Kidney disease and renal function

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Summary

- This chapter presents findings on the prevalence of self-reported doctor-diagnosed chronic kidney disease and of having been tested for chronic kidney disease, as well as direct measurement of renal function, urinary albumin excretion, and survey-defined chronic kidney disease stage. It uses data from HSE 2009 and 2010 combined.
- 1.0% of men and 1.3% of women reported having doctor-diagnosed chronic kidney disease (CKD). The prevalence of self-reported kidney disease increased with age, rising from less than 1% among those aged 16-44 to 2.7% in men aged 75 and over and 3.4% among women in that age group.
- The prevalence of self-reported doctor-diagnosed kidney disease varied by equivalised household income, and was highest among men and women in the lowest income quintile (1.8% and 1.9% respectively).
- 7.6% of men and 7.9% of women reported being tested for kidney disease. There was no significant difference for being tested by Strategic Health Authority (SHA), Spearhead status or equivalised household income.
- 49% of men and 52% of women had abnormal kidney function, i.e. estimated glomerular filtration rate (eGFR) levels less than 90 ml/min/1.73m^2; this included 6% of men and 7% of women who had levels less than 60 ml/min/1.73m^2. The proportion of both men and women with abnormal eGFR levels increased with age.
- Urinary excretion of abnormal quantities of albumin was found in 9% of men and 8% of women, and in most cases this was micro-albuminuria (8% in each sex) rather than macro-albuminuria (1% or less). Prevalence of albuminuria was highest in older adults; it was generally around 5%-6% in the younger age groups, rising to 26% of men and 19% of women aged 75 and over.
- Overall, 6% of men and 7% of women had stage 3-5 CKD (survey-defined), comparable with levels found in other international studies. There was strong variation by age, with fewer than 1% of men and women aged 16-24 at stage 3-5, but prevalence rose to 29% of men and 35% of women aged 75 and over.
- The prevalence of survey-defined CKD (stage 1-5) was significantly higher for participants in Spearhead PCTs than non-Spearhead PCTs (14% of men and 15% of women in Spearhead PCTs, 11% and 12% respectively in non-Spearhead PCTs) and in the lowest income quintile (15% of men and 16% of women in the lowest income quintile, 9% of men and 10% of women in the highest income quintile). The survey did not show a similar variation by Spearhead status or income for the more serious stage 3-5 CKD, although other studies have shown strong inverse association between socio-economic status and CKD.

8.1 Introduction

This chapter reports on the prevalence of chronic kidney disease (CKD) in the adult population aged 16 and over in England. The 2009 report presented the results of the first survey of kidney disease in England in a nationally representative general population sample. This report combines HSE 2009 and HSE 2010 to provide data from more than 6,000 participants and hence greater precision of estimates. Prevalence of self-reported doctor-diagnosed kidney disease and laboratory measures of impaired kidney function are examined in relation to demographic and socio-economic parameters.

CKD is defined as persistent kidney damage. A classification of CKD was first developed by the Kidney Disease Outcome Quality Initiative (KDOQI) in 2002, based on markers of kidney damage such as blood or protein in the urine and assessment of the filtration function of the kidney (the glomerular filtration rate, GFR).[1] Gold standard methods of measuring GFR use inert or radioactive substances (such as inulin, or chromium-labelled EDTA) that are only excreted by the kidneys, and measure the decay in blood levels after injection to derive the GFR. These are too costly and time consuming for routine use. Until the 1990s, routine assessment of filtration relied on the serum creatinine level, creatinine being a metabolic product of protein breakdown filtered by the kidneys. This is an insensitive measure of kidney function because serum creatinine level is affected by both creatinine production, largely from muscle, and by kidney excretion. New prediction equations estimate the glomerular filtration rate (eGFR) by taking into account factors associated with creatinine production such as age, sex and ethnic group. The most widely used was the Modification of Diet and Renal Disease (MDRD) formula[2] but recently the more accurate Chronic Kidney Disease Epidemiology Collaboration (CKDEpi) formula has been introduced.[3] The analyses in this chapter use the MDRD as this is still the measure in widespread use in England and internationally.

The KDOQI classification uses a reduction in eGFR and the presence of other markers of kidney damage, such as albuminuria (presence of albumin, a protein, in the urine), to define five stages of chronic kidney disease. Normal renal function is defined in the National Service Framework for Renal Services as eGFR at or above 90 ml/min/1.73m^2 with no other evidence of kidney damage.[4] This framework classifies kidney disease using the KDOQI system.[1] These stages are given in Table 8A.

Table 8A

Stages of chronic kidney disease[4]

Stage	GFR (ml/min/1.73m^2)	Description
1	90 or more	Normal or increased GFR but with other evidence of kidney damage
2	60–89	Slight decrease in GFR, with other evidence of kidney damage
3A	45–59	Moderate decrease in GFR, with or without other evidence of kidney damage
3B	30–44	
4	15–29	Severe decrease in GFR, with or without other evidence of kidney damage
5	less than 15	Established renal failure

Stage 3-5 CKD, an eGFR less than 60 ml/min/1.73m^2, has been widely used in prevalence estimates. Chronicity is based on a duration of three months. Most studies have only used single measures (as here in the HSE) so will tend to overestimate prevalence, compounded by the fact that MDRD underestimates the true GFR at low normal levels, also increasing prevalence of CKD.

The CKD classification is under review to take into account the latest evidence.[5] The CKD Prognosis Collaboration has added extensive new data on the prognostic significance of low eGFR and albuminuria based on pooling of data from population and high risk cohorts, and has studied age/eGFR and age/albumin to creatinine ratios (ACR) interactions. Both MDRD eGFR and ACR were independent factors associated with all cause mortality and cardiovascular disease (CVD) mortality in general population cohorts (21 studies, 1.2 million

participants)[6] and in high risk cohorts (10 cohorts, 0.27million participants).[7] eGFR and ACR were also independent risk factors for all kidney outcomes (end-stage renal disease (ESRD), progression and acute kidney injury) in these general and high risk population cohorts.[8]

CKD is recognised as a global public health problem. Studies in Australia, USA, and Europe have found an overall prevalence of 10-16% in adults.[9,10,11,12] One study from the USA, using serial National Health and Nutrition Examination Survey (NHANES) data, has shown an increase in prevalence over the last few decades.[13] Some key factors associated with moderate CKD (eGFR<60 ml/min/1.73m^2) are increasing age, female sex (though this may be partly an artefact of the eGFR equation), lower socio-economic status, hypertension (both as cause and consequence), and diabetes. Key factors associated with progression of CKD include proteinuria (protein in the urine including albumin) and higher blood pressure levels. Obesity and metabolic syndrome are also associated with CKD by a variety of mechanisms and not just through Type 2 diabetes and hypertension. The obesity pandemic will increase CKD prevalence in developed and developing countries. The health transition in developing countries, with a switch from communicable to non-communicable diseases as the leading causes of disability and premature death, includes CKD as one of the significant emerging diseases.

The main absolute risk associated with CKD is cardiovascular morbidity and mortality.[14] Some patients have progressive loss of kidney function and may develop symptoms due to complications such as anaemia; those who develop severe CKD may require renal replacement therapy (RRT) by dialysis or transplantation.[15] National registries have demonstrated the inexorable rise of patients on RRT in high and middle income countries. In England in 2009, the rate of people starting RRT was 109 per million population (pmp) and the prevalence of RRT was 794 pmp.[16] Such treatments are costly, with the annual cost of haemodialysis being over £20,000 per person.[17]

In certain minority ethnic groups (south Asian, Black), the prevalence of CKD is similar to other groups,[18] but they have high rates of renal replacement therapy.[19] The high proportion of these people with severe CKD suggests that the disease progresses more rapidly among these groups.

There have a been a variety of policy initiatives in England which address CKD, including the National Renal Service Framework (NSF) Part 2;[4] the General Practice Quality Outcomes Framework (QOF), which has indicators for the detection and management of CKD;[20] NICE guidelines on management of patients with CKD;[21] and the introduction of eGFR reporting in clinical biochemistry laboratories; as well as guidance by specialist clinicians.[22]

8.2 Methods and definitions

8.2.1 Assessment of history of kidney disease

The interviewer asked all adult participants about their family and personal history of chronic kidney disease. Additional questions were asked about the following:

- Being at risk for kidney disease;
- Being tested for kidney disease, and if so how long ago, using what type of test, and what the results had been; and
- For those with chronic kidney disease, the age at diagnosis and their current treatment.

8.2.2 Measurement of renal function

Spot urine samples were collected from adults who gave written consent at the nurse visit. These were posted to the Biochemistry Department at the Royal Victoria Infirmary (RVI), Newcastle-upon-Tyne, where creatinine and albumin concentrations were measured.[23]

Adults were also asked by the nurse for written consent to have blood samples taken. A

tube of clotted blood was also posted to the RVI, where it was spun, separated, and serum creatinine measured, using an internationally standardised enzymatic method.[24,25,26]

Details of laboratory analysis, internal quality control, and external quality assurance are provided in Volume 2, Methods and documentation.

