Department of Health

health

The prevalence of indicators for chronic kidney disease in the Victorian population

Victorian Health Monitor 2009–10 supplementary report

State Government Victoria

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Victorian Health Monitor 2009–10
supplementary report

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Summary

Summary

Between 2009 and 2010 the Victorian Department of Health conducted the Victorian Health Monitor (VHM), a statewide cross-sectional health measurement survey. The VHM collected food and nutrition information, as well as a range of physical and biomedical measurement data to produce prevalence estimates for diabetes, cardiovascular disease and related risk factors (such as obesity and high blood pressure) from a representative sample of adults aged 18–75 years in Victoria. The VHM also collected indicators for chronic kidney disease (CKD), including reduced kidney function (eGFR <60 ml/min/1.73m^2) and kidney damage (albuminuria–an albumin:creatinine ratio ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females).

- The VHM results showed one in ten (9.1 per cent) survey participants had an indicator for CKD, which included reduced kidney function (eGFR <60 ml/min/1.73m^2) and/or kidney damage (albuminuria).
- Applying the prevalence rate to the 2010 population produces an estimate of 360,000 Victorians aged 18–75 years with an indicator for CKD.
- The prevalence of reduced kidney function was 3.5 per cent (140,000 adults in 2010). Prevalence was higher for females (4.1 per cent), compared with males (2.9 per cent).
- The prevalence of kidney damage was 6.4 per cent (260,000 adults in 2010). Prevalence increased with age for males, but not for females.
- The prevalence of indicators for early CKD (stages 1–3) was 9.0 per cent and about 0.1 per cent of survey participants had an indicator for CKD at stages 4–5.
- The prevalence of proteinuria was 4.3 per cent; it was higher for females (5.8 per cent), compared with males (2.8 per cent).
- The prevalence of haematuria was 23.4 per cent; it was higher for females (33.1 per cent), compared with males (13.6 per cent).
- The prevalence rates for both kidney damage and reduced kidney function in Australia in 1999–2000 were similar to the rates in Victoria in 2009–10.
- There was a relationship between the social determinants of health and having an indicator for CKD.
- Diabetes, high blood pressure and elevated triglycerides were associated with having an indicator for CKD, after adjustment for age and sex.

1. Introduction

1. Introduction

In 2006 chronic kidney disease (CKD) contributed to almost 10 per cent of all deaths, and in 2006–07, CKD contributed to more than 1.1 million hospitalisations in Australia, primarily for dialysis and kidney replacement therapy (AIHW 2009). In Victoria, the number of patients with end stage kidney disease (ESKD) requiring renal replacement therapy continues to grow at approximately 6 per cent each year (Department of Health 2009).

Risk factors for CKD include a family history of kidney disease, increasing age, previous kidney disease or injury, diabetes, cardiovascular disease, high blood pressure, being overweight or obese, smoking and poor nutrition (AIHW 2013; KHA 2012; Thomas 2007). High rates of CKD have also been observed among people of Aboriginal or Torres Strait Islander origin (AIHW 2011).

Clinical biomarkers for CKD include measures of kidney function and measures of kidney damage. Serum creatinine is used to estimate the glomerular filtration rate (eGFR), which is a measure of kidney function. The prevalence data for eGFR, as presented in this report, are based on eGFR measures derived using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula (White et al. 2010). This formula provides less bias and improved precision over other methods at eGFR <60 ml/min/1.73m^2 (Johnson et al. 2012a; Johnson et al. 2012b; KHA 2012). Kidney damage can be detected by imaging tests or biopsy, but is usually ascertained by the presence or absence of certain markers such as albuminuria, proteinuria, or haematuria (AIHW 2009; Johnson et al. 2004; KHA 2007). Albuminuria is the preferred indicator of kidney damage (Johnson et al. 2012b), because it offers greater sensitivity and improved precision for detecting lower, but clinically significant, levels of proteinuria, compared with total protein. Haematuria can be unreliable, and requires excluding menstrual or other urological causes.

Unless otherwise stated in this report, 'reduced kidney function' refers to an eGFR <60 ml/min/1.73m^2, calculated using the CKD-EPI formula and 'kidney damage' refers to albuminuria, where an albumin:creatinine ratio (ACR) was ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females. Survey participants with either reduced kidney function or kidney damage are classified as having an indicator for CKD. Although they are indicators for kidney disease, CKD is only diagnosed when reduced kidney function or kidney damage has been observed for three months or more.

Until recently, CKD was diagnosed and managed using the Kidney Disease Outcomes Quality Initiative (KDOQI); it categorises the disease into five stages of severity based on the level of kidney function, defined by the eGFR (NKF 2002; White et al. 2010) (Table 1). However, the KDOQI system has been criticised for not providing a realistic indication of renal prognosis, which in turn influences subsequent disease management (Tonelli et al. 2011).

To overcome this, a matrix has been developed that categorises each stage of CKD based on the presence of kidney damage (albuminuria) and level of kidney function—with or without reduced kidney function (eGFR <60 ml/min/1.73m^2) (Johnson et al. 2012b; KHA 2012). The matrix aligns disease management more closely with the level of patient risk, as outlined in Table 1.

Table 1: Classification of chronic kidney disease

Classification of chronic kidney disease					
KDOQI stage of kidney function			Albuminuria Stage		
		Kidney function	Normal (urine ACR mg/mmol)	Microalbuminuria (urine ACR mg/mmol)	Macroalbuminuria (urine ACR mg/mmol)
Stage	Description	eGFR (ml/min/1.73m^2)	Male: <2.5 Female: <3.5	Male: 2.5–25 Female: 3.5–35	Male: >25 Female: >35
1	Kidney damage with normal GFR	≥90	Not CKD unless haematuria, structural or pathological abnormalities present		
2	Kidney damage with mild ↓ GFR	60–89			
3a	Moderate ↓ GFR#	45–59			
3b	Moderate ↓ GFR#	30–44			
4	Severe ↓ GFR#	15–29			
5	Kidney failure#	<15 or on dialysis			

Source: Johnson et al. 2012; KHA 2012a.

Subjects may or may not have evidence of kidney damage.

KDOQI: Kidney Disease Outcomes Quality Initiative.

Green: Normal kidney function with no evidence of kidney damage, based on an eGFR ≥60 ml/min/1.73m^2 with normoalbuminuria.

Yellow: Normal to mild reduction in kidney function with kidney damage, based on an eGFR ≥60 ml/min/1.73m^2 with microalbuminuria, or a moderate reduction in kidney function with no evidence of kidney damage, based on an eGFR 45–59 ml/min/1.73m^2 with normoalbuminuria.

Orange: Moderate reduction in kidney function with/without evidence of kidney damage, based on an eGFR 30–44 ml/min/1.73m^2 with normoalbuminuria, or an eGFR 30–59 ml/min/1.73m^2, with microalbuminuria.

Red: Severe reduction in kidney function to kidney failure, based on an eGFR <30 ml/min/1.73m^2 irrespective of albuminuria status; or macroalbuminuria present, irrespective of eGFR.

Reduced kidney function and kidney damage are independent risk factors for cardiovascular disease (KHA 2012). For patients with renal disease or diabetes, the presence of albuminuria is associated with an increased risk of progressive renal impairment, cardiovascular disease, and overall mortality (Atkins et al. 2004). People with CKD are at risk of developing ESKD, requiring dialysis or transplantation; they are also predisposed to developing premature cardiovascular disease, with an increased risk of death from heart attack or stroke (Anavekar et al. 2004; Go et al. 2004). In 2004 about 30 per cent of all new ESKD was due to diabetes (McDonald et al. 2006), compared with 17 per cent in 1994 (Disney 1996). The other common causes of ESKD were glomerulonephritis (25 per cent) and vascular kidney disease, related to hypertension or atherosclerosis (13 per cent) (McDonald et al. 2006).

Although information about dialysis, transplantation and death associated with ESKD is readily available (ANZDATA 2013), not much is known about the burden of early CKD (stages 1–3). Prevalence measures of early CKD are difficult to obtain because the disease often remains undetected until the latter stages (Department of Health 2009). Many people do not know they have kidney disease because up to 90 per cent of kidney function can be lost before symptoms are evident (AIHW 2009). Early detection allows for early intervention to minimise loss of function, which leads to better outcomes, including delayed disease progression, reduced cardiovascular disease risk and improved quality of life. The progression of CKD can often be delayed by controlling modifiable risk factors and with appropriate disease management (AIHW 2013; Chadban et al. 2003).

