1 Introduction

Chronic kidney disease (CKD) is marked by long-term and usually irreversible loss of kidney function. It may have severe health outcomes. For people who develop end-stage kidney disease, treatment is expensive and requires intensive health services.

People with CKD are at risk of developing various complications and comorbidities, including cardiovascular diseases, respiratory system infections, bone and muscle problems, and anaemia. These problems can begin at a very early stage, even before CKD is detected, and the risks increase with the severity of CKD.

Many of the factors that increase a person's risk of developing CKD are common in Australia. With an ageing population and increasing prevalence of some risk factors, the number of Australians at risk of CKD is increasing. Nevertheless, effective prevention of CKD is possible as many of these risk factors are modifiable.

The kidneys

The kidneys are two bean-shaped organs located at the back of the abdomen. Each is about the size of a fist. They act as the body's filters, controlling the level of water and various chemicals, producing certain essential hormones, and clearing waste products from the blood. The waste products and any excess water are eliminated from the body through the bladder in the form of urine. When the kidneys do not work effectively, the body's chemical balance may be changed, essential bodily processes may be disrupted, and waste products may build up in the blood. This causes damage to the body's organs and systems, and may result in a range of serious complications.

How are kidney problems detected?

Initial evidence of kidney damage or reduction in kidney function can be detected through routine blood or urine testing. A blood test might find excess levels of waste products that are normally passed into the urine, or a urine test find blood or substances from the blood, that would normally not leak out of the kidneys. The most common indicators of kidney damage are proteins in the urine (proteinuria or albuminuria), blood in the urine (haematuria) and raised levels of urea or creatinine (a waste product of protein metabolism) in the blood.

Kidney function is measured by the glomerular filtration rate (GFR). The glomeruli are networks of blood vessels in the kidneys where the blood is filtered and waste products are removed. The glomerular filtration rate is a measurement of the amount of blood the kidneys clear of waste products in one minute.

Chronic kidney disease

The US Kidney Disease Outcome Quality Initiative (K/DOQI) has developed a definition and clinical guidelines for chronic kidney disease, which were published by the National Kidney Foundation of America (NKF) in 2002. This definition has been widely accepted by

the kidney community in Australia and around the world, and has been endorsed by Kidney Health Australia (Mathew & Johnson 2005).

According to the K/DOQI definition, the presence of chronic kidney disease should be established based on the occurrence of kidney damage and the level of kidney function, regardless of the specific diagnosis of diseases and conditions causing the damage. To be diagnosed with chronic kidney disease, a person must have evidence of kidney damage and/or reduced kidney function lasting for at least 3 months (Box 1.1).

Box 1.1: Diagnostic criteria for chronic kidney disease

In the clinical setting, a patient is diagnosed with CKD if he/she meets either of the following criteria:

1. *Kidney damage for 3 months or more, as defined by structural or functional abnormalities of the kidney, with or without decreased GFR, manifest by either:*
   - *pathological abnormalities; or*
   - *markers of kidney damage, including abnormalities in the composition of the blood or urine, or abnormalities in imaging tests.*
2. *Glomerular filtration rate (GFR) <60 mL/min/1.73 m^2 for 3 months or more, with or without other markers of kidney damage.*

Source: Adapted from NKF 2002.

Severity of chronic kidney disease

The K/DOQI definition classifies chronic kidney disease into five stages of severity, based on evidence of kidney damage and the degree of kidney function reduction, classified by GFR (Box 1.2). Despite the diversity of causes of CKD, the functional changes and clinical manifestations are quite similar across the spectrum. Although the use of the word 'stage' implies progression of disease, it is important to note that treatment can slow, delay or prevent further kidney damage in many cases. The proportion of people with CKD who will progress from one stage to the next, and the rate of this progression, are unknown.

In some people with severe CKD, kidney function is insufficient to sustain life and death will follow in a short period (weeks to a month or two). These people are regarded as having 'end-stage kidney disease' (ESKD), and require dialysis or a kidney transplant to survive. People receiving dialysis or living with a kidney transplant are said to have 'treated ESKD'.

Development and course of chronic kidney disease

CKD is a complex disease. It can be caused by a variety of different diseases and conditions, and in most cases develops over a number of years. It is usually asymptomatic until the very late stages, but can lead to impairment of many different organs and body systems even from the very early stages. End-stage kidney disease requires specialised and expensive treatment.

A brief outline of the course of this disease (Figure 1.1) and its main features are provided below. These are discussed in more detail in the following chapters.

Box 1.2: Severity of chronic kidney disease

Stage 1: Kidney damage with GFR at least 90 mL/min/1.73 m²

People with stage 1 CKD have evidence of kidney damage (structural or functional abnormalities of the kidney), but without decreased GFR. There are usually no symptoms.

Stage 2: Kidney damage with GFR 60 to 89 mL/min/1.73 m²

People with stage 2 CKD have evidence of kidney damage with some reduction in GFR. Most patients at this stage have no symptoms. They usually have high blood pressure and may have laboratory abnormalities indicating dysfunction in other organs.