Serum creatinine levels were used to estimate glomerular filtration rate (eGFR), a measure of renal (kidney) function, using the following four MDRD (Modification of Diet in Renal Disease) formulae (Table 8B).[2]

Table 8B

MDRD equations to estimate glomerular filtration rate (eGFR)

Men	
Black ethnic group	$175 \times (\text{Serum creatinine} / 88.4)^{-1.154} \times \text{age}^{-0.203} \times 1.21$
Other ethnic groups	$175 \times (\text{Serum creatinine} / 88.4)^{-1.154} \times \text{age}^{-0.203}$
Women	
Black ethnic group	$175 \times (\text{Serum creatinine} / 88.4)^{-1.154} \times \text{age}^{-0.203} \times 0.742 \times 1.21$
Other ethnic groups	$175 \times (\text{Serum creatinine} / 88.4)^{-1.154} \times \text{age}^{-0.203} \times 0.742$

In line with best practice, the discrete numeric value for results in the normal range (90 ml/min/1.73m^2 or more) was not reported by the laboratory.

8.2.3 Definitions

Doctor-diagnosed kidney disease was defined as a positive answer to both questions:
'Do you yourself now have, or have you ever had chronic kidney disease? Don't include simple urine infections, a single episode of kidney stone disease or kidney cancer.'
And if so,
'Were you told by a doctor that you had chronic kidney disease?'

Renal function was assessed in two ways: eGFR from serum creatinine level, and urinary albumin. Due to the low prevalence of severe CKD, data from HSE 2009 and HSE 2010 were combined for this report, to provide larger numbers and thus greater precision. Even so, the more severe stages of CKD were collapsed in analysis, combining stages 3a and 3b, and also stages 4 and 5. Thus eGFR was categorised as 90ml/min/1.73m^2 or more; 60-89ml/min/1.73m^2; 30-59 ml/min/1.73m^2; and less than 30ml/min/1.73m^2.

Albuminuria, the presence of albumin in the urine, was measured using the albumin:creatinine ratio, which correlates well with 24hour urinary albumin excretion.[27] Normal values are up to 2.5mg/mmol in men and up to 3.5mg/mmol in women. Abnormal levels are split into two groups. Micro-albuminuria is defined as small, though raised, excretion of albumin (greater than 2.5 to 30mg/mmol in men and greater than 3.5 to 30mg/mmol in women). Macro-albuminuria is defined as more than 30mg/mmol (in either sex).[28]

Chronic Kidney Disease was evaluated using both eGFR and the presence of albumin in the urine. Stage of kidney failure was defined as follows:

Table 8C

Stages of kidney failure used in analysis

Stage	Description
Normal	eGFR 90 ml/min/1.73m^2 or more and normal albuminuria
1	eGFR 90 ml/min/1.73m^2 or more and micro- or macro-albuminuria
2	eGFR 60-89 ml/min/1.73m^2 and micro- or macro-albuminuria
3A/3B	eGFR 30-59 ml/min/1.73m^2, regardless of albuminuria
4/5	eGFR less than 30 ml/min/1.73m^2, regardless of albuminuria

8.2.4 Analyses

Self-reported data from the initial interview were weighted using the interviewer non-response weights; urine data when analysed without blood data were weighted using the nurse non-response weights; and blood data, whether analysed alone or in conjunction with urine data, were weighted using the blood non-response weights, to give nationally-representative results. The weights from the individual survey years were used for each participant.

All analyses that are not presented by age-group were age-standardised, except for comparisons of the prevalence of survey-defined CKD and self-reported kidney disease, for which numbers were too small (Tables 8.14 and 8.15). There were also too few participants with doctor-diagnosed kidney disease to report these results separately by sex. For participants without diagnosed kidney disease, the results were identical for men and women, so Table 8.14 is presented for all men and women combined.

8.3 Response rates

Response rates to the urine sample are shown in Table 8.5. A valid urine sample was obtained from 88% of men and 86% of women aged 16 and over who had a nurse visit in HSE 2009 or HSE 2010. Overall, 5% of men and 7% of women refused to provide a sample; 2% of women were excluded because they were pregnant; and a further 6% of men and women did not attempt a sample for other reasons. Response was lowest in the youngest age group among both men and women, and these were the most likely to refuse to give a sample. Older women were the most likely not to give a sample for other reasons (often relating to poor physical health).

Response rates to the blood sample are shown in Table 8.6. A valid non-fasting blood sample was obtained from 77% of men and 73% of women who had a nurse visit. Response was highest among men aged 25-74, and among women aged 35-74. 13% of men and 14% of women refused to provide a sample, with rates of refusal much higher among those aged 16-34, and particularly women aged 16-24, than among older adults. A further 5% of men and 6% of women were not eligible; this proportion was highest among both men and women aged 75 and over, and among women aged 16-34 (the age group most likely to be pregnant).

Table 8.7 shows the proportions providing valid results for each of the blood analytes. In each case, results were obtained for the great majority of those who provided samples. It should be noted that vitamin D was not measured in HSE 2009. **Tables 8.5 – 8.7**

8.4 Self-reported doctor-diagnosed kidney disease and testing for kidney disease

8.4.1 Prevalence of self-reported doctor-diagnosed kidney disease, by age and sex

Overall, 1.0% of men and 1.3% of women reported doctor-diagnosed chronic kidney disease. Prevalence of kidney disease increased with age from less than 1% among those aged 16-44 to 2.7% in men aged 75 and over and 3.4% among women in that age group.

7.6% of men and 7.9% of women reported that they had been tested for kidney disease. The pattern for having been tested for kidney disease was similar to that of prevalence of self-reported kidney disease, generally increasing with age; it was highest in men aged 65-74 and women aged 75 and over (15.6% and 15.3% respectively). Figures 8A and 8B show this age pattern. **Table 8.1, Figures 8A, 8B**

Figure 8A

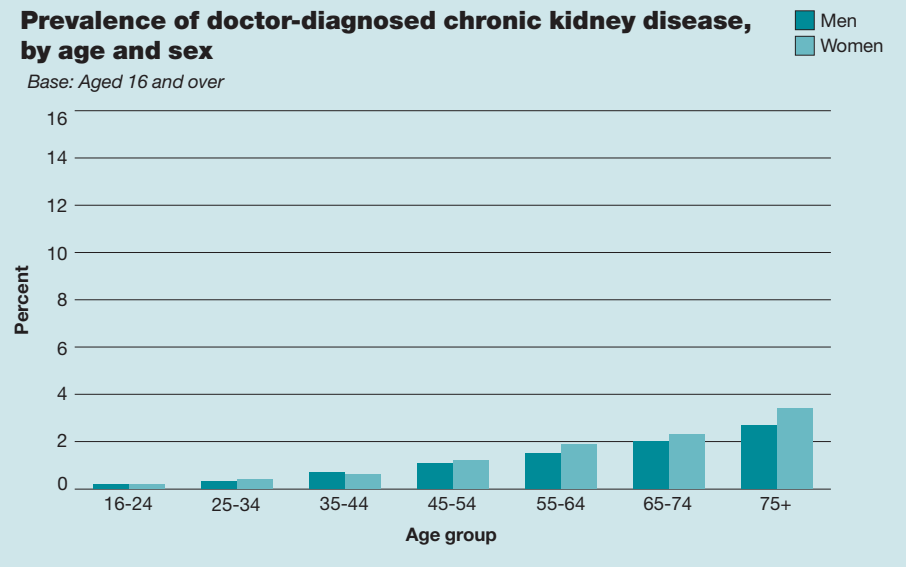
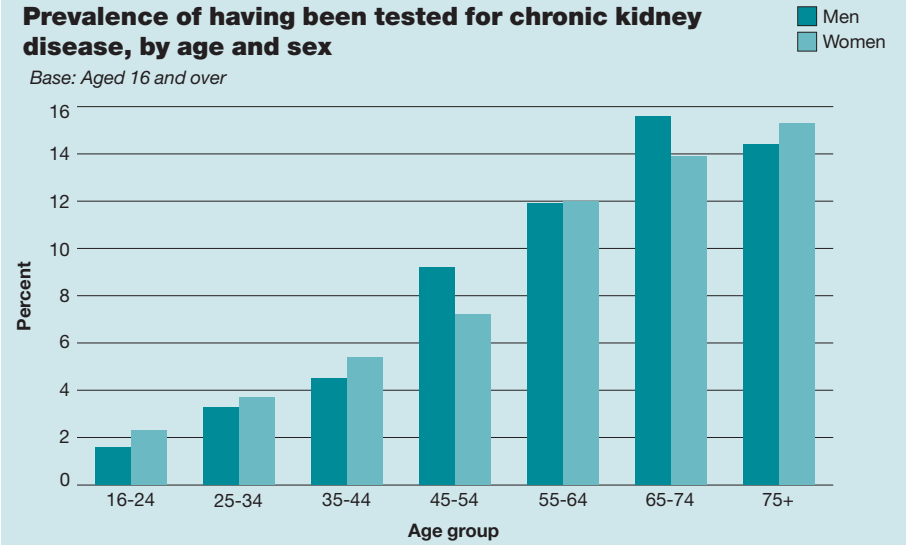


Figure 8B



8.4.2 Prevalence of self-reported doctor-diagnosed kidney disease, by Strategic Health Authority, equivalised household income and Spearhead status

The prevalence of self-reported kidney disease varied by equivalised household income. It was highest among both men and women in the lowest income quintile (1.8% and 1.9% respectively) while their counterparts in the higher income quintiles had the lowest prevalence of chronic kidney disease (0.9% in the highest three quintiles for men, and 0.5%-1.3% in the highest two quintiles for women). However, there was no significant difference by income in the proportion of participants reporting that they had been tested for kidney disease.