The most recent information on the prevalence of CKD in Australia comes from the AusDiab survey, a nationwide cross-sectional survey of non-institutionalised Australians aged 25 years or more (Dunstan et al. 2002), conducted in 1999–2000, with follow up in 2005 and 2012. The survey results suggested in 1999–2000, about 11.5 per cent of Australian adults had evidence of kidney damage with albuminuria or proteinuria, and/or reduced kidney function (eGFR <60 ml/min/1.73m^2) (White et al. 2010). Further, every year about 0.4 per cent of the population develops reduced kidney function and 0.7 per cent develops evidence of kidney damage (Tanamas et al. 2013).

In 2009–10 the Victorian Department of Health conducted the Victorian Health Monitor (VHM), a statewide cross-sectional, health measurement survey. The VHM collected baseline physical and biomedical measurement data from a representative sample of adults aged 18–75 years in Victoria, to produce estimates of the prevalence of diabetes, heart disease, obesity, dyslipidaemia and hypertension (Department of Health 2012a). The survey collected nutrition information and risk factors for chronic disease, as well as biomarkers for kidney function (eGFR) and kidney damage (albuminuria, proteinuria, haematuria). This report uses the results of the VHM to estimate the prevalence of indicators for CKD and to explore risk factors associated with CKD in Victorian adults.

2. Methods

Methods

Ethics

The Human Research Ethics Committee of the Baker IDI Heart and Diabetes Institute approved the VHM. All participants provided written, informed consent.

Procedure and participants

The VHM was conducted between May 2009 and April 2010. Sample selection was based on a stratified cluster sample of Census collection districts (CDs) within the eight Victorian Department of Health regions (http://www.health.vic.gov.au/regions/). The survey included 50 randomly selected CDs, with 25 selected from greater Melbourne (metropolitan area) and 25 from the balance of the state (rural areas).

One eligible person (aged 18–75 years) from each household selected within each CD was randomly selected to participate. The sampling frame excluded persons with an intellectual disability, pregnant women and those too unwell to participate. The final sample comprised 3,653 participants. The survey involved an initial household visit to participants to collect demographic information, followed by a visit to a local test site for biomedical and physical examination and response to a risk factor questionnaire. Participants were then asked to complete three 24-hour dietary recall interviews, conducted over a six-week period.

Test sites for collecting biomedical and physical measures were established in each CD included in the sample. The procedures used for the biomedical examination were closely aligned with the protocol recommended by the World Health Organization (WHO 1999).

Indicators for CKD

Blood samples were collected from survey participants at test sites by venipuncture, after an overnight fast of 10 or more hours. All samples were centrifuged at test sites to separate serum and plasma fractions and were transported from test sites each day to a central Melbourne laboratory for analysis. Survey participants also provided a spot urine sample at the test sites.

Serum and urinary creatinine was determined by a modified Jaffe (alkaline picrate kinetic) method using an Advia 2400 Chemistry Analyser (Siemens Healthcare Diagnostics). This method is traceable to the isotope dilution mass spectrometry (IDMS) reference method.

Urinary albumin was measured by polyethylene glycol-enhanced immunoturbidimetric assay using an Advia 2400 Chemistry Analyser (Siemens Healthcare Diagnostics). The ACR was calculated for each participant and albuminuria was determined if the ACR was ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females.

Urinary protein was measured with a Pyrogallol Red-Molybdate complex (Dye Binding) method using an Advia 2400 Chemistry Analyser (Siemens Healthcare Diagnostics). Proteinuria was defined as a protein:creatinine ratio (PCR) ≥0.20 mg/mg (22.6 mg/mmol). Because there is no universally accepted definition of proteinuria (Martin 2011), this value was selected to enable comparison to the findings of the AusDiab survey (Chadban 2002; White et al. 2010).

An eGFR was calculated for each participant using serum creatinine measures and the CKD-EPI formula (White et al. 2010), modified to exclude the factor applied to African-Americans. This report defines reduced kidney function where an eGFR is less than 60 ml/min/1.73m^2.

Haematuria was measured by peroxidise-like activity using Multistix 10 SG urinalysis strips (Siemens Healthcare Diagnostics) and was classified as the presence or absence of blood in the urine. This differs from the method used to determine the presence of haematuria in the AusDiab survey, which included a repeat dipstick test and confirmation of haematuria by urine microscopy of >10,000 red blood corpuscles/mL.

Most analyses in this report classified VHM survey respondents as having an indicator for CKD if they had reduced kidney function (eGFR <60 ml/min/1.73m^2) and/or albuminuria (as evidence of kidney damage). This definition excludes proteinuria and is consistent with the latest position statements on diagnosing and measuring CKD (Johnson et al. 2012a; Johnson et al. 2012b).

To diagnose CKD, changes in glomerular filtration rate and markers of kidney damage must be persistent for three months or more. The VHM used a similar methodology for measuring indicators of CKD at the population level as was used in other Australian studies (Chadban et al. 2003). However, as with other studies of this nature, the VHM only provided limited evidence of the prevalence of diagnosed CKD:

- It was a single, cross-sectional survey that did not follow up participants for biomarkers of CKD after three months.
- It did not consider factors other than CKD that are known to affect urinary albumin and protein excretion (Glassock 2010); nor did it identify haematuria due to menstrual or other urological causes.
- It did not identify factors independent of renal function that can affect plasma creatinine levels, such as diet (meat intake) and muscle mass (Afzali et al. 2007).

Risk factors for CKD

A risk factor questionnaire was used to establish participant demographic characteristics, medical history (personal history of diabetes, cardiovascular disease–including high blood pressure, and general health and wellbeing) and selected modifiable chronic disease risk factors (tobacco use, physical activity, sedentary behaviour, nutrition, and psychological distress). Additional physical and biomedical measures were taken during the survey, including weight, height, blood pressure, fasting blood glucose and blood lipids. The glossary contains definitions of the information collected for the VHM.

The survey defined diabetes and impaired fasting glucose based on the values for fasting blood glucose concentration outlined in the World Health Organization (WHO 2006) report on diagnosing and classifying diabetes. Survey participants were classified as having diabetes if they were previously diagnosed with the disease and were taking medication for their condition, or if they had a fasting plasma glucose level ≥7.0 mmol/L. Participants were classified as having impaired fasting glucose if they had a fasting plasma glucose level between 6.1 and <7.0 mmol/L. Participants with a fasting plasma glucose level <6.1 mmol/L were defined as having normal fasting glucose levels.

Three individual at-rest blood pressure measures were taken during the survey and the first two measures were used to determine an average or mean blood pressure. However, if the difference between the first and second measure was greater than 10 mmHg and 6 mmHg (for the systolic and diastolic blood pressure respectively), then the third measurement was considered, and the mean of the two closest readings was used. People with an average blood pressure greater than or equal to 140/90 mmHg were defined as having high blood pressure.

Recommendations by the National Heart Foundation and the Australian Institute of Health and Welfare (NHF and AIHW 1990) were used to classify individual lipid abnormalities. Elevated triglyceride levels were defined where serum triglyceride levels were ≥2.0 mmol/L. Total cholesterol, low-density lipoprotein (LDL) and high-density lipoprotein (HDL) levels were also obtained. Elevated total cholesterol levels were defined where total cholesterol levels were ≥5.5 mmol/L and elevated LDL cholesterol levels were defined where serum LDL cholesterol was ≥3.5 mmol/L. Reduced HDL cholesterol levels were defined where serum HDL cholesterol was <1.0 mmol/L for males or <1.3 mmol/L for females. Binary variables were created from these measures based on thresholds for abnormality and considered in the risk factor modelling (Table 10).

The survey included height and weight measurements to determine body mass index (BMI), a measure of overall adiposity. Height was measured to the nearest 0.1 cm without shoes using a stadiometer and weight was measured without shoes and excess clothing to the nearest 0.1 kg using digital weighting scales. An obese BMI was determined based on the World Health Organization (WHO 2000) definition, where weight in kg/height in m^2 is ≥30 kg/m^2.