Stage 3: GFR 30 to 59 mL/min/1.73 m²*

People with stage 3 CKD have a significant reduction in GFR. They may or may not show other signs of kidney damage. Blood tests will show increased levels of urea and creatinine, and often there will be indications of dysfunction in other organs. Although patients may have symptoms, they often remain asymptomatic even though their kidney function may be reduced by as much as 70%.

Stage 4: GFR 15 to 29 mL/min/1.73 m²*

People with stage 4 CKD have severely reduced kidney function. Blood levels of urea and creatinine increase, and there is greater evidence of dysfunction in other organs. Patients usually have only mild symptoms.

Stage 5: GFR less than 15 mL/min/1.73 m²*

In most cases, stage 5 CKD is marked by a range of symptoms and laboratory abnormalities in several organ systems, which are collectively referred to as uraemia. Patients at this stage may need to be prepared for kidney replacement therapy (dialysis or transplant), which will be required when kidney function is no longer sufficient to sustain life.

** with or without evidence of kidney damage*

Source: Adapted from Obrador & Pereira 2002.

Complex causality and multiple risk factors

As with many other chronic diseases, the causes of CKD are complex and there are a number of factors that can increase risk. Kidney function can be damaged by a variety of causes, such as glomerulonephritis, polycystic kidney diseases, diabetes and high blood pressure. However, the pathways leading to CKD are not clear. CKD can also progress at different rates, depending on the underlying cause of the disease.

Although there is no information on the prevalence of different causes of CKD in general in Australia, there are data on the causes of end-stage kidney disease in people receiving kidney replacement therapy. In 2003, around 53% of cases of treated ESKD in Australia were caused by diseases occurring inside the kidneys and urinary tract. These include inflammation and infection of the kidneys, infections and blockages of the urinary tract, drug-induced kidney impairments, inherited kidney disorders and congenital malformations. More than 40% of cases resulted from complications of other diseases and conditions, mainly diabetes and high blood pressure. In around 7% of cases, the cause could not be determined (Excell & McDonald 2005b).

A number of factors contribute to the development and progress of CKD. Smoking and physical inactivity can significantly increase the risk of developing CKD. Poor nutrition and obesity also increase risk indirectly by influencing the development of biomedical risk factors such as Type 2 diabetes. Older people, people with a family history of CKD and Indigenous Australians also tend to have a greater risk of kidney damage (Chadban et al. 2003; Briganti et al. 2002; Hoy et al. 1998).

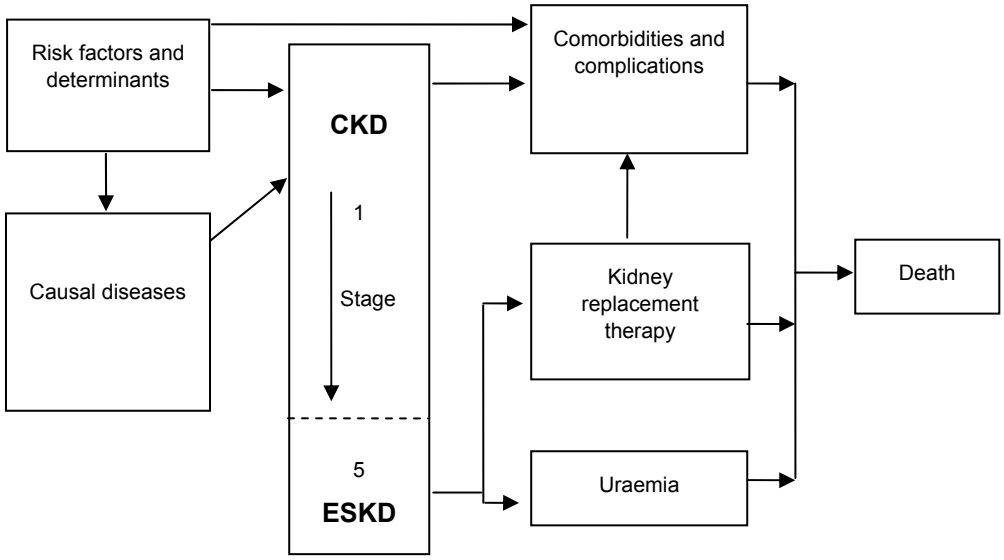

Figure 1.1: The course of chronic kidney disease

Asymptomatic nature of chronic kidney disease

In most cases of CKD, kidney function deteriorates over a period of years, but usually a person with CKD has no specific symptoms until the late stages. Initially the only signs of the disease are abnormal results of blood and urine tests (such as a raised blood urea and creatinine, or protein in the urine). A person can lose up to 85% of kidney function before even feeling sick. For this reason, the diagnosis of CKD is often delayed or missed.