There were also no significant differences by Strategic Health Authority (SHA) or by Spearhead status[29] in the prevalence of reporting or being tested for kidney disease.

Tables 8.2-8.4

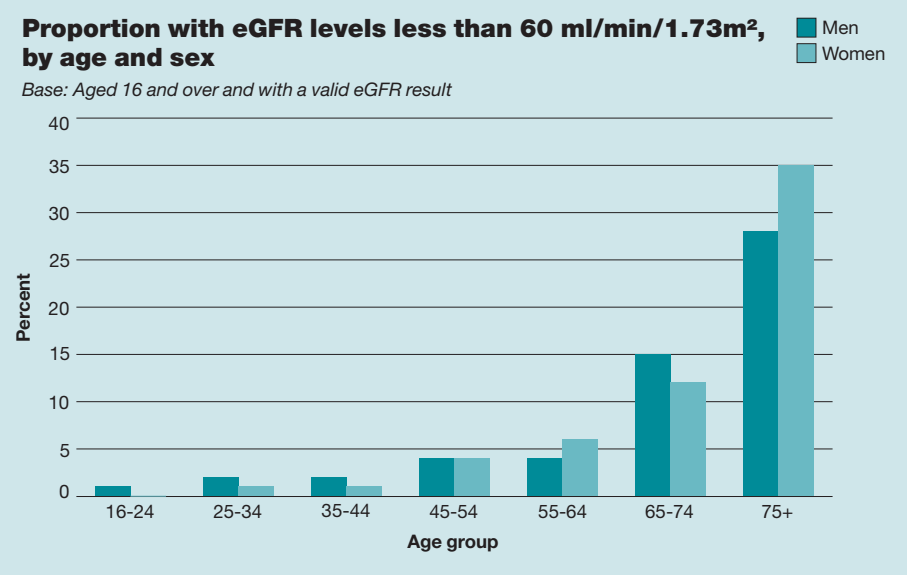
8.5 Renal function and survey-defined kidney disease

8.5.1 Serum creatinine and eGFR levels, by age and sex

Mean serum creatinine levels were considerably higher in men than in women (83.7mmol/l and 65.6mmol/l respectively). Levels increased steadily with age, for women from 60.6mmol/l in those aged 16-24 to 76.4mmol/l in those aged 75 and over, and for men from 78.0mmol/l in those aged 16-24 to 94.2mmol/l in those aged 75 and over.

49% of men and 52% of women had abnormal eGFR (estimated Glomerular Filtration Rate) levels (below 90ml/min/1.73m^2). A much lower proportion had eGFR levels below 60ml/min/1.73m^2 (6% of men and 7% of women). The proportion of both men and women with abnormal eGFR levels increased with age, from 15% of men and 13% of women aged 16-24 to 79% of men and 86% of women aged 75 and over. Similarly, the proportion with eGFR levels below 60ml/min/1.73m^2 increased from 1% of men and fewer than 1% of women aged 16-24 to 28% of men and 35% of women aged 75 and over, as illustrated in Figure 8C. No cases were recorded in the survey of adults aged up to 44 with eGFR levels below 30ml/min/1.73m^2, and above this age prevalence of these low levels was 1% or less in both men and women. **Table 8.8, Figure 8C**

Figure 8C



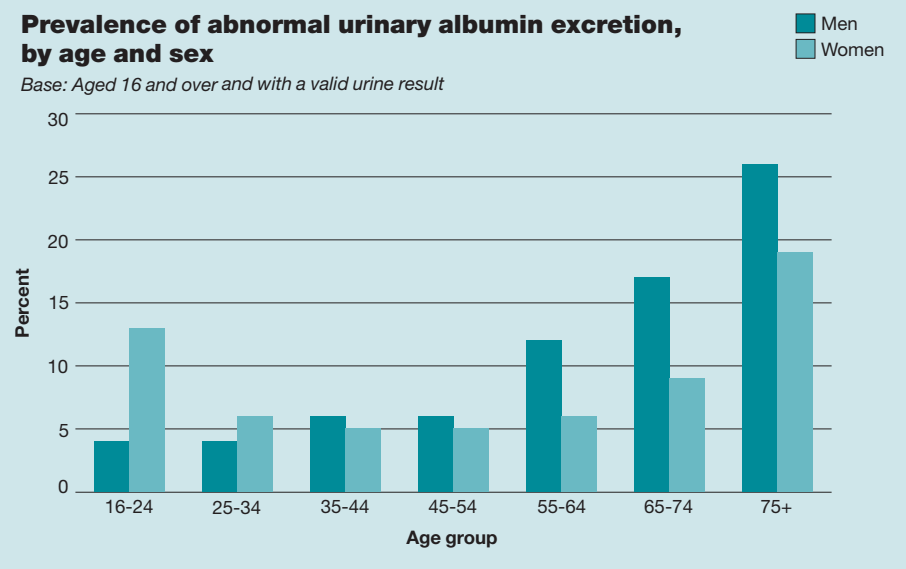
8.5.2 Urinary albumin excretion, by age and sex

Excretion of abnormal quantities of albumin was found in 9% of men and 8% of women. In most cases this was micro-albuminuria (8% in each sex) rather than macro-albuminuria (1% or less). Prevalence of albuminuria was highest in older adults; it was generally around 5%-6% in the younger age groups and rose to 26% of men and 19% of women aged 75 and over. There was an anomalous result for women aged 16-24 (12% with slightly abnormal levels of albumin); this much higher level was probably due to contamination from menstruation rather than renal disease.[30] **Table 8.9, Figure 8D**

8.5.3 Survey-defined chronic kidney disease, by age and sex

Survey-defined CKD uses a combination of eGFR levels and urinary albumin excretion status to provide an estimate of prevalence of different stages of kidney disease. 13% of both men and women had any survey-defined CKD (stages1-5), with a strong age gradient particularly from the age of 65-74. Stage 1 CKD was uncommon at every age in both men and women (with the exception of women aged 16-24[30]), but the prevalence of stages 2, 3a/3b, and 4/5 increased with age in both sexes. Stage 3 CKD became generally more common than stage 2 in men and women aged 45 and over.

Figure 8D



Overall, 6% of men and 7% of women had stage 3-5 CKD, comparable with levels found in other international studies (see Discussion section). Again there was strong variation by age, as shown in Figure 8E, with less than 1% of men and women aged 16-24 at stage 3-5, rising to 29% of men and 35% of women aged 75 and over. Kidney disease at stage 4-5 was rare at less than 1% in either sex. **Table 8.10, Figure 8E**

8.5.4 Survey-defined chronic kidney disease (age-standardised), by Strategic Health Authority, equivalised household income and Spearhead status

The proportion of participants with survey-defined CKD did not vary significantly by Strategic Health Authority.

Prevalence of any CKD (stage 1-5) differed by quintile of equivalised household income, increasing from 9% of men and 10% of women in the highest income quintile to 15% of men and 16% of women in the lowest income quintile. However, prevalence of stage 3-5 CKD was not significantly different by income quintile.

Although the differences in prevalence of survey-defined CKD between participants living in Spearhead and non-Spearhead PCTs appeared small, they were significant, with 14% of men and 15% of women in Spearhead PCTs having stage 1-5 CKD, and 11% and 12% respectively in non-Spearhead PCTs. **Tables 8.11- 8.13**

8.5.5 Survey-defined chronic kidney disease stage, by self-reported doctor-diagnosed chronic kidney disease

Fewer than 2% of participants reported doctor-diagnosed chronic kidney disease (see Section 8.4.1). Table 8.14 shows that among participants who reported having doctor-diagnosed kidney disease, 40% had normal renal function, 35% had stage 3a/3b survey-defined CKD, and 14% had stage 4/5 survey-defined CKD. Among participants who did not report doctor-diagnosed kidney disease, 12% had any stage of survey-defined CKD, with half of these having stage 3a/3b and less than 1% having more serious disease.