Information on the social determinants of health was obtained with the interviewer-administered risk factor questionnaire. Survey participants were asked a series of questions about socioeconomic factors, psychosocial risk factors and community and societal characteristics. Socioeconomic factors included household income levels, highest levels of education attained, occupation, country of birth and the main language spoken at home.

Information was collected on psychological distress using the Kessler 6 Psychological Distress Scale (K6) (Kessler et al. 2002). The K6 is a six-item questionnaire designed to yield a measure of psychological distress in the previous 30 days, based on questions about anxiety levels and depressive symptoms experienced by individuals. More specifically, the K6 includes questions about nervousness, hopelessness, restlessness, sadness, effort and worthlessness. Each K6 question has the same response categories: all of the time, most of the time, some of the time, a little of the time and none of the time (that are scored 4 through to 0). The six items are summed to yield scores ranging from 0 to 24. Individuals with scores of 0–12 are categorised as probably not having a serious mental illness and those with scores 13–24 as having a probable serious mental illness (Kessler et al. 2010). Validation studies in a number of different countries, including Australia, show the K6 performs well as a screening tool in large population surveys, with good concordance against independent studies of clinical diagnoses of serious mental illness (Kessler et al. 2002; 2003; Furukawa et al. 2003).

Information on community and societal characteristics was obtained from questions about levels of social support. Participants were asked whether they could get help from family, friends or neighbours when needed and whether they could rely on a relative, or a friend not living with them, to care for them (or their children) in an emergency.

In addition to the social determinants of health, survey participants were asked about other risk factors for CKD. They were asked if they had ever experienced an atherosclerotic event such as a stroke, angina, heart attack, coronary bypass operation, had an angioplasty, or had ever had a stent inserted. Participants who reported having experienced any of these events were classified as having had a previous diagnosis of at least one cardiovascular disease.

Survey participants were also asked about their smoking history. The survey tool used to determine smoking status was previously validated by the Australian Institute of Health and Welfare (AIHW 1998). Participants were defined as ‘current smokers’ if they reported smoking daily or occasionally.

They were defined as ‘ex-smokers’ if they no longer smoked but reported having smoked at least 100 cigarettes, or similar, in their lifetime. ‘Non smokers’ included participants who reported never having smoked or having smoked less than 100 cigarettes, or similar, in their lifetime.

Information on physical activity was obtained through a series of activity-based questions included in the interviewer-administered risk factor questionnaire. Activity levels were determined in terms of total time spent in moderate levels of physical activity in the previous week. The *National physical activity guidelines for adults* (DoHA 1999) recommend adults undertake at least 150 minutes of moderate to vigorous activity each week. Survey participants who reported participating in at least 150 minutes of moderate activity in the past week were classified as doing ‘sufficient’ activity to meet the national guidelines. Participants who reported between 10 and 149 minutes of moderate activity in the past week were classified as doing ‘insufficient’ activity to meet the national guidelines. Participants who reported doing less than 10 minutes of moderate activity in the past week were classified as being ‘physically inactive’.

Statistical analysis

The aim of the statistical analysis was to produce population level estimates for CKD indicators in Victoria. Prevalence estimates and their 95 per cent confidence intervals were calculated. To account for the clustering and stratification of the survey design, and to adjust for non-response, the data were weighted to match the age and sex distribution of the 2008 estimated resident population of Victoria aged 18–75 years (Department of Health 2012a). To eliminate the effect that differences in age structure may have on estimates from different populations, prevalence estimates (percentages) were age standardised to the 2006 estimated resident population of Victoria aged 18–75 years.

To address the growing burden of CKD in Victoria, it is important to be able to identify and understand the relative contribution of risk factors to the development and progression of CKD. Survey-weighted bivariate logistic regression models were used to test the relationship between individual indicators for the social determinants of health that were collected in the VHM and having an indicator for CKD. A dependant binary variable was constructed for modelling. VHM participants were classified as either having or not having an indicator for CKD, based on the presence of having or not having reduced kidney function and/or kidney damage (eGFR <60 ml/min/1.73m^2 (CKD-EPI) or an ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females).

A multivariate logistic regression model was developed to identify risk factors associated with having an indicator for CKD, using data from the VHM. The dependant binary variable used in the multivariate modelling was the same used in the bivariate modelling of the social determinants, as described above. Bivariate logistic regression modelling was initially conducted to identify possible risk factors associated with having an indicator for CKD. Plausible influential risk factor variables with a p-value less than 0.2 in the bivariate models were included in the multivariate logistic regression model. The variables entered into the multivariate model were adjusted for age and sex. Using backward elimination, non-significant variables (p>0.05) with the highest p-values were sequentially removed to yield the final model (Table 10). The Hosmer-Lemeshow goodness-of-fit test was used to test the model fit.

All analyses were conducted using Stata statistical software version 12.1 (StataCorp, College Station, Texas, USA). Statistical significance was determined at p<0.05.

3. Prevalence of indicators for CKD

Prevalence of indicators for CKD

Table 2 shows the prevalence of indicators for CKD, by level of kidney function and kidney damage, for VHM participants aged 18–75 years. The categories in the table are based on the recently developed risk matrix for CKD (Johnson et al. 2012b; KHA 2012) (Table 1). Over 90 per cent of survey participants had normal levels of kidney function (eGFR ≥60 ml/min/1.73m^2) with no evidence of kidney damage (albuminuria). Of those classified as being at risk of CKD, 7.7 per cent (310,000 adults in 2010) had a mild level of risk (yellow), with about 1.4 per cent (50,000 adults in 2010) having either a moderate or severe level of risk for CKD (orange and red).

Table 2: Prevalence of indicators for CKD, by stage of kidney function and level of kidney damage

Kidney function		Albuminuria[b]		
Stage	eGFR (ml/min/1.73m^2)[a]	Normal	Microalbuminuria[c]	Macroalbuminuria[d]
1	≥90	90.9% (89.3–92.2)	7.7% (6.6–8.9)	0.7%* (0.3–1.5)
2	60–89			
3a	45–59		0.7% (0.5–1.2)	
3b	30–44			
4	15–29			
5	<15 or on dialysis			

a eGFR calculation based on CKD-EPI formula.

b Albuminuria based on an ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females.

c Microalbuminuria based on an ACR 2.5–25 mg/mmol for males or 3.5–35 mg/mmol for females.

d Macroalbuminuria based on an ACR >25 mg/mmol for males or >35 mg/mmol for females.

Green: Normal kidney function with no kidney damage.

Yellow: Normal to mild decrease in kidney function with presence of kidney damage, based on an eGFR ≥60 ml/min/1.73m^2 with microalbuminuria, or a moderate decrease in kidney function with no kidney damage present, based on an eGFR 45–59 ml/min/1.73m^2 with normoalbuminuria.

Orange: Moderate decrease in kidney function with/without presence of kidney damage, based on an eGFR 30–44 ml/min/1.73m^2 with normoalbuminuria, or an eGFR 30–59 ml/min/1.73m^2, with microalbuminuria.

Red: Severe decrease in kidney function to kidney failure, based on an eGFR <30 ml/min/1.73m^2, irrespective of albuminuria status; or macroalbuminuria present, irrespective of eGFR.

The data are weighted to the age and sex distribution of the 2008 estimated resident population of Victoria and are age standardised to the 2006 estimated resident population of Victoria.

* Estimate has a relative standard error of 25–50 per cent and should be interpreted with caution.

Table 3 shows the prevalence of specific indicators for CKD:

- The prevalence of reduced kidney function (eGFR <60 ml/min/1.73m^2) for survey participants aged 18–75 years was 3.5 per cent (140,000 adults in 2010). Prevalence was higher for females (4.1 per cent), compared with males (2.9 per cent) (p=0.038) (Table 3). The prevalence of reduced kidney function was negligible among males and females aged less than 45 years, but increased to 15.9 per cent for males and 24.1 per cent for females aged 65–75 years (p=0.035) (Figure 1).
- Albuminuria was present in 6.4 per cent of all participants (260,000 adults in 2010), with no significant difference in prevalence between males (6.8 per cent) and females (6.0 per cent) (p=0.417) (Table 3). The prevalence of albuminuria increased with age for males (p=0.037), while for females, the increase in albuminuria with age was not significant (p=0.255) (Figure 1).