Specialised treatment at end stage

In people with end-stage kidney disease, kidney function is no longer sufficient to sustain life. ESKD is one of the most severe outcomes of chronic kidney disease. Before the 1960s, death resulted very soon after reaching end-stage, but over the last 40 years there have been significant advances in our understanding of this condition and its treatment, especially kidney replacement therapy (dialysis and transplant). Since kidney replacement therapy became available and accessible, the lives of many people with ESKD have been prolonged. However, this treatment is still far from perfect. With kidney replacement therapy, the lives of patients with ESKD can be sustained, but the quality of their lives is much reduced and life expectancy is still shortened. Not all people with ESKD will agree to or be well enough to receive kidney replacement therapy.

Multi-organ impairment

ESKD is not the only health outcome of chronic kidney disease. CKD can affect all the organs and systems in the body. Although it is generally asymptomatic until the later stages, impairments of other organ systems due to poor kidney function occur and can be seen at the early stages, such as cardiovascular diseases, bone problems, anaemia and sleep apnoea (Johnson 2004). CKD has profound impacts on the circulatory system. There is substantial evidence that CKD is an independent risk factor for cardiovascular disease (Go et al. 2004).

The risks of damage to the circulatory system, as well as to other organs and systems, increase progressively with worsening kidney function. Many people with CKD do not develop ESKD or die from it directly, but die from complications of CKD, particularly heart disease and respiratory infections.

Prevention and management of chronic kidney disease

There is no cure for chronic kidney disease, but the disease is highly preventable and treatable, and progression can be slowed or stopped.

Although there are many factors that can increase the risk of developing CKD, there is strong evidence that many of these factors are modifiable and preventable. Although smoking reduces kidney function and increases the risk of kidney damage, these risks are diminished once smoking is stopped (Briganti et al. 2002; Pinto-Sietsma et al. 2000). A number of studies have shown that blood pressure lowering is associated with substantial slowing of the rate of decline in kidney function (Kshirsagar et al. 2000). In people with diabetes, tight control of blood sugar levels can retard progression of kidney damage and reduce vascular risk (DCCT 1993).

Once CKD has been diagnosed, appropriate therapeutic intervention has been demonstrated in a high-risk population to reduce the rate of progressive deterioration in kidney function and death by 20–50% (Hoy et al. 2003). For patients with advanced CKD, early referral to a nephrologist for consultation and treatment, and receiving care from a multidisciplinary team, have been found to significantly improve the outcomes of kidney replacement therapy and increase patients' life span (Curtis et al. 2005; Mendelssohn 2005).

Although CKD has many characteristics that are different from other chronic diseases, its occurrence and development largely interact with the onset and progress of certain of these diseases, such as diabetes and cardiovascular disease. Effective strategies for the prevention and management of CKD not only need to address kidney problems, but also need to tackle the problems of other related diseases and shared risk factors.

Although the burden posed by CKD is substantial, there is no national monitoring system for this disease. In the hope of stimulating discussion on this important topic, a brief outline of a possible national monitoring framework for CKD, including examples of potential indicators, is included in Appendix 3 of this report.

Purpose and structure of this report

This report compiles the latest information on CKD from a variety of data sources, with a focus on the modifiable and preventable risk factors associated with chronic kidney disease and the major causes of end-stage kidney disease in those receiving kidney replacement therapy. The aims of the report are:

1. to provide an overview of CKD and its impact on the Australian population and the health care system in Australia;
2. to describe the major risk factors for CKD and trends in recent years;
3. to examine trends in the incidence, prevalence and major causes of treated end-stage kidney disease; and
4. to review the current status of prevention and management of the disease.

The information provided in this report should serve as a vital resource for anyone with an interest in the area, especially those who are developing policies and providing services to help reduce the burden of CKD.

The report consists of six chapters.

- This introduction provides a definition of CKD, gives a brief overview of the major impacts of CKD, describes its major characteristics and outlines key issues in the CKD field.
- Chapter 2 documents detailed information on the burden of CKD. Aspects of its incidence and prevalence, impact on people's health and life, contribution to mortality, health service usage and health expenditure are described.
- Chapter 3 provides information on the risk factors for and causes of CKD.
- Chapter 4 examines the major causes of treated end-stage kidney disease. Information on trends in the incidence and prevalence of treated end-stage kidney disease due to these causes is given to highlight changes over recent years.
- Chapter 5 reviews the current situation with regard to the prevention and management of CKD in Australia. Information on strategies known to reduce exposure to risk factors and interventions to prevent further worsening of the disease is presented.
- Chapter 6 focuses on the burden of CKD among Aboriginal and Torres Strait Islander people. This population is disproportionately affected by CKD and particularly ESKD. Information on prevalence, incidence, health service use and mortality are presented and compared with the general population where possible.

The report also contains three appendix sections. An outline of methods, data sources and their limitations is included in Appendix 1, which also provides coding lists for CKD, using the International Classification of Diseases (ICD-10) and the International Classification of Primary Care (ICPC-2). Appendix 2 presents data relating to the Caring for Australians with Renal Impairment (CARI) guidelines on the adequacy of haemodialysis. Appendix 3 presents some information regarding the monitoring of CKD and related risk factors in Australia.

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