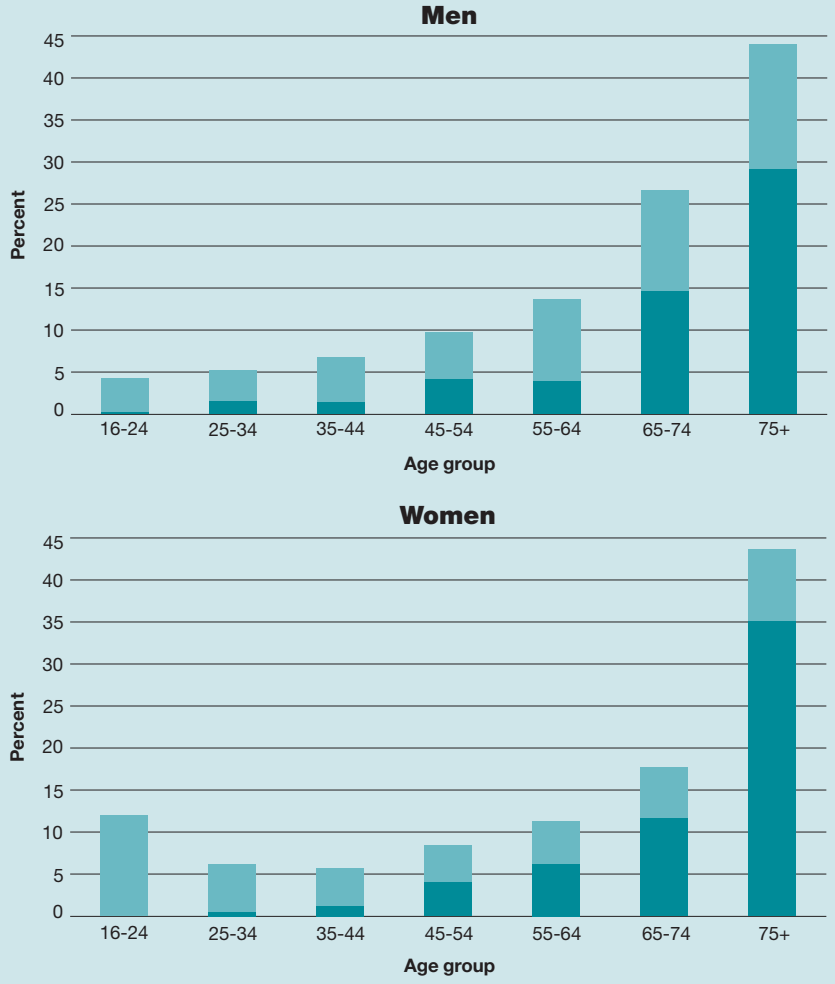
Table 8.15 shows that among those with stage 3a/3b disease according to the survey definition, only 5% of cases in men and 6% in women reported being diagnosed. The survey identified only 10 cases of stage 4/5 CKD; not all reported a diagnosis of kidney disease. **Tables 8.14, 8.15**

Figure 8E

Prevalence survey-defined chronic kidney disease stage, by age and sex

Stage 1-2
Stage 3-5

Base: Aged 16 and over with valid blood and urine samples



8.6 Discussion

8.6.1 Methodological issues

Estimating GFR from serum creatinine

The MDRD equation for estimating Glomerular Filtration Rate, although it has been in general use, is now recognised as having a number of limitations. The CKDEpi formula is more accurate, and will overcome some of the limitations of the MDRD method when it is widely used.[3] Data presented here use MDRD as this is the formula currently used by clinical biochemistry laboratories in the UK, but there will be opportunities for comparison with CKDEpi as secondary analyses.

Other limitations

An important limitation of health surveys, including the HSE, is that a single sample is tested and therefore the persistence of reduced eGFR levels cannot be shown. Given the individual variation in renal function, more extreme values will be averaged out on repeated testing (regression to the mean); this would reduce the prevalence of a low eGFR. Similarly, only a single sample of urine is tested for the albumin:creatinine ratio in the HSE (see below, about two thirds of people with single raised ACR will have persistently raised ACR). The results shown in this report may therefore slightly overestimate the prevalence of CKD, but are the best approximation available to the situation in the general population.

Even with more than 6,000 participants, there are too few cases from the key minority ethnic groups to give robust data on ethnic differences in prevalence. South Asians and Black groups have higher rates of renal replacement therapy[19] but have been found to have lower prevalence of CKD than Caucasians.[18]

Prevalence of stage 4/5 CKD is likely to be underestimated as, while the HSE is able to adjust for non-response among the general population in private households, it may not fully account for some in whom more severe CKD (stage 4/5) will be more common. This would include those who were not able to give a blood or urine sample because of poor health and those who did not participate due to concurrent illness or hospitalisation, as well as those who were in residential care.

8.6.2 Prevalence and severity of CKD

The number of participants in HSE 2010 was around double the numbers sampled for HSE 2009, so overall the results reported in this chapter, based on combined data from HSE 2009 and 2010, are more precise and less subject to random fluctuation. The prevalence of self-reported doctor-diagnosed kidney disease in men was higher in HSE 2009 (1.5%) but the value reported in this chapter (1.0%) is likely to be more accurate.

These results expand on those presented in last year's report, which were the first nationally representative, population-based data on the prevalence of CKD in England using laboratory measures calibrated to allow use of an accepted formula (MDRD) for estimating glomerular filtration rate. The overall prevalence of moderate to severe CKD (stages 3-5) was 6%; prevalence increased with age from 1-2% in those aged 16-44 to over 30% in those aged 75 and over. Prevalence was greater in women.

The overall prevalence of stage 3-5 CKD can be compared with data from other developed countries using national (US National Health and Nutrition Examination Survey (NHANES)) and regional (Nord-Trondelag, Norway Hunt II) surveys which have used the MDRD equation.[9,10,13] Other national surveys have either used different eGFR measures (Ausdiab used Cockcroft-Gault) or have a small population base.[12,31] The prevalence reported in NHANES III (1988-94) was 4.5%, in NHANES IV (1999-2004) 8.0%[13], and in Hunt II (1995-7) 4.4%.[10] The rising prevalence in the USA is partly explained by the rising prevalence of diabetes, hypertension and obesity.[13] In the NHANES surveys, the prevalence of more advanced CKD (eGFR less than 30ml/min/1.73m^2, stage 4) was uncommon at around 0.2-0.4%.[9,13] Between country comparisons need to take account of ethnicity as paradoxically Black people have a lower prevalence of CKD despite higher rates of starting dialysis for end-stage kidney disease.

The most well known UK study, Neoerica, had a different design, based on extraction of prevalence from GP computer systems in certain areas. Key differences from the HSE 2009/10 were that the sample was not representative of the population of England (patients were from GP practices in Kent, Surrey and Manchester), and it was based on selective testing (i.e. GPs testing for an indication) rather than universal testing as in HSE. The proportions tested rose with age, as expected.[11] It is hard to derive population-based prevalence estimates from such data but extrapolation of age- and sex-specific prevalence data to the England population gave an estimated prevalence of CKD 3-5 of 10.9% in females and 5.8% in males. This was high, although their method should actually underestimate prevalence because people with no serum creatinine data were assumed not to have CKD.

The Quality and Outcomes Framework (QOF) was implemented in April 2004 in an effort to improve detection, treatment and management of chronic diseases in the UK. Primary care (GP) practices submit data to the Quality Management Analysis System (QMAS). These data are used to calculate individual practices' QOF achievement to support practice payment processes. Prevalence in 21 clinical areas is also available, and the fifth year of the QOF (April 2010 to March 2011) used data from 8,245 practices, representing almost 100% of registered patients in England.[32,33]

Using data from QOF in 2010/11, the national prevalence of chronic kidney disease stage 3 to 5 in the registered population aged 18 and over was 4.3%.[32] The figure is similar to previous years (4.1% in 2008/09, 4.2% in 2009/10). As expected, the prevalence from QOF data, which is based on GP testing and recording, is lower than that found in the HSE (6%), which includes those that have not visited a GP, or who have undiagnosed disease. The expected prevalence derived from Neoerica was higher still, but was not from a nationally representative sample of the free-living general population.

Both the NHANES and Hunt studies found the same age and sex patterns as those found in the HSE 2009/10. The high prevalence and associations of CKD in older people are well described using baseline data from the Medical Research Council (MRC)'s *Trial of Assessment and Management of Older People*.[34] The MRC study also found differences between the sexes, with higher prevalence among women than men; these are paradoxical, given the higher incidence rate of starting dialysis in men, and may partly reflect biases in the MDRD equation, with greater underestimation of GFR at lower levels in women. This would be corrected by use of the new CKDEpi equation, which is more accurate in classifying CKD stage 3-5.[3]

The HSE 2009/10 gave conflicting findings of the relationship of prevalent CKD and socio-economic status, finding some evidence of association for all CKD and area deprivation (Spearhead status), but a less clear cut picture for CKD 3-5. This may reflect the difficulty of achieving accurate measurement of very low prevalence, even when two survey years' data are combined. An association of socio-economic determinants with CKD has been found in previous studies. Socially deprived people have a higher incidence and prevalence of CKD in developed countries, though the magnitude of the effect varies between countries.[35,36,37,38] In one UK study, individuals living in the most socially deprived areas had a 45% increased risk of new diagnosis of CKD compared with those living in the most affluent areas.[35] Similar differences have been observed in Sweden comparing manual and professional workers.[36] Furthermore, CKD progresses more rapidly in socially deprived patients.[39,40] The effects on both incidence and progression are mediated through many intermediate factors working at the individual level (e.g. low birth weight, smoking, obesity, poor compliance with medical advice, diabetes, and hypertension) or area level (e.g. poor primary care services and inadequate access to secondary care).[37,41]

The prevalence of stage 1 and 2 CKD is more problematic to interpret because there is systematic underestimation of true GFR in people with normal or near normal levels, so considerable misclassification occurs between these two stages. More reliable is the prevalence of a raised urinary albumin:creatinine ratio (ACR) in those with stage 1 or 2 CKD, as a marker of early kidney damage (and/or more widespread dysfunction of small blood vessels), though for clinically useful definitions evidence is needed from more than one ACR result. A single raised ACR was common in the HSE 2009/10, at 8% in men and 9% in women. Prevalence increased with age; other studies have shown that, like low eGFR, raised ACR was greater in less privileged groups, at least in men.[42] The prevalence of persistently raised ACR (i.e. two or three positive out of three samples) in NHANES III was 6.3% and in Hunt II it was 6.5%; these are consistent with HSE data, as persistence of a raised ACR occurs in about two-thirds of cases. A consistently raised ACR is a well recognised marker of kidney damage in diabetes, predicting further loss of kidney function as well as mortality[43] but this is also true of non-diabetics.[6] Recent analysis of pooled cohort data by the CKD Prognosis Consortium have demonstrated that both eGFR and ACR are important when assessing prognosis, as each has independent effects on mortality and kidney outcomes. ACR levels have prognostic impact at all levels of eGFR, including in stage 3-5.[5,6,7,8]