- Proteinuria was present in 4.3 per cent of all participants, with prevalence higher for females (5.8 per cent), compared with males (2.8 per cent) (p=0.001) (Table 3).
- The prevalence of haematuria was 23.4 per cent, with prevalence higher for females (33.1 per cent), compared with males (13.6 per cent) (p=0.000) (Table 3).

The prevalence of an indicator for CKD was defined based on the presence of reduced kidney function (eGFR<60 ml/min/1.73m^2) and/or kidney damage (albuminuria), as described in the latest position statements on diagnosing and managing CKD (Johnson et al. 2012a; Johnson et al. 2012b). This is equivalent to the yellow, orange and red areas of the classification matrix for CKD (Table 1 and Table 2). The prevalence of an indicator for CKD was 9.1 per cent (360,000 adults in 2010), with no significant difference in prevalence observed between males (8.9 per cent) and females (9.4 per cent) (p=0.641) (Table 3). Although prevalence increased with age for males (p=0.033), prevalence did not increase significantly with age for females (p=0.099) (Figure 1).

Table 3: Prevalence of individual indicators for CKD

	Males		Females		Total	
	%	95% CI	%	95% CI	%	95% CI
eGFR <60 ml/min/1.73m^2 [a]	2.9	2.0 – 4.3	4.1	3.2 – 5.3	3.5	2.7 – 4.6
Albuminuria[b]	6.8	5.6 – 8.3	6.0	4.6 – 7.7	6.4	5.3 – 7.6
Microalbuminuria[c]	6.0	4.9 – 7.4	5.5	4.3 – 7.1	5.8	4.9 – 6.8
Macroalbuminuria[d]	0.8*	0.4 – 1.5	0.4*	0.2 – 0.9	0.6*	0.3 – 1.1
Proteinuria[e]	2.8	2.0 – 4.0	5.8	4.5 – 7.4	4.3	3.5 – 5.3
Haematuria[f]	13.6	11.3 – 16.2	33.1	29.9 – 36.4	23.4	21.3 – 25.6
Indicator for CKD[g]	8.9	7.5 – 10.6	9.4	7.7 – 11.4	9.1	7.8 – 10.7

a eGFR calculation based on CKD-EPI formula.

b Albuminuria based on an ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females.

c Microalbuminuria based on an ACR 2.5–25 mg/mmol for males or 3.5–35 mg/mmol for females.

d Macroalbuminuria based on an ACR >25 mg/mmol for males or >35 mg/mmol for females.

e Proteinuria based on a protein:creatinine ratio (PCR) ≥22.6 mg/mmol (≥20 mg/mg).

f Haematuria based on presence of blood on dipstick.

g Indicator for CKD based on an eGFR <60 ml/min/1.73m^2 or an eGFR ≥60 ml/min/1.73m^2 with albuminuria (ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females).

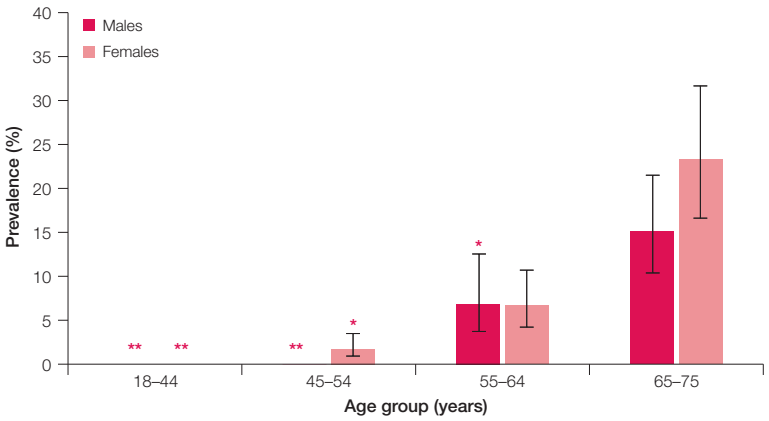
95%CI = 95 per cent confidence interval.

The data are weighted to the age and sex distribution of the 2008 estimated resident population of Victoria and are age standardised to the 2006 estimated resident population of Victoria.

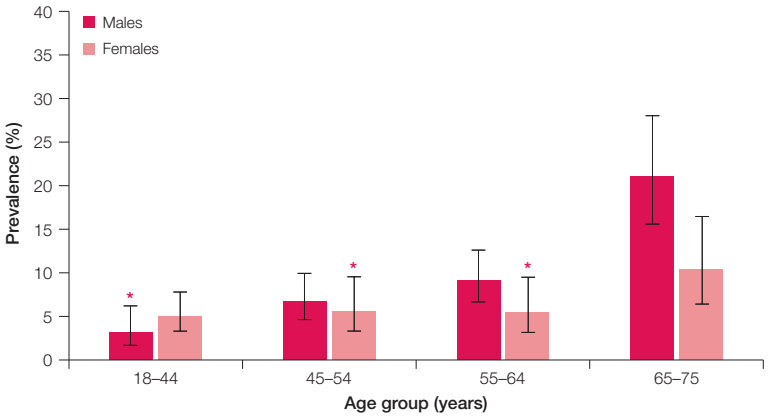
* Estimate has a relative standard error of 25–50 per cent and should be interpreted with caution.

Figure 1: Prevalence of indicators for CKD, by age group and sex

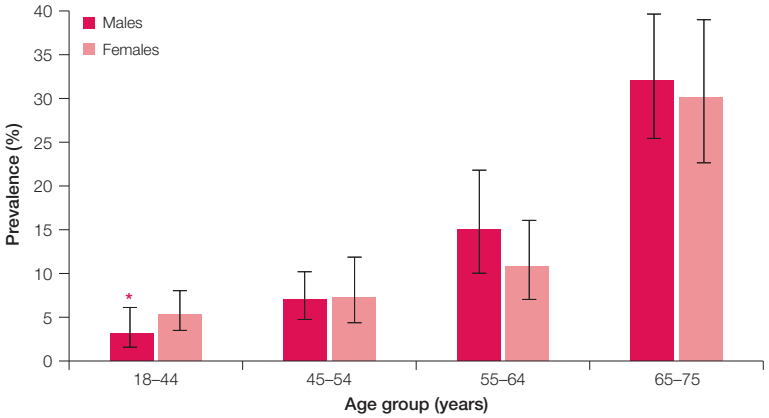
a) eGFR <60 ml/min/1.73m² [a]



b) Albuminuria [b]



c) Indicator for CKD [c]



a eGFR calculation based on CKD-EPI formula.

b Albuminuria based on an ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females.

c Indicator for CKD based on an eGFR <60 ml/min/1.73m² or an eGFR ≥60 ml/min/1.73m² with albuminuria (ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females).

Error bars represent 95 per cent confidence intervals.

* Estimate has a relative standard error of 25–50 per cent and should be interpreted with caution.

** Estimate has a relative standard error greater than 50 per cent and is not reported because it is not reliable.

About 9.0 per cent of participants had an indicator for early CKD (stages 1–3) and about 0.1 per cent had an indicator for severely reduced kidney function or kidney failure (stages 4–5) (Table 4).

Table 4: Prevalence by stage of CKD[a]

Stage of CKD	%	95% CI
Stage 1 (Albuminuria with eGFR ≥90)	2.6	1.9 – 3.7
Stage 2 (Albuminuria with eGFR 60–89)	3.0	2.5 – 3.6
Stage 3a (Moderately decreased eGFR 45–59)	3.0	2.4 – 3.7
Stage 3b (Moderately decreased eGFR 30–44)	0.4*	0.3 – 0.8
Stage 4 (Severely decreased eGFR 15–29)	**	
Stage 5 (Kidney failure eGFR <15 or on dialysis)	**	

a Albuminuria is based on an ACR ≥2.5 mg/mmol males or ≥3.5 mg/mmol for females. The eGFR measures were derived using the CKD-EPI equation.

95%CI = 95 per cent confidence interval.

