of calculus disease was higher in men than women.¹⁹

Inherited and Congenital Kidney Disease

In Oman, inherited kidney diseases are relatively common, leading to a serious healthcare burden.²⁰ With inherited kidney diseases, there is an increased rate of ESKD. Congenital malformations and genetic disorders are associated with 39% of perinatal deaths in hospitals, as reported by the MOH in 2008.²⁰ Similar to other Middle East countries, the rate of consanguineous marriages is high.²⁰ The high rate of consanguinity is anticipated to be associated with increased frequency of a wide range of genetically inherited diseases including those causing CKD in childhood. Cystinuria is a rare genetic disease leading to kidney calculi. This condition was found to be more frequent (4%) in Oman when compared to the worldwide prevalence (1%), possibly attributed to the high rate of consanguineous marriages.²¹

A hospital-based study on recessive genetic disorders, commonly found in pediatric clinics, was performed to evaluate the observed birth incidence of these disorders from 1993 to 2002.²⁰ Autosomal recessive polycystic kidney disease (PKD) was the 3rd most frequent disease with an incidence of 1 in 12 000 births.²⁰ Both renal tubular acidosis and congenital nephrotic syndrome have an incidence of 1 in 20 000 births, whereas ciliopathies such as Bardet-Biedl syndrome and Meckel-Gruber syndrome have an incidence of 1 in 30 000 and 1 in 50 000, respectively.²⁰

Primary hyperoxaluria type 1 is a common cause of ESKD in Omani children. In a single-center study, 100% consanguinity was observed in the 4 studied families with primary hyperoxaluria type 1.²² The studied patients (n = 18) had severe disease with early presentation, since they were diagnosed at earlier age (< 5 years) than that found in other studies.²² Genetic analysis of the *AGXT* gene was performed for these families and c.33-34insC was the most common detected mutation.²²

Meckel-Gruber syndrome, which is a rare lethal autosomal recessive condition characterized by cystic kidney dysplasia and central system malformations, is caused by genetic defects in a growing number of *MKS* genes. The *MKS3* was mapped for the first time in families from Oman and Pakistan.²³

A study of 33 pediatric Omani patients with a diagnosis of polycystic disease of the liver and kidney, including autosomal recessive PKD, autosomal dominant PKD, congenital hepatic fibrosis, and Caroli disease, was performed at the Royal Hospital, the largest tertiary hospital in Oman. Although uncommon, these genetic diseases were found with a frequency of 1.5 per 1 000 000 population.²⁴ Autosomal recessive PKD was the most frequently detected condition with a frequency of 1.3 per 1 000 000 population.²⁴ The mean age at diagnosis of the studied patients was 27 months. Furthermore, neonatal kidney failure was reported in 2 autosomal recessive PKD patients. These conditions constitute significant mortality and morbidity for the affected patients and supportive management of portal hypertension and CKD until liver or kidney transplantation is required.²⁴

It is clear that many of these autosomal recessively inherited genetic disorders are more common due to high rates of consanguinity. A premarriage

education and health evaluation program is a major public health policy that is now carried out throughout Oman. There are major genetic studies underway for various inherited kidney disorders including cystic kidney diseases that will provide a major contribution to our knowledge of these diseases and their impact on CKD and its progression to ESKD. Additionally, autosomal dominant PKD is one of the most common inherited diseases leading to ESKD affecting 4 to 6 million people worldwide.²⁵ In Oman, the prevalence of autosomal dominant PKD has not been reported, but it is estimated to be 5% in the countries of the Gulf Cooperation Council.²⁶ DNA linkage analysis can be considered for adult patients suspected to be autosomal dominant PKD, but not for pediatric patients where the cysts will develop during childhood and confirmation can be done in adulthood.

Systemic Lupus Erythematosus

Systemic lupus erythematosus is a common chronic systemic inflammatory autoimmune disease which follows an aggressive course in many patients.²⁷ Tribal and geographical differences were observed in terms of organ involvement among Omani SLE patients, suggesting both genetic and environmental impacts.²⁸ In addition, geographical clustering of childhood onset SLE was recognized in the Eastern region of Oman (Sharqiya region), comprising 41% of the identified SLE children.²⁹⁻³¹

The clinical disease spectrum of SLE patients appears to be consistent with what found in neighboring Middle East countries and Caucasian populations. It has been shown that 51% of our patients had renal involvement, which is similar to that found in Kuwait (37%), Saudi Arabia (61%), and Caucasian patients (51%).^{27,32-34} In a retrospective study of familial juvenile SLE, researchers found that in children from Oman and Saudi Arabia, the most prevalent features were mucocutaneous manifestations, arthritis, and nephritis.³⁵ An autosomal mode of inheritance was suggested in many families.³⁵

From a public health perspective, the epidemiological data suggests differences in the mean age of onset of SLE. It was found that an earlier age of onset occurred in Omani children (8.6 years) compared to Saudi (12.1 years) and other Arabic countries, supporting the requirement for

much larger prospective and multicenter studies.³⁵ As mentioned earlier, lupus glomerulonephritis was the most prevalent pathology accounting for 30.4% of secondary glomerular disease.¹⁶ There are 2 major studies being carried on at the moment, both epidemiological and genetic ones of large scale which will shed light on the complexity, severity, and comorbidities associated with SLE in the country as a whole.