Most people identified with CKD in routine clinical practice are older, due to both the higher underlying prevalence and more frequent blood testing. There has been controversy about the prognostic significance of CKD stages and eGFR levels in older people, with some contending that there is over diagnosis of CKD as a 'disease' for what is an age-related decline. Whilst there is evidence of some attenuation of relative effects of a low eGFR in older people, effects are still seen. The modification by age of the effect of eGFR and ACR

on prognosis is an ongoing research area of the CKD Prognosis Consortium, taking into account relative and absolute effects.[5,44]

8.6.3 Awareness

Overall, 1.1% of HSE 2009/2010 participants aged 16 and over reported a doctor diagnosis of CKD. This is similar to the figure of 2.0% (95% confidence interval 1.4-2.6%) in the American population aged 20 and over in 1999-2000.[45] Unlike the US study, which found much lower awareness in women than men, there was no difference by sex in the HSE 2009/2010.

Awareness of CKD was low, especially in older people. This low awareness has also been found in the US.[46] As Table 8.15 shows, most people who had CKD stage 1 to 3b, as defined by eGFR estimated from a single serum creatinine sample and a single urine analysis of albumin excretion, did not report they had doctor-diagnosed CKD. Among older participants, more than one in eight people aged 65-74 and one in three aged 75 and over had stage 3-5 CKD. However, most of these did not report a diagnosis of CKD.

References and notes

1 Kidney Disease Outcomes Quality Initiative. *Clinical Practice Guidelines for Chronic Kidney Disease: Evaluation, Classification, and Stratification*. National Kidney Foundation, 2002. www.kidney.org/Professionals/kdoqi/

2 Levey AS, Coresh J, Greene T et al. *Expressing the MDRD equation for estimating GFR with IDMS traceable (gold standard) serum creatinine values*. J Am Soc Nephrol 2005;**16**:69A.

3 Levey AS, Coresh J, Schmid CH, Zhang Y, Castro AF, Feldman H et al. *A new equation to estimate glomerular filtration rate*. Ann Int Med 2009;**150**:604-12.

4 Department of Health. *National Service Framework for Renal Services – Part Two: Chronic kidney disease, acute renal failure and end of life care*. DH, London, 2004.

5 Levey AS, De Jong P, Coresh J et al. *The definition, classification, and prognosis of chronic kidney disease: a KDIGO controversies conference report*. Kidney International 2011;**80**:17-28.

6 Chronic Kidney Disease Prognosis Consortium. *Association of estimated glomerular filtration rate and albuminuria with all-cause and cardiovascular mortality in general population cohorts: a collaborative meta-analysis*. Lancet 2010;**375**:2073-81.

7 van der Velde M, Matsushita K, Coresh J et al. *Lower estimated glomerular filtration rate and higher albuminuria are associated with all-cause and cardiovascular mortality. A collaborative meta-analysis of high risk population cohorts*. Kidney International 2011;**79**:1341-52.

8 Gansevoort RT, Matsushita K, van der Velde M et al. *Lower estimated GFR and higher albuminuria are associated with adverse kidney outcomes. A collaborative meta-analysis of general and high-risk population cohorts*. Kidney Intrenational 2011;**80**:93-104.

9 Coresh J, Astor BC, Greene T, Eknoyan G, Levey AS. *Prevalence of chronic kidney disease and decreased kidney function in the adult US population: Third National Health and Nutrition Examination* Survey. Am J Kidney Dis 2003;**41**:1-12.

10 Hallan SJ, Coresh J, Astor BC, Asberg A, Powe NR, Romunstad S et al. *International comparison of the relationship of chronic kidney disease prevalence and ESRD risk*. J Am Soc Nephrol 2006;**17**:2275-84.

11 Stevens PE, O'Donoghue DJ, de Lusignan S, van Vlymen L, Klebe B, Middleton R et al. *Chronic kidney disease management in the United Kingdom: NEOERICA project results*. Kidney International 2007;**72**:92-99.

12 Chadban SJ, Briganti EM, Kerr PG et al. *Prevalence of kidney damage in Australian adults: the Ausdiab kidney study*. J Am Soc Nephrol 2003;**14**:s131-8.

13 Coresh J, Selvin E, Stevens LA, Manzi J, Kusek JW, Eggers P et al. *Prevalence of chronic kidney disease in the United States*. JAMA 2007;**298**:2038-47.

14 Go AS, Chertow GM, Fan D, McCulloch CE, Hsu C. *Chronic kidney disease and the risks of death, cardiovascular events, and hospitalisation*. N Engl J Med 2004;**351**:1296-1305.

15 Chow F, Briganti E, Kerr P, Chadban S, Zimmet P, Atkins R. *Health related quality of life in Australian adults with renal insufficiency: a population based study*. Am J Kidney Dis 2003;**41**:596-604.

16 Feest T, Fogarty D et al (eds). Chapters 1 and 2 in *UK Renal Registry 2010*. 13th Annual Report of the Renal Association. www.renalreg.com/Reports/2010.html

17 *NHS reference costs 2008-2009*. Department of Health, London, 2010. www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_111591

18 Dreyer G, Hull S, Aitken Z, Chesser A, Yacoub MM. *The effect of ethnicity on the prevalence of diabetes and associated chronic kidney disease*. QJ Med 2009;**102**:261-69

19 Roderick PJ, Raleigh VS, Hallam L, Mallick NP. *The Need and Demand for Renal Replacement Therapy in Ethnic Minorities in England*. J Epidemiol Community Health 1996;**50**:334-9.

20 Quality and Outcomes Framework database accessed at www.qof.ic.nhs.uk.

21 National Institute for Health and Clinical Excellence. *Early identification and management of chronic kidney disease in adults in primary and secondary care. Clinical Guidelines. CG73*. NICE, London, 2008.

22 Burden R, Tomson C, Guideline Development Committee, Joint Specialty Committee on Renal Disease of the Royal College of Physicians of London and the Renal Association. *Identification, management and referral of adults with chronic kidney disease: concise guidelines*. Clin Med 2005;**5**:635-42.

23 Sodium and potassium levels were also measured.

24 Myers GL, Miller WG, Coresh J et al. *Recommendations for improving serum creatinine measurement: a report from the Laboratory Working Group of the National Kidney Disease Education Program*. Clin Chem 2006;**52**:5-18.

25 This was chosen because the Jaffe method overestimates creatinine levels in samples that are not spun and separated promptly after collection, due to production of chromagens. The enzymatic assay is not affected by this.

26 Serum total and HDL-cholesterol, haemoglobin, plasma ferritin, and glycated haemoglobin were also measured.

27 Nathan DM, Rosenbaum C, Protasowicki VD. *Single-void urine samples can be used to estimate quantitative microalbuminuria*. Diabetes Care 1987;**10**:414-8.

28 National Collaborating Centre for *Chronic Conditions. Chronic kidney disease. National clinical guideline for early identification and management in adults in primary and secondary care*. Royal College of Physicians, London, 2008.

29 Spearhead PCTs are the most health deprived areas of England. They are areas in the bottom fifth nationally for three or more indicators relating to life expectancy at birth, cancer and cardiovascular disease (CVD) mortality and the index of multiple deprivation.

30 There was an anomalous result for women aged 16-24, with 12% recorded as having slightly abnormal levels of albumin. This high level was only observed in 2010 data; the prevalence in this age group in 2009 was 6%. It is likely that this much higher level in 2010 was due to contamination from menstruation rather than renal disease.

31 Viktorsdottir O, Palsson R, Andresdottir MB, Aspelund T, Gudnason V, Indridason OS. *Prevalence of chronic kidney disease based on estimated glomerular filtration rate and proteinuria in Icelandic adults*. Nephrol Dial Transplant 2005;**20**:1799-807.

32 The NHS Information Centre Prescribing and Primary Care Services. *Quality and Outcomes Framework Achievement Data 2010/11*.The NHS Information Centre, Leeds, 2011. www.ic.nhs.uk/webfiles/publications/002_Audits/QOF_2010_11/QOF_Achievement_and_Prevalence_Bulletin_2010_11_v1.0.pdf

33 Figures published by the NHS Information Centre are derived from the Quality Management Analysis System (QMAS), a national system developed by NHS Connecting for Health. QMAS uses data from general practices to calculate individual practices' QOF achievement. Users of data derived from QMAS should recognise that QMAS was established as a mechanism to support the calculation of practice QOF payments. It is not a comprehensive source of data on quality of care in general practice, but it is potentially a rich and valuable source of such information, providing that the limitations of the data are acknowledged.