The data are weighted to the age and sex distribution of the 2008 estimated resident population of Victoria and are age standardised to the 2006 estimated resident population of Victoria.

* Estimate has a relative standard error of 25–50 per cent and should be interpreted with caution.

** Estimate has a relative standard error greater than 50 per cent and is not reported because it is not reliable.

4. Comparisons with the Australian Diabetes, Obesity and Lifestyle study (AusDiab)

Comparisons with the Australian Diabetes, Obesity and Lifestyle study (AusDiab)

The prevalence of CKD in the Australian population is unknown, but was previously inferred from indicators for CKD measured in the 1999–2000 AusDiab (Australian Diabetes, Obesity and Lifestyle) survey (Dunstan et al. 2001). Like the VHM, the results of the AusDiab survey were based on a spot urine sample. The results of follow-up testing for survey participants with adverse results in the AusDiab survey and the VHM are unknown, so it is not possible to determine whether those with adverse results actually had CKD (that is, reduced kidney function and/or kidney damage present three months post-initial testing).

Several articles were published on indicators for CKD, based on results from the AusDiab survey (Atkins et al. 2004; Chadban 2002; Chadban et al. 2003; White et al. 2010). However, specific definitions for indicators vary between published articles and are not always comparable with results from the VHM. The difficulties with comparisons are further compounded by differences in laboratory testing between the two surveys.

Table 5 presents adult population prevalence estimates for a range of CKD indicators based on results from both surveys. The data from the AusDiab survey was obtained from published sources and is relevant to the adult Australian population aged 25 years or more in 1999–2000. The data from the VHM is relevant to the adult Victorian population aged 18–75 years in 2009–2010. The analysis below interprets comparisons between the surveys cautiously, given the methodological differences. However, some VHM data were adjusted specifically to improve comparability; for example, the definition for CKD at stages 1–2 includes proteinuria as well as albuminuria. Therefore, the prevalence of an indicator for CKD at stage 1 and stage 2 for Victoria is different in Table 5, compared with results in Table 4 of this report.

Table 5 shows the prevalence of an indicator for CKD by stage appears to be similar between the VHM and the AusDiab survey. The 95 per cent confidence intervals for estimates at stages 1–3 overlap, even though there are differences in the age range for adults and results from both surveys should be age standardised to a single reference population, the survey designs and methodologies are different, and there is a ten year time interval between the two surveys. Each stage in the table reflects the staging in Table 1 of this report, with the addition of proteinuria at stages 1–2. The eGFR is based on serum creatinine levels and was derived using the CKD-EPI formula (White et al 2010). It was not possible to compare the prevalence of severely reduced kidney function and kidney failure (stage 4 and stage 5) between the two surveys because the estimates were not (statistically) reliable.

Comparing the 95 per cent confidence intervals showed:

- The prevalence of albuminuria was similar between the two surveys. Most participants with albuminuria had microalbuminuria, and fewer than 1 per cent of participants in both surveys had macroalbuminuria.
- The prevalence of proteinuria was significantly higher for Victorian adults in 2009–10, compared with Australian adults in 1999–2000.
- The prevalence of haematuria was significantly higher for Victorian adults in 2009–10, compared with Australian adults in 1999–2000. However, the AusDiab survey included a repeat dipstick test and confirmation of haematuria with urine microscopy. The VHM did not include confirmation testing for haematuria and this may account for some of the difference in prevalence observed between the two surveys.

Despite the methodological differences, the noted similarities in prevalence between the surveys suggest the prevalence rate for these indicators has not changed over time. However, the number of people with reduced kidney function and/or kidney damage in the population has likely increased, reflecting population growth. Using the 9.1 per cent prevalence rate for indicators of CKD in Victoria (see Table 3), the number of Victorians aged 18–75 years with reduced kidney function and/or kidney damage has likely increased from 310,000 in 2001 to 360,000 in 2010.

Table 5: Comparison of the prevalence of individual indicators for CKD

	AusDiab 1999–2000		VHM 2009–10	
Indicators for CKD	%	95% CI	%	95% CI
Stage 1 (Albuminuria or proteinuria with eGFR ≥90)[a]	2.3	1.7 – 3.1	3.6	2.7 – 4.8
Stage 2 (Albuminuria or proteinuria with eGFR 60–89)[a]	3.4	2.6 – 4.4	4.0	3.4 – 4.7
Stage 3a (Moderately decreased eGFR 45–59)[a]	4.8	3.6 – 6.3	3.0	2.4 – 3.7
Stage 3b (Moderately decreased eGFR 30–44)[a]	0.8	0.5 – 1.1	0.4*	0.3 – 0.8
Stage 4 (Severely decreased eGFR 15–29)[a]	0.3	0.1 – 0.1	**	
Stage 5 (Kidney failure eGFR <15 or on dialysis)[a]	**		**	
Albuminuria[b]	6.6	5.4 – 7.8	6.4	5.3 – 7.6
Microalbuminuria[b]	6.0	4.8 – 7.2	5.8	4.9 – 6.8
Macroalbuminuria[b]	0.7	0.5 – 0.9	0.6*	0.3 – 1.1
Proteinuria[c]	2.4	1.6 – 3.1	4.3	3.5 – 5.3
Haematuria[d]	4.6	3.8 – 5.4	23.4	21.3 – 25.6

a Stages 1–2 include those with either albuminuria (ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females) or proteinuria (PCR ≥22.6 mg/mmol). The eGFR measures were derived using the CKD-EPI equation. The AusDiab results are from White et al. 2010 (table 3).

b Albuminuria is based on an ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females; microalbuminuria is based on ACR 2.5–25 mg/mmol for males or 3.5–35 mg/mmol for females; macroalbuminuria is based on an ACR >25 mg/mmol for males or >35 mg/mmol for females. The AusDiab results are from Atkins et al. 2004 (table 1).

c Proteinuria is based on a PCR ≥22.6 mg/mmol (≥20 mg/mg). The AusDiab results are from Chadban et al. 2003 (table 1).

d The AusDiab haematuria results are based on ≥1+ haematuria on dipstick, confirmed by repeat ≥1+ haematuria on dipstick and urine microscopy of >10,000 red blood corpuscles/ml. VHM haematuria based on presence of haematuria on dipstick. The AusDiab results are from Chadban et al. 2003 (table 2).

95%CI = 95 per cent confidence interval.

The AusDiab data are relevant to the adult Australian population aged 25 years or more in 1999–2000. The VHM data are relevant to the adult Victorian population aged 18–75 years in 2009–10.

The VHM data are weighted to the age and sex distribution of the 2008 estimated resident population of Victoria and are age standardised to the 2006 estimated resident population of Victoria.

* Estimate has a relative standard error of 25–50 per cent and should be interpreted with caution.

** Estimate has a relative standard error greater than 50 per cent and is not reported because it is not reliable.

5. The social determinants of health and CKD

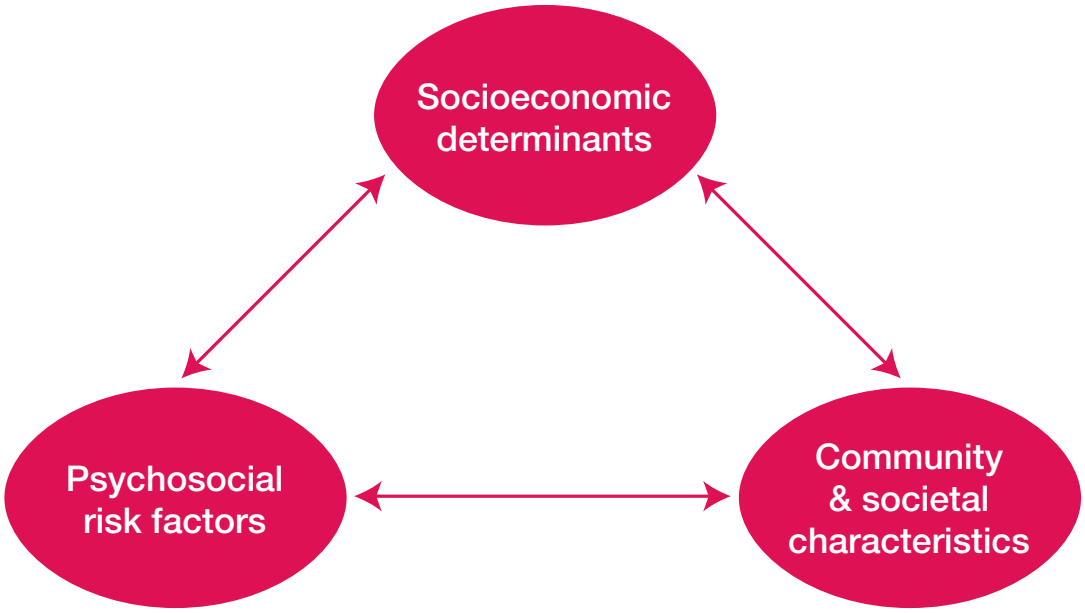
The social determinants of health and CKD