RENAL REPLACEMENT THERAPY

In 1980, an intermittent peritoneal dialysis program was implemented for ESKD patients, and in 1983, a hemodialysis program was started.³⁶ Continuous ambulatory peritoneal dialysis was only introduced in 1992.³⁶ The main dialysis unit in Muscat has a registry that collects data from all ESKD patients commencing RRT. The data collection is similar to that employed by the United States Renal Data System. Nowadays, there are 18 renal dialysis centers throughout the country with a total of 216 dialysis machines.² There were 1206 patients on hemodialysis and 92 on continuous ambulatory peritoneal dialysis at the end of 2013.³⁷ In general, hemodialysis is the preferred dialysis modality in the Middle East countries, while peritoneal dialysis is available on a limited scale.³⁸ However, there is a recent increasing trend in utilization of peritoneal dialysis in the Gulf countries including Oman.⁷

Similar to the nearby countries, 6.6% of hemodialysis patients were found positive for hepatitis B antigen.³⁶ In contrast, lower prevalence of hepatitis C virus infections were found in Omani patients with hemodialysis (26.5%) compared to the other Gulf countries.³⁹ The estimated annual mortality rate in hemodialysis population is about 10%, and infections and cardiovascular diseases are the most frequent causes.³⁶

Although kidney transplantation is the gold standard management strategy for people with ESKD, kidney transplantation program was initiated in 1988 as a collaborating project between the two main academic and service organizations in this country that is Sultan Qaboos University and the MOH.⁹ It started with both living related donor and deceased donor transplants. Transplantation from living unrelated donor was not and is still not performed in Oman, in order to avoid hidden commercialism, despite some Omani patients had such operations abroad and they are being followed

up in the country.

Transplant regulations were established in Oman in 1994 and were supported by formal ministerial decision. The brain death criteria have been accepted by civil authorities and religious authorities but have not yet been accepted by the public at large, possibly due to poor educational programs and media advertisements. A survey was carried out in 2010 to evaluate the attitude of our population toward organ transplantation and the results showed great public acceptance of kidney donation during life and very low acceptance of after death donation.⁴¹ Religious and sociocultural factors have to be further addressed and regulations and laws have to be strengthened to further improve the service and to curtail organs commercialism practices.

Although Oman deceased donor transplants program was among the earlier programs in the Gulf region, it was not fully sustainable and the transplantation program turns now to be mainly living related donor transplants program. The absence of resources to establish a committed organisational unit for deceased donor transplants was the major challenge causing its unsustainability compared to neighbouring countries. The program requires a good network of donors' coordinators throughout all intensive care units. Similarly, the absence of kidney support societies is an important hurdle that the government has to tackle and to ease the establishment of such important public services to further improve the care of people with ESKD.

The disturbing effects caused by unregulated commercial transplants performed outside the country, which is called transplant tourism, contributed to some extent to the unsustainability of this program. Interestingly, the support of the Declaration of Istanbul, in which the ethical guidelines and framework for transplantation was established, had led to immediate decrease in commercial transplants and a noticed increase in the number of transplants performed in Oman during the period of 2007 to 2009 (from 12 to 23 operations).⁴⁰ However, in recent years, there is an increasing trend towards commercial transplantation, especially from Pakistan and China, as well as countries that suffer from political unrest and natural disasters, where the poor being targeted for their organs in exchange for a financial gain.

CONCLUSIONS

Chronic kidney disease is among the most common challenges to both the health care providers and the public in Oman. The annual incidence of ESKD is estimated to be approximately 120 per million population in Oman.^[37, 7] From a public health perspective, it is necessary to continue to perform basic epidemiologic research to identify and evaluate early onset CKD and implement treatments designed to manage and slow disease progression. A lack of comprehensive epidemiological data concerning etiology and stage of CKD and ESKD within the Omani population emphasizes the urgent need for the establishment of such data and strengthens the ongoing need for a comprehensive nation-wide renal registry. Nephrologists in Oman need to be aware of demographic and epidemiological data in this rapidly changing country in order to plan diagnostic, management, and preventative strategies for kidney diseases. Similar to the global picture, diabetic and hypertensive nephropathies are the main contributors to the development of CKD in Oman. This growing burden needs to be recognized and addressed by both preventative strategies such as screening clinics, educating primary care physicians, and raising public awareness of disease and lifestyle modifications.

The establishment of national kidney societies (eg, a national kidney foundation) and support groups (eg, a kidney patient association) is vitally important. Implementing comprehensive central strategies to consolidate the living related donor kidney transplantation and supporting kidney organ donation is the way forward in treating people with ESKD. Similarly, increasing utilization of peritoneal dialysis and home hemodialysis approach is a very important service to provide for a growing ESKD population. Some key points are:

- Oman is the second largest country in the South East of Arabian Peninsula that has a total population of 3 831 553.
- The burden of noncommunicable diseases including chronic kidney disease is a serious health care issue in Oman.
- There is a gradual increase in the prevalence of ESKD and outpatients morbidity caused by CKD in Oman.
- Improvement of kidney transplant service is demanded.

CONFLICT OF INTEREST

None declared.

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