The 2010/11 disease prevalence tables were based on prevalence submissions to QMAS at the end of the 2010/11 financial year. The all-age disease prevalence figures are based on 8,245 general practices. These practices covered almost 100% of registered patients in England (based on registration data from the Prescription Pricing Division of the NHS Business Services Authority for the quarter January to March 2011).

34 Roderick P, Atkins RJ, Smeeth L et al. *Detecting chronic kidney disease in older people: what are the implications?* Age Ageing 2008;**37**:179-86.

35 Drey N, Roderick P, Mullee M, Rogerson M. *A population-based study of the incidence and outcomes of diagnosed chronic kidney disease*. Am J Kidney Dis 2003;**42**:677-84.

36 Fored CM, Ejerblad E, Fryzek JP, Lambe M, Lindblad P, Nyren O et al. *Socio-economic status and chronic renal failure: a population-based case-control study in Sweden*. Nephrol Dial Transplant 2003;**18**:82-8.

37 Shoham DA, Vupputuri S, Diez Roux AV, Kaufman JS, Coresh J, Kshirsagar AV et al. *Kidney disease in life-course socioeconomic context: the Atherosclerosis Risk in Communities (ARIC) Study*. Am J Kidney Dis 2007;**49**:217-26.

38 White SL, McGeechan K, Jones M, Cass A, Chadban SJ, Polkinghorne KR et al. *Socio-economic disadvantage and kidney disease in the United States, Australia and Thailand*. Am J Public Health 2008; **98**:1306-13.

39 Krop JS, Coresh J, Chambless LE, Shahar E, Watson RL, Szklo M et al. A *community-based study of explanatory factors for the excess risk for early renal function decline in blacks vs whites with diabetes: the Atherosclerosis Risk in Communities study*. Arch Intern Med 1999;**159**:1777-83.

40 Merkin SS, Coresh J, Roux AV, Taylor HA, Powe NR. *Area socioeconomic status and progressive CKD: the Atherosclerosis Risk in Communities (ARIC) Study*. Am J Kidney Dis 2005;**46**:203-13.

41 Nzerue CM, Demissochew H, Tucker JK. *Race and kidney disease: role of social and environmental factors*. J Nat Med Assoc 2002;**94**(8 Suppl):28S-38S.

42 Martins D, Tareen N, Zadshir A et al. *The association of poverty with the prevalence of albuminuria: data from the Third National Health and Nutrition Examination Survey (NHANES III)*. Am J Kidney Dis 2006:**47**;965-71.

43 Neil A, Hawkins M, Potok M, Thorogood M, Cohen D, Mann J. *A prospective population-based study of micro-albuminuria as a predictor of mortality in NIDDM*. Diabetes Care 1993;**16**:996-1003.

44 Glassock RJ, Winnearls C. *An epidemic of chronic kidney disease: fact or fiction?* Neph Dial Transplant 2008;**23**:1117-21.

45 Coresh J, Byrd-Holt D, Astor B et al. *Chronic kidney disease awareness prevalence and trends amongst US adults 1999-2000*. J Am Soc Nephrol 2005;**16**:180-8.

46 Vassalotti JA, Li S, McCullough PA, Bakris GL. *Kidney early evaluation program: a community-based screening approach to address disparities in chronic kidney disease*. Semin Nephrol 2010;**30**:66-73.

Tables

Table 8.1

Prevalence of self-reported doctor-diagnosed chronic kidney disease and having been tested for kidney disease, by age and sex[a]

Aged 16 and over *2009/2010*

Reported chronic kidney disease	Age group							Total
	16-24	25-34	35-44	45-54	55-64	65-74	75+	
	%	%	%	%	%	%	%	%
Men								
Have doctor-diagnosed chronic kidney disease	0.2	0.3	0.7	1.1	1.5	2.0	2.7	1.0
Been tested for kidney disease	1.6	3.3	4.5	9.2	11.9	15.6	14.4	7.6
Women								
Have doctor-diagnosed chronic kidney disease	0.2	0.4	0.6	1.2	1.9	2.3	3.4	1.3
Been tested for kidney disease	2.3	3.7	5.4	7.2	12.0	13.9	15.3	7.9
Bases (unweighted)								
Men	*612*	*770*	*1029*	*972*	*1001*	*834*	*592*	*5810*
Women	*751*	*1056*	*1309*	*1266*	*1114*	*905*	*853*	*7254*
Bases (weighted)								
Men	*1013*	*1089*	*1199*	*1112*	*953*	*662*	*492*	*6521*
Women	*960*	*1068*	*1210*	*1128*	*989*	*726*	*690*	*6771*

[a] Estimates are shown to one decimal place because of generally low prevalence rates.

Table 8.2

Prevalence of self-reported doctor-diagnosed chronic kidney disease and having been tested for kidney disease (observed and age-standardised), by Strategic Health Authority[a] and sex[b]

Aged 16 and over *2009/2010*

Reported chronic kidney disease	Strategic Health Authority									
	North East	North West	Yorkshire & the Humber	East Midlands	West Midlands	East of England	London	South East Coast	South Central	South West
	%	%	%	%	%	%	%	%	%	%
Men										
Observed										
Have doctor-diagnosed chronic kidney disease	1.0	1.1	1.1	0.9	1.2	0.6	1.3	0.7	0.7	1.4
Been tested for kidney disease	7.7	6.1	7.8	7.0	8.8	7.0	8.4	5.3	8.2	9.3
Standardised										
Have doctor-diagnosed chronic kidney disease	0.9	1.0	1.1	0.8	1.2	0.6	1.4	0.7	0.7	1.3
Been tested for kidney disease	7.3	6.0	8.1	6.6	8.8	6.8	9.4	5.2	8.2	8.7
Women										
Observed										
Have doctor-diagnosed chronic kidney disease	1.5	1.9	1.0	1.4	0.7	1.3	1.6	1.3	0.7	1.0
Been tested for kidney disease	11.3	8.4	7.0	8.8	8.1	7.3	6.8	7.5	8.2	7.6
Standardised										
Have doctor-diagnosed chronic kidney disease	1.4	1.8	1.0	1.3	0.7	1.3	2.0	1.3	0.7	0.9
Been tested for kidney disease	10.5	8.1	7.2	8.4	8.0	7.4	7.6	7.6	7.9	7.3
Bases (unweighted)										
Men	*422*	*806*	*580*	*580*	*609*	*654*	*607*	*476*	*495*	*581*
Women	*598*	*977*	*707*	*710*	*772*	*776*	*773*	*622*	*595*	*725*
Bases (weighted)										
Men	*315*	*855*	*666*	*588*	*678*	*736*	*957*	*531*	*535*	*660*
Women	*367*	*908*	*689*	*588*	*717*	*735*	*972*	*579*	*526*	*692*

[a] This table provides data for regional analysis by the configuration of Strategic Health Authorities (SHAs) in place from July 2006.

[b] Estimates are shown to one decimal place because of generally low prevalence rates.

Table 8.3

Prevalence of self-reported doctor-diagnosed chronic kidney disease and having been tested for kidney disease (age-standardised), by equivalised household income and sex[a]

Aged 16 and over — *2009/2010*

Reported chronic kidney disease	Equivalised household income quintile				
	Highest	2nd	3rd	4th	Lowest
	%	%	%	%	%
Men					
Have doctor-diagnosed chronic kidney disease	0.9	0.9	0.9	1.2	1.8
Been tested for kidney disease	7.7	7.4	8.3	7.0	7.8
Women					
Have doctor-diagnosed chronic kidney disease	1.3	0.5	1.6	1.0	1.9
Been tested for kidney disease	7.0	6.7	9.6	8.4	9.7
Bases (unweighted)					
Men	*1124*	*1050*	*924*	*880*	*713*
Women	*1174*	*1193*	*1151*	*1181*	*1083*
Bases (weighted)					
Men	*1257*	*1188*	*1021*	*915*	*817*
Women	*1129*	*1147*	*1052*	*1055*	*981*

[a] Estimates are shown to one decimal place because of generally low prevalence rates.

Table 8.4

Prevalence of self-reported doctor-diagnosed chronic kidney disease and having been tested for kidney disease (age-standardised), by Spearhead status[a] and sex[b]

Aged 16 and over — *2009/2010*

Reported chronic kidney disease	Spearhead status	
	Non-Spearhead PCT	Spearhead PCT
	%	%
Men		
Have doctor-diagnosed chronic kidney disease	1.0	1.1
Been tested for kidney disease	7.8	7.3
Women		
Have doctor-diagnosed chronic kidney disease	1.2	1.3
Been tested for kidney disease	7.5	8.7
Bases (unweighted)		
Men	*3607*	*2203*
Women	*4427*	*2828*
Bases (weighted)		
Men	*4179*	*2342*
Women	*4281*	*2490*

[a] Spearhead PCTs are the most health deprived areas of England. They are areas in the bottom fifth nationally for three or more indicators relating to life expectancy at birth, cancer and cardiovascular disease (CVD) mortality and the index of multiple deprivation.

[b] Estimates are shown to one decimal place because of generally low prevalence rates.