The social determinants of health contribute to the disparities that exist in the health and wellbeing of individuals in the population (Wilkinson and Marmot 2003). The World Health Organization described the social determinants as:

> *'… the conditions in which people are born, grow, live, work and age, including the health system. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels'* (WHO 2013)

In their public health model of the social determinants of health, Ansari et al. (2003) identified three distinct components of the social determinants of health. These include socioeconomic determinants, psychosocial risk factors, and community and societal characteristics, all of which are interrelated (Figure 2):

Figure 2: The public health model of the social determinants of health



Source: Ansari et al. 2003.

Table 6 summarises the social determinants according to whether they are socioeconomic, psychosocial, or community and societal characteristics.

Table 6: Social determinants in the public health model of the social determinants of health

Socioeconomic determinants	Psychosocial risk factors	Community and societal characteristics
Age	Poor social networks	Social networks and support structures
Sex/gender	Low self-esteem	Social and community participation
Ethnicity	Self-efficacy	Civic and political involvement and empowerment
Education	Depression	Trust in people and social institutions
Occupation	Anxiety	Tolerance of diversity
Income	Insecurity	Altruism, philanthropy and voluntary work
Employment	Loss of sense of control	Poverty
Religion	High physical/psychological demand	Residence (rural, urban, remote)
Housing (affordability, security of tenure, structure and maintenance of building, occupancy, including overcrowding)	Chronic stress	Income inequality
	Isolation	Crime rate
	Anger/hostility	Domestic violence
	Coping	Unemployment rate
	Perception/expectations	

Source: Ansari et al. 2003.

The VHM collected information on a range of social determinants including socioeconomic, psychosocial, and community and societal characteristics. This section of the report examines the social determinants of health in relation to the prevalence of having an indicator for CKD.

Socioeconomic determinants

Strong and consistent socioeconomic differentials in health have been observed in Victoria, and more broadly across Australia (Department of Health 2012b; AIHW 2012). The determinants include components measuring socioeconomic status—such as occupation, education, income and area-based indicators (ABS 2008; Galobardes et al. 2006)—as well as individual demographic characteristics like age, sex and ethnicity (Ansari et al. 2003). The VHM collected both household and individual-level information about several socioeconomic characteristics relevant to the social determinants of health.

Table 7 shows the prevalence and odds of having an indicator for CKD by selected socioeconomic indicator. The odds ratios in the table were adjusted for age and sex. There was a consistent pattern or association between those with low socioeconomic status and those with an indicator for CKD:

- The odds of having an indicator for CKD were 1.6 times higher for survey participants from the most disadvantaged areas of the state, compared with the least disadvantaged areas of the state.
- The odds of having an indicator for CKD were twice as high for participants with a household income <$20,000, compared with participants with an income $80,000 or more.
- The odds of having an indicator for CKD were 1.8 times higher for participants whose highest level of education was secondary school and 4.5 times higher for those with a primary school education, compared with participants with a university or tertiary education.
- The odds of having an indicator for CKD were higher for white collar and blue collar workers, compared with professionals.
- There were no significant relationships observed between indicators for CKD and ethnicity.

Table 7: Prevalence and odds of having an indicator for CKD[a], by selected socioeconomic indicator

Socioeconomic indicator	%	95% CI	OR	95% CI	p-values
IRSD quintile[b]					
Q5: Least disdvantaged	7.2	5.5 – 9.3	1.00		
Q4	9.0	6.2 – 12.8	1.24	0.85 – 1.81	0.259
Q3	7.3	4.6 – 11.3	1.01	0.60 – 1.71	0.958
Q2	9.6	7.0 – 13.1	1.38	0.94 – 2.02	0.095
Q1: Most disdvantaged	11.0	8.3 – 14.5	1.57	1.04 – 2.35	0.031
Annual household income					
$80,000+	9.7	7.2 – 12.9	1.00		
$40–<$80,000	8.7	7.0 – 10.9	1.16	0.87 – 1.56	0.310
$20–<$40,000	8.2	5.9 – 11.3	1.06	0.72 – 1.56	0.750
<$20,000	10.2	8.0 – 12.8	2.05	1.38 – 3.04	0.001
Highest level of education attained					
University/tertiary institute	6.4	4.1 – 9.9	1.00		
TAFE/trade cert/diploma	9.5	6.2 – 14.4	1.51	0.87 – 2.61	0.135
Highschool	10.5	8.7 – 12.7	1.83	1.16 – 2.89	0.010
Primary school or less	16.4	11.1 – 23.6	4.54	2.12 – 9.75	0.000
Occupation					
Professional	7.5	5.5 – 10.1	1.00		
White collar	11.3	8.5 – 14.9	1.95	1.27 – 3.01	0.003
Blue collar	10.3	7.7 – 13.6	1.66	1.07 – 2.57	0.025
Country of birth					
Australia	9.3	7.8 – 11.0	1.00		
Born overseas	8.4	6.9 – 10.0	0.98	0.77 – 1.23	0.827
Main language spoken at home					
English	9.3	7.8 – 11.0	1.00		
Language other than English	8.5	6.4 – 11.3	0.92	0.61 – 1.39	0.679

a Indicators for chronic kidney disease include an eGFR <60 ml/min/1.73m^2 (CKD-EPI) (White et al. 2010) and/or presence of albuminuria (ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females).

b The Index of Relative Socioeconomic Disadvantage (IRSD) is an area-based measure of socioeconomic disadvantage developed by the Australian Bureau of Statistics (ABS 2008).

95%CI = 95 per cent confidence interval.

OR = Odds ratio.

The data are weighted to the age and sex distribution of the 2008 estimated resident population of Victoria and are age standardised to the 2006 estimated resident population of Victoria.

Odds ratios are adjusted for age and sex.

Psychosocial risk factors

The term 'psychosocial' was defined as 'pertaining to the influence of social factors on an individual's mind or behaviour, and to the interrelation of behavioural and social factors' (Martikainen et al. 2002, p. 1091). Examples of psychosocial factors include poor social networks, low self-esteem, self-efficacy, insecurity and chronic stress.

The VHM collected information on psychological distress, which is a risk factor for a range of health conditions including depression and cardiovascular disease (Holden et al. 2010; Kelly et al. 2009).

Table 8 shows the prevalence and odds of having an indicator for CKD by level of psychological distress. The odds ratios in the table were adjusted for age and sex. The odds of having an indicator for CKD were 2.4 times higher for survey participants with a probable serious mental illness (based on K6 scores), compared with participants who had no probable serious mental illness.

Table 8: Prevalence and odds of having an indicator for CKD[a], by level of psychological distress[b]

Level of psychological distress	%	95% CI	OR	95% CI	p-values
No probable serious mental illness (K6 0–12)	9.1	7.6 – 10.7	1.00		
Probable serious mental illness (K6 13–24)	14.7*	8.2 – 25.0	2.38	1.5 - 3.9	0.001

a Indicators for chronic kidney disease include an eGFR <60 ml/min/1.73m^2 (CKD-EPI) (White et al. 2010) and/or presence of albuminuria (ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females).

b Levels of psychological distress are based on the Kessler 6 Psychological Distress Scale (K6).

95% CI = 95 per cent confidence interval.

OR = Odds ratio.

The data are weighted to the age and sex distribution of the 2008 estimated resident population of Victoria and are age standardised to the 2006 estimated resident population of Victoria.

Odds ratios are adjusted for age and sex.

* Estimate has a relative standard error of 25–50 per cent and should be interpreted with caution.

Community and societal characteristics

Community and societal characteristics are connected to health and wellbeing (Ansari et al. 2003; Wilkinson and Marmot 2003). They are closely aligned with the concept of 'social capital', which includes 'social relations, formal and informal social networks, group membership, trust, reciprocity and civic engagement. Social capital is generally understood as the property of the group rather than the property of the individual' (Harper 2001, p. 3).

The VHM collected information on social and support networks. Family, friends and neighbours are among the more immediate sources of care and support for individuals if they need help with everyday activities or unforeseen contingencies. They are part of the social environment where adults spend a large part of each day and where children grow and develop. Social and support networks refer to informal relationships that individuals have with family, friends, neighbours and other members of their community. These networks often serve as a resource, providing individuals with information or emotional, practical and financial support. These resources are often provided to an individual without obligation, except for a norm of reciprocity. At a social level, social and support networks provide individuals with a sense of belonging.

Survey participants were asked whether they could get help from family, friends or neighbours when needed and whether they could rely on a relative, or a friend not living with them, to care for them (or their children) in an emergency.

Table 9 shows the prevalence and odds of having an indicator for CKD by indicator of social support. The odds ratios are adjusted for age and sex. There were no significant relationships observed between indicators for CKD and levels of social support.

Table 9: Prevalence and odds of having an indicator for CKD[a], by selected indicator of social support

Indicator of social support	%	95% CI	OR	95% CI	p-values
Can get help in an emergency					
Yes	9.1	7.8 – 10.7	1.00		
No	7.6	4.7 – 12.0	1.12	0.57 – 2.21	0.731
Can get help from friends, family or neighbours when needed					
Help from all	9.2	6.7 – 12.6	1.00		
Help from two	9.0	6.9 – 11.7	1.04	0.61 – 1.77	0.872
Help from one	8.0	5.4 – 11.8	0.87	0.55 – 1.35	0.519
Help from none	15.3	9.9 – 22.9	1.74	0.85 – 3.54	0.125

a Indicators for chronic kidney disease include an eGFR <60 ml/min/1.73m^2 (CKD-EPI) (White et al. 2010) and/or presence of albuminuria (ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females).

95% CI = 95 per cent confidence interval.

OR = Odds ratio.

The data are weighted to the age and sex distribution of the 2008 estimated resident population of Victoria and are age standardised to the 2006 estimated resident population of Victoria.

Odds ratios are adjusted for age and sex.

6. Risk factors for CKD

Risk factors for CKD

Table 10 presents risk factors identified as being associated with having an indicator for CKD. The information in the table was derived from the VHM using a multivariate logistic regression model.

The dependant binary variable used in the model was defined based on VHM participants with an indicator for CKD (eGFR <60 ml/min/1.73m^2 (CKD-EPI) or an eGFR ≥60 ml/min/1.73m^2 with albuminuria present) and all other participants (no indicator for CKD). Bivariate modelling was undertaken initially with potential risk factors before the multivariate model was developed (see Methods section).

After adjusting for age, sex and all other variables in the model, having an indicator for CKD was significantly associated with the following risk factors:

- High blood pressure (≥140/90 mmHg)—The odds of having an indicator for CKD were 2.0 times higher for survey participants with high blood pressure, compared with participants who did not have high blood pressure (p=0.000).
- Diabetes—The odds of having an indicator for CKD were 2.0 times higher for survey participants with diabetes, compared with participants with normal fasting glucose levels (p=0.017).
- Elevated triglycerides (≥2.0 mmol/L)—The odds of having an indicator for CKD were 1.5 times higher for survey participants with elevated triglyceride levels, compared with participants with normal triglyceride levels (p=0.026).

Previous studies have demonstrated similar associations (AIHW 2009; AIHW 2011; Barri Y 2008; Stengel et al. 2003; Wang et al. 2008).

Although the other variables in the model are all known risk factors for CKD and were significant at the bivariate level (p<0.05), they were not significant at the multivariate level (p>0.05), after adjusting for age, sex and all other variables in the model. In part, this may reflect a lack of sensitivity in variable definition. The dependent variable in the model, having an *indicator* for CKD, is not the same as actually having CKD. The case definition for having an indicator for CKD in the survey was based on the results of a spot urine and fasting blood test, whereas CKD is actually diagnosed after observing reduced kidney function and/or kidney damage for at least three months. Many of the survey participants with an indicator for CKD may not actually have persistent symptoms.

In addition, some of the non-significant independent variables in the final model (such as a previous diagnosis of a cardiovascular disease) were obtained by administering a chronic disease risk factor questionnaire to survey participants. Having a previous diagnosis of a cardiovascular disease was based on a series of questions aimed at lifetime prevalence of having at least one of a specific series of cardiovascular conditions and procedures. The cardiovascular questions were not based on current disease status and did not incorporate all cardiovascular conditions. Having a previous diagnosis of a cardiovascular disease was also based on self-report, so may have been subject to recall bias.

Physical activity levels were also determined from responses to a series of questions on physical activity in the past week, included in the interviewer-administered questionnaire. The information was based on participant self-report, so it may also have been subject to recall bias.

Finally, smoking status was collected in the questionnaire, using a validated survey tool. Although it was non-significant in our model, our data indicated a pattern that is similar to other studies (Briganti et al. 2002; Schiffl et al. 2000), where a history of smoking (being an ex-smoker) is associated with renal function.

Table 10: Prevalence and odds having an indicator for CKD[a], by selected risk factor

Risk factor	%	95% CI	OR	95% CI	p-values
High blood pressure[b]					
No	7.9	6.5 – 9.4	1.0		
Yes	13.4	10.1 – 17.7	2.0	1.5 – 2.7	0.000
Cardiovascular disease[c]					
No	8.8	7.4 – 10.5	1.0		
Yes	12.9	8.6 – 19.1	1.6	0.9 – 2.8	0.101
Diabetes[d]					
Normal fasting glucose	8.3	6.9 – 9.9	1.0		
Impaired fasting glucose	7.8	4.9 – 12.1	1.2	0.6 – 2.2	0.549
Diabetes	15.4	10.5 – 21.9	2.0	1.1 – 3.5	0.017
Obese body mass index[e]					
No	7.7	6.3 – 9.3	1.0		
Yes	12.9	8.8 – 18.4	1.4	0.9 – 2.0	0.146
Elevated triglycerides[f]					
No	7.9	6.7 – 9.3	1.0		
Yes	14.2	9.8 – 20.1	1.5	1.1 – 2.1	0.026
Smoking status[g]					
Non smoker	8.2	6.7 – 9.9	1.0		
Ex-smoker	15.2	10.4 – 21.7	1.5	1.0 – 2.3	0.069
Current smoker	9.2	6.4 – 13.1	1.1	0.7 – 1.7	0.756
Physical activity level[h]					
Sufficient to meet national guidelines	8.1	6.7 – 9.8	1.0		
Insufficient to meet national guidelines	11.2	8.1 – 15.3	1.4	0.9 – 2.3	0.139
Inactive	9.0	6.3 – 12.6	1.2	0.7 – 2.0	0.604

a Indicators for chronic kidney disease include an eGFR <60 ml/min/1.73m^2 (CKD-EPI formula see White et al. 2010) and/or presence of albuminuria (ACR ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females).

b High blood pressure status based on an average blood pressure of ≥140/90 mmHg.

c Cardiovascular disease status based on self-report of ever having had atherosclerotic event—angina, heart attack, stroke, coronary bypass surgery, percutaneous coronary intervention.

d Diabetes status based on self-report of ever having been diagnosed with diabetes and being on medication for diabetes, or having a fasting plasma glucose (FPG) ≥7.0 mmol/L; Impaired fasting glucose is based on FPG 6.1–<7.0 mmol/L; Normal fasting glucose is based on FPG <6.1 mmol/L.

e Body mass index ≥30 kg/m^2.

f Elevated triglycerides ≥2.0 mmol/L.

g Current smoker based on whether smoke daily or occasionally; Ex-smoker based on having smoked at least 100 cigarettes in lifetime, but no longer smoke; Non smoker based on having smoked less than 100 cigarettes in lifetime.

h Sufficient physical activity based on ≥150 minutes of moderate activity/week; Insufficient physical activity based on 1–149 minutes of moderate activity/week; Inactive based on 0 minutes of moderate activity/week.