Table 8.5

Response to urine spot sample, by age and sex

Aged 16 and over with a nurse visit *2009/2010*

Response	Age group							Total
	16-24	25-34	35-44	45-54	55-64	65-74	75+	
	%	%	%	%	%	%	%	%
Men								
Urine sample obtained	83	86	89	88	91	89	87	88
Attempted but not obtained	0	0	0	0	1	0	0	0
Unable to obtain urine sample for reasons other than refusal	6	4	6	7	6	6	9	6
Respondent refused to give urine sample	10	9	5	5	3	4	3	5
Women								
Urine sample obtained	70	78	88	90	92	90	81	86
Attempted but not obtained	1	0	0	0	0	1	0	0
Unable to obtain urine sample for reasons other than refusal	7	6	4	4	5	4	14	6
Respondent refused to give urine sample	17	8	5	6	4	5	4	7
Not applicable (pregnant)	5	8	2	0	-	-	-	2
Bases (unweighted)								
Men	*343*	*460*	*701*	*674*	*677*	*606*	*399*	*3860*
Women	*464*	*663*	*935*	*911*	*815*	*632*	*568*	*4988*

Table 8.6

Response to blood sample, by age and sex

Aged 16 and over with a nurse visit *2009/2010*

Response	Age group							Total
	16-24	25-34	35-44	45-54	55-64	65-74	75+	
	%	%	%	%	%	%	%	%
Men								
Valid non-fasting blood sample taken	69	76	79	84	78	76	68	77
Agreed, not obtained	5	1	4	2	6	5	6	4
Refused	22	21	13	10	10	10	12	13
Not applicable[a]	3	2	3	3	5	8	13	5
Not attempted	1	0	1	1	1	1	2	1
Women								
Valid non-fasting blood sample taken	52	59	79	80	80	76	69	73
Agreed, not obtained	6	7	5	5	6	7	5	6
Refused	33	21	12	11	9	9	14	14
Not applicable[a]	8	11	4	3	3	7	10	6
Not attempted	2	2	1	1	2	1	3	2
Bases (unweighted)								
Men	*343*	*460*	*701*	*674*	*677*	*606*	*399*	*3860*
Women	*464*	*663*	*935*	*911*	*815*	*632*	*568*	*4988*

[a] On anticoagulants or had fits in the past, and among women, pregnant.

Table 8.7

Proportion providing valid samples for each blood analyte, by age and sex

Aged 16 and over with a nurse visit *2009/2010*

Response	Age group							Total
	16-24	25-34	35-44	45-54	55-64	65-74	75+	
	%	%	%	%	%	%	%	%
Men								
Total cholesterol	65	71	75	80	73	71	64	72
HDL-cholesterol	65	71	75	80	73	71	64	72
Glycated haemoglobin	64	71	75	79	73	71	64	72
Creatinine	64	68	73	78	71	71	62	71
Vitamin D[a]	63	70	73	79	69	71	63	71
Women								
Total cholesterol	48	55	73	75	76	71	65	68
HDL-cholesterol	48	55	73	75	76	71	65	68
Glycated haemoglobin	48	55	72	75	76	70	64	67
Creatinine	47	54	71	74	74	70	64	67
Vitamin D[a]	49	56	71	74	73	69	64	67
Bases (unweighted)								
Men	*343*	*460*	*701*	*674*	*677*	*606*	*399*	*3860*
Women	*464*	*663*	*935*	*911*	*815*	*632*	*568*	*4988*

[a] Based on 2010 sample only. Vitamin D not measured in 2009.

Table 8.8

Serum creatinine and eGFR[a] levels, by age and sex

Aged 16 and over with a valid eGFR result *2009/2010*

Mean serum creatinine and eGFR levels	Age group							Total
	16-24	25-34	35-44	45-54	55-64	65-74	75+	
Men								
Serum creatinine								
Mean (mmol/L)	78.0	80.6	82.3	85.4	81.4	92.2	94.2	83.7
Standard error of the mean	0.87	0.74	0.58	1.81	0.65	3.32	1.58	0.56
eGFR levels								
% Normal (90+ ml/min/1.73m^2)	85	69	53	44	38	22	21	51
% with 60-89 ml/min/1.73m^2	14	30	45	52	58	63	50	43
% with 30-59 ml/min/1.73m^2	1	2	2	4	4	14	28	6
% with less than 30 ml/min/1.73m^2	-	-	-	0	-	1	0	0
% with less than 60 ml/min/1.73m^2	*1*	*2*	*2*	*4*	*4*	*15*	*28*	*6*
Women								
Serum creatinine								
Mean (mmol/L)	60.6	62.6	62.9	65.4	66.8	69.0	76.4	65.6
Standard error of the mean	0.65	0.56	0.43	0.50	0.70	0.84	1.18	0.26
eGFR levels								
% Normal (90+ ml/min/1.73m^2)	87	71	59	40	30	22	14	48
% with 60-89 ml/min/1.73m^2	13	28	40	56	64	66	51	45
% with 30-59 ml/min/1.73m^2	-	1	1	4	6	12	35	7
% with less than 30 ml/min/1.73m^2	-	-	-	-	1	1	0	0
% with less than 60 ml/min/1.73m^2	*0*	*1*	*1*	*4*	*6*	*12*	*35*	*7*
Bases (unweighted)								
Men	*213*	*311*	*506*	*525*	*478*	*428*	*246*	*2707*
Women	*210*	*351*	*661*	*667*	*598*	*436*	*358*	*3281*
Bases (weighted)								
Men	*443*	*470*	*546*	*512*	*426*	*306*	*221*	*2925*
Women	*412*	*485*	*542*	*512*	*449*	*327*	*312*	*3038*

[a] eGFR is estimated Glomerular Filtration Rate.

Table 8.9

Urinary albumin excretion, by age and sex

Aged 16 and over with a valid urine sample *2009/2010*

Albuminuria[a]	Age group							Total
	16-24	25-34	35-44	45-54	55-64	65-74	75+	
	%	%	%	%	%	%	%	%
Men								
Normal	96	96	94	94	88	83	74	91
Micro-albuminuria	4	4	6	6	11	15	25	8
Macro-albuminuria	-	-	-0	0	0	2	2	0
Women								
Normal	87	94	95	95	94	91	81	92
Micro-albuminuria	12[b]	6	5	5	5	8	18	8
Macro-albuminuria	0	0	0	0	1	1	1	1
Bases (unweighted)								
Men	*281*	*393*	*613*	*588*	*607*	*538*	*343*	*3363*
Women	*325*	*509*	*821*	*814*	*740*	*560*	*460*	*4229*
Bases (weighted)								
Men	*574*	*616*	*683*	*634*	*546*	*380*	*279*	*3712*
Women	*547*	*614*	*696*	*648*	*566*	*412*	*397*	*3880*

[a] Normal urinary albumin: up to 2.5mg/mmol for men; up to 3.5mg/mmol for women.
Micro-albuminuria: more than 2.5mg/mmol to 30mg/mmol for men; more than 3.5mg/mmol to 30mg/mmol for women.
Macro-albuminuria: more than 30mg/mmol for men and women.

[b] There was an anomalous result for women aged 16-24 (12% with slightly abnormal levels of albumin); this much higher level was probably due to contamination from menstruation rather than renal disease.

Table 8.10

Survey-defined chronic kidney disease stage, by age and sex

Aged 16 and over with valid blood and urine samples *2009/2010*

Kidney disease stage[a]	Age group							Total
	16-24	25-34	35-44	45-54	55-64	65-74	75+	
	%	%	%	%	%	%	%	%
Men								
Normal	96	95	93	90	86	73	56	87
Stage 1	3	1	2	2	4	2	4	3
Stage 2	1	2	3	3	6	10	11	4
Stage 3a/3b	0	2	2	4	4	14	29	6
Stage 4/5	-	-	-	0	-	1	0	0
Stage 3-5	*0*	*2*	*2*	*4*	*4*	*15*	*29*	*6*
Any kidney disease (Stage 1-5)	*4*	*5*	*7*	*10*	*14*	*27*	*44*	*13*
Women								
Normal	88	94	94	92	89	82	56	87
Stage 1	11[b]	3	2	2	2	1	2	3
Stage 2	2	2	3	2	3	5	7	3
Stage 3a/3b	-	1	1	4	6	11	35	7
Stage 4/5	-	-	-	-	1	0	1	0
Stage 3-5	*0*	*1*	*1*	*4*	*6*	*12*	*35*	*7*
Any kidney disease (Stage 1-5)	*12*	*6*	*6*	*8*	*11*	*18*	*44*	*13*
Bases (unweighted)								
Men	*195*	*288*	*461*	*481*	*443*	*403*	*224*	*2495*
Women	*173*	*317*	*612*	*623*	*564*	*409*	*313*	*3011*
Bases (weighted)								
Men	*406*	*434*	*499*	*466*	*393*	*289*	*199*	*2686*
Women	*340*	*441*	*497*	*476*	*420*	*305*	*271*	*2750*

[a] Normal: eGFR 90+ ml/min/1.73m^2 and normal albuminuria
Stage 1: eGFR 90+ ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 2: eGFR 60-89 ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 3a/3b: eGFR 30-59 ml/min/1.73m^2 regardless of albuminuria
Stage 4/5: eGFR less than 30 ml/min/1.73m^2 regardless of albuminuria.

[b] There was an anomalous result for women aged 16-24 (12% with slightly abnormal levels of albumin); this much higher level was probably due to contamination from menstruation rather than renal disease.