95% CI = 95 per cent confidence interval.

OR = Odds ratio.

The data are weighted to the age and sex distribution of the 2008 estimated resident population of Victoria and are age standardised to the 2006 estimated resident population of Victoria.

Odds ratios are adjusted for age and sex, as well as all other variables in the model.

The Hosmer-Lemeshow goodness-of-fit test suggests a well-fitted model with no significant difference between predicted and observed values (F=0.92, p=0.517).

7. Implications for planning

Implications for planning

Surveys like the VHM help us understand the health burden from CKD in Victoria. The results showed 9.1 per cent of Victorian adults had an indicator for CKD in 2009–10. Comparisons with the 1999–2000 AusDiab survey results showed no evidence of a change in the prevalence rate over time. However, although the prevalence rate for reduced kidney function and/or kidney damage has probably not changed, the number of adults with CKD has likely increased as a result of population growth. Further, the numbers are expected to keep growing over time with population ageing and expected increases in risk factors for CKD, including comorbid conditions (Department of Health 2013).

In 2013 the department released *Renal directions: better services and improved kidney health for Victorians*, a strategy to address the growing burden of CKD in Victoria (Department of Health 2013). The strategy takes a whole-of-system approach to renal health. It emphasises strengthening and sustaining existing renal services, and improving service access and the quality and range of services available. It also highlights the importance of healthy lifestyles and preventing disease, as well as early detection and management of those diagnosed with CKD.

The results of the VHM showed 9 per cent of all survey participants had an indicator for early CKD (stages 1–3) and about 0.1 per cent had an indicator for severely reduced kidney function or kidney failure (stages 4–5). Although many of those identified at stages 1–3 in the survey may not actually have CKD, they are at increased risk of disease and they present an opportunity to significantly reduce the CKD burden with early diagnosis and appropriate clinical management to prevent disease progression.

Current evidence does not support population screening for CKD; however, opportunistic testing of people is recommended, especially for those with known risk factors (Johnson et al. 2012b). The survey results provide important insights to help identify people Victorians at increased risk of CKD. The results show a strong relationship between the social determinants of health and CKD, especially the socioeconomic determinants and psychological distress. High blood pressure, diabetes and elevated triglycerides are also identified as important risk factors for CKD. Other studies have identified these factors (AIHW 2009; AIHW 2011; Barri Y 2008; Stengel et al. 2003; Wang et al. 2008), but this is the first survey to identify risk factors at the population level in Victoria.

Overall, the survey results indicate the scope for potential health gain with the strategy in Victoria and provide an important baseline for future monitoring.

Abbreviations

Abbreviations

ABS	Australian Bureau of Statistics
ACR	Albumin-creatinine ratio
AIHW	Australian Institute of Health and Welfare
ANZDATA	Australian and New Zealand Dialysis and Transplant Registry
AusDiab	Australian Diabetes, Obesity and Lifestyle study
BMI	Body mass index
CD	Census collection district
CKD	Chronic kidney disease
CKD-EPI	Chronic Kidney Disease Epidemiology Collaboration
DoHA	Department of Health and Ageing
eGFR	Estimated glomerular filtration rate
ESKD	End stage kidney disease
HDL	high-density lipoprotein
IDMS	Isotope dilution mass spectrometry
KDOQI	Kidney Disease Outcomes Quality Initiative
KHA	Kidney Health Australia
LDL	Low-density lipoprotein
NKF	National Kidney Foundation
PCR	Protein-creatinine ratio
VHM	Victorian Health Monitor
WHO	World Health Organization

Glossary

Glossary

Albuminuria	Albuminuria was defined as an albumin:creatinine ratio of ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females.
Cardiovascular disease	Cardiovascular disease included angina, myocardial infarction, stroke, coronary bypass surgery and percutaneous coronary interventions.
Country of birth	Participants were asked to identify their country of birth. Their responses were categorised to 'Australia' or 'born overseas', for the purposes of analysis.
Diabetes	The presence of diabetes was defined on the basis of fasting plasma glucose ≥7.0 mmol/L or receiving current treatment with oral hypoglycaemic medications or insulin.
Early CKD	Chronic kidney disease at stages 1–3.
Education	Participants were asked to report their highest level of education attained. Their responses were categorised into primary school or less, high school, TAFE/trade certificate, university/tertiary institute.
Elevated low-density lipoprotein (LDL) cholesterol	Elevated LDL cholesterol was defined as serum LDL cholesterol ≥3.5 mmol/L.
Elevated total cholesterol	Elevated total cholesterol was defined as serum total cholesterol ≥5.5 mmol/L.
Elevated triglycerides	Elevated triglycerides was defined as serum triglycerides ≥2.0 mmol/L.
Glomerular filtration rate (GFR)	GFR is a standard measure of the filtering capacity of the kidneys. It is estimated (eGFR) from an equation using serum creatinine, age and sex.
Haematuria	Haematuria was defined based on the presence of haematuria on a dipstick, indicating the presence of blood in the urine.
High blood pressure	High blood pressure was defined on the basis of having an average blood pressure ≥140/90 mmHg.
Household income	Participants were asked to report their gross annual household income. This was categorised to four levels for analysis: $80,000+, $40–<80,000, $20–<40,000, <$20,000.
Impaired fasting glucose	Impaired fasting glucose was defined as fasting plasma glucose ≥6.1 mmol/L but <7.0 mmol/L.

Index of relative socioeconomic disadvantage (IRSD)	IRSD is constructed using principal component analysis of socioeconomic variables at the level of the census collection district (CD). Participants were classified into quintiles of disadvantage based on IRSD scores for their CD of residence, with quintile 1 corresponding to the highest disadvantage and quintile 5 the lowest disadvantage.
Insufficient physical activity	Physical activity time was the sum of the time spent walking or performing moderate physical activity per week, plus double the time spent in vigorous physical activity. Insufficient physical activity was defined as 1–149 minutes per week of physical activity.
Kidney damage	Kidney damage was defined as having albuminuria, where the albumin:creatinine ratio was ≥2.5 mg/mmol for males or ≥3.5 mg/mmol for females.
Low high-density lipoprotein (HDL) cholesterol	Low HDL cholesterol was defined as HDL cholesterol <1.0 mmol/L in men and <1.3 mmol/L in women.
Main language spoken at home	Participants were asked about the language they spoke at home. Their responses were categorised to 'English' or 'speak another language other than English at home', for the purposes of analysis.
Obesity	Obesity was determined where a participant had a BMI ≥30 kg/m^2.
Occupation	Participants were asked about their main occupation for most of their life. Their main occupation was then categorised as either a professional, white collar or blue collar occupation.
Physical inactivity	Physical activity time was the sum of the time spent walking or performing moderate physical activity per week, plus double the time spent in vigorous physical activity. Physical inactivity was defined as zero minutes per week of physical activity.
Proteinuria	Proteinuria was defined as a protein:creatinine ratio of ≥22.6 mg/mmol or ≥20 mg/mg.
Psychological distress	Psychological distress was determined where a participant scored ≥13 points on the Kessler 6 questionnaire.
Reduced kidney function	Reduced kidney function refers to an estimated glomerular filtration rate <60 ml/min/1.73m^2, based on the CKD-EPI formula.

Smoking status	Smoking status was defined based on the following categories: • Ex-smoker: people who currently did not smoke but used to smoke and had smoked at least 100 cigarettes during their lifetime. • Non-smoker: people who had never smoked or those who did not smoke currently and had smoked fewer than 100 cigarettes during their lifetime. • Current smoker: people who smoked daily or occasionally.
Social support	Social support was measured using questions about support from family, friends and neighbours with the following response options: 'no, not at all', 'not often', 'sometimes', 'yes, definitely'. Those who responded with 'yes, definitely' formed one category and everyone else formed the other category.
Sufficient physical activity	Physical activity time was the sum of the time spent walking or performing moderate physical activity per week, plus double the time spent in vigorous physical activity. Sufficient physical activity was defined as ≥150 minutes per week of moderate physical activity.

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