Table 8.11

Survey-defined chronic kidney disease stage (observed and age-standardised), by Strategic Health Authority[a] and sex

Aged 16 and over with valid blood and urine samples — *2009/2010*

Kidney disease stage[b]	Strategic Health Authority									
	North East	North West	Yorkshire & the Humber	East Midlands	West Midlands	East of England	London	South East Coast	South Central	South West
	%	%	%	%	%	%	%	%	%	%
Men										
Observed										
Normal	80	86	87	89	86	87	90	91	89	85
Stage 1	2	4	1	3	4	1	3	1	3	4
Stage 2	8	6	5	3	4	5	3	5	2	6
Stage 3a/3b	10	5	7	5	6	7	4	3	6	5
Stage 4/5	-	-	-	0	-	0	1	-	-	-
Stage 3-5	*10*	*5*	*7*	*6*	*6*	*7*	*4*	*3*	*6*	*5*
Any kidney disease (Stage 1-5)	*20*	*14*	*13*	*11*	*14*	*13*	*10*	*9*	*11*	*15*
Standardised										
Normal	79	86	87	91	87	86	88	91	88	86
Stage 1	2	4	1	3	4	1	3	1	3	4
Stage 2	8	6	5	2	4	5	3	5	3	5
Stage 3a/3b	11	4	7	4	5	8	5	4	6	5
Stage 4/5	-	-	-	0	-	0	1	-	-	-
Stage 3-5	*11*	*4*	*7*	*4*	*5*	*8*	*6*	*4*	*6*	*5*
Any kidney disease (Stage 1-5)	*21*	*14*	*13*	*9*	*13*	*14*	*12*	*9*	*12*	*14*
Women										
Observed										
Normal	84	85	88	86	83	90	90	84	89	89
Stage 1	4	2	3	3	4	2	4	3	3	3
Stage 2	6	4	3	2	5	3	2	4	2	2
Stage 3a/3b	7	9	6	7	8	5	3	9	7	6
Stage 4/5	-	1	-	0	-	-	0	0	-	-
Stage 3-5	*7*	*10*	*6*	*8*	*8*	*5*	*4*	*9*	*7*	*6*
Any kidney disease (Stage 1-5)	*16*	*15*	*12*	*14*	*17*	*10*	*10*	*16*	*11*	*11*
Standardised										
Normal	84	86	88	87	82	90	88	84	89	89
Stage 1	4	2	3	4	4	2	4	4	3	3
Stage 2	6	3	3	2	6	3	2	4	2	2
Stage 3a/3b	6	8	7	7	9	5	5	8	6	5
Stage 4/5	1	-	0	0	-	-	1	0	-	-
Stage 3-5	*6*	*8*	*7*	*7*	*9*	*5*	*6*	*8*	*6*	*5*
Any kidney disease (Stage 1-5)	*16*	*14*	*12*	*13*	*18*	*10*	*12*	*16*	*11*	*11*
Bases (unweighted)										
Men	*180*	*278*	*258*	*279*	*260*	*287*	*245*	*218*	*192*	*298*
Women	*278*	*332*	*321*	*296*	*317*	*279*	*312*	*298*	*214*	*364*
Bases (weighted)										
Men	*127*	*314*	*266*	*264*	*280*	*318*	*384*	*235*	*223*	*276*
Women	*154*	*343*	*288*	*238*	*278*	*264*	*426*	*265*	*199*	*296*

[a] This table provides data for regional analysis by the configuration of Strategic Health Authorities (SHAs) in place from July 2006.

[b] Normal: eGFR 90+ ml/min/1.73m^2 and normal albuminuria
Stage 1: eGFR 90+ ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 2: eGFR 60-89 ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 3a/3b: eGFR 30-59 ml/min/1.73m^2 regardless of albuminuria
Stage 4/5: eGFR less than 30 ml/min/1.73m^2 regardless of albuminuria.

Table 8.12

Survey-defined chronic kidney disease stage (age-standardised), by equivalised household income and sex

Aged 16 and over with valid blood and urine samples *2009/2010*

Kidney disease stage[a]	Equivalised household income quintile				
	Highest	2nd	3rd	4th	Lowest
	%	%	%	%	%
Men					
Normal	91	87	87	87	85
Stage 1	1	2	4	2	3
Stage 2	3	5	4	4	7
Stage 3a/3b	4	6	5	7	5
Stage 4/5	-	0	-	-	0
Stage 3-5	*4*	*6*	*5*	*7*	*5*
Any kidney disease (Stage 1-5)	*9*	*13*	*13*	*13*	*15*
Women					
Normal	90	88	87	89	84
Stage 1	3	2	3	2	5
Stage 2	3	4	2	2	5
Stage 3a/3b	5	5	7	7	6
Stage 4/5	-	0	0	-	0
Stage 3-5	*5*	*6*	*8*	*7*	*6*
Any kidney disease (Stage 1-5)	*10*	*12*	*13*	*11*	*16*
Bases (unweighted)					
Men	*557*	*526*	*428*	*364*	*275*
Women	*570*	*564*	*516*	*493*	*416*
Bases (weighted)					
Men	*566*	*568*	*437*	*370*	*342*
Women	*486*	*510*	*442*	*438*	*412*

[a] Normal: eGFR 90+ ml/min/1.73m^2 and normal albuminuria
Stage 1: eGFR 90+ ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 2: eGFR 60-89 ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 3a/3b: eGFR 30-59 ml/min/1.73m^2 regardless of albuminuria
Stage 4/5: eGFR less than 30 ml/min/1.73m^2 regardless of albuminuria.

Table 8.13

Survey-defined chronic kidney disease stage (age-standardised), by Spearhead status[a] and sex

Aged 16 and over with valid blood and urine samples *2009/2010*

Kidney disease stage[b]	Spearhead status	
	Non-Spearhead PCT	Spearhead PCT
	%	%
Men		
Normal	89	86
Stage 1	2	3
Stage 2	4	5
Stage 3a/3b	5	6
Stage 4/5	0	0
Stage 3-5	*5*	*6*
Any kidney disease (Stage 1-5)	*11*	*14*
Women		
Normal	88	85
Stage 1	3	4
Stage 2	3	4
Stage 3a/3b	6	7
Stage 4/5	0	0
Stage 3-5	*6*	*8*
Any kidney disease (Stage 1-5)	*12*	*15*
Bases (unweighted)		
Men	*1623*	*872*
Women	*1905*	*1106*
Bases (weighted)		
Men	*1778*	*908*
Women	*1772*	*978*

[a] Spearhead PCTs are the most health deprived areas of England. They are areas in the bottom fifth nationally for three or more indicators relating to life expectancy at birth, cancer and cardiovascular disease (CVD) mortality and the index of multiple deprivation.

[b] Normal: eGFR 90+ ml/min/1.73m^2 and normal albuminuria
Stage 1: eGFR 90+ ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 2: eGFR 60-89 ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 3a/3b: eGFR 30-59 ml/min/1.73m^2 regardless of albuminuria
Stage 4/5: eGFR less than 30 ml/min/1.73m^2 regardless of albuminuria.

Table 8.14

Survey-defined chronic kidney disease stage, by self-reported kidney disease

Aged 16 and over with valid blood and urine samples[a] *2009/2010*

Kidney disease stage[b]	Self-reported doctor-diagnosed kidney disease	
	Yes	No
	%	%
Normal	40	88
Stage 1	4	3
Stage 2	7	4
Stage 3a/3b	35	6
Stage 4/5	14	0
Stage 3-5	*48*	*6*
Any kidney disease (Stage 1-5)	*60*	*12*
Bases (unweighted)	*60*	*5446*
Bases (weighted)	*54*	*5382*

[a] Too few participants reported doctor-diagnosed kidney disease to analyse these data by sex. For those without reported doctor-diagnosed disease, the results were identical for men and for women.

[b] Normal: eGFR 90+ ml/min/1.73m^2 and normal albuminuria.
Stage 1: eGFR 90+ ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 2: eGFR 60-89 ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 3a/3b: eGFR 30-59 ml/min/1.73m^2 regardless of albuminuria
Stage 4/5: eGFR less than 30 ml/min/1.73m^2 regardless of albuminuria.

Table 8.15

Prevalence of self-reported kidney disease, by survey-defined chronic disease stage and sex

Aged 16 and over with valid blood and urine samples *2009/2010*

Self-reported doctor-diagnosed kidney disease	Kidney disease stage[a]			
	Normal	Stage 1	Stage 2	Stages 3a/3b
	%	%	%	%
Men				
Self-reported kidney disease	0	-	2	5
No self-reported kidney disease	100	100	98	95
Women				
Self-reported kidney disease	1	3	2	6
No self-reported kidney disease	99	97	98	94
Bases (unweighted)				
Men	*2129*	*60*	*137*	*165*
Women	*2604*	*74*	*106*	*221*
Bases (weighted)				
Men	*2348*	*67*	*119*	*148*
Women	*2393*	*85*	*87*	*180*

[a] Normal: eGFR 90+ ml/min/1.73m^2 and normal albuminuria
Stage 1: eGFR 90+ ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 2: eGFR 60-89 ml/min/1.73m^2 and micro- or macro-albuminuria
Stage 3a/3b: eGFR 30-59 ml/min/1.73m^2 regardless of albuminuria
Stage 4/5: eGFR less than 30 ml/min/1.73m^2 regardless of albuminuria.

Note that results for Stages 4/5 are not shown due to low bases.