Undiagnosed Chronic Kidney Disease in primary care: ethnic inequalities and CVD risk management – cross-sectional study in general practice.

Mariam Molokhia Department of Population Health Sciences, KCL

Grace Okoli Centre for Primary Care and Public Health
Barts and The London School of Medicine and Dentistry, Queen Mary University of London

Patrick Redmond Department of Population Health Sciences, KCL

Elham Asgari GSTT HOSPITAL NHS FOUNDATION TRUST

Catriona Shaw KING'S COLLEGE HOSPITAL NHS FOUNDATION TRUST

Peter Schofield Department of Population Health Sciences, KCL

Mark Ashworth Department of Population Health Sciences, KCL

Stevo Durbaba Department of Population Health Sciences, KCL

Dorothea Nitsch Department of Non-communicable Disease Epidemiology, London School of Hygiene & Tropical Medicine

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ABSTRACT 231

Background: Undiagnosed chronic kidney disease is associated with poorer quality of care.

Aim: To determine the proportion and determinants of CKD which has not been formally recorded (Read coded).

Design and setting: A cross-sectional survey, in an ethnically diverse adult population, was undertaken using primary care electronic health records (EHR) from 47/49 GP clinics in Lambeth, South London.

Method: Multivariable logistic regression analysis examined the association of demographic factors, selected comorbidities, deprivation and CVD risk management in CKD with coding status as outcome.

Results: 286,162 adults, of whom 9,325 (3.3%) individuals were identified with CKD Stage 3-5, (assigned as CKD based on eGFR values). Of those identified with CKD 4,239 (45.5%) were Read coded, and 5,086 (54.5%) were uncoded. Of those we identified with CKD stage 3-5, individuals aged ≥ 50 years were more likely to be coded for CKD, compared to those aged <50 years. Lower levels of coding were independently associated with deprivation and Black Caribbean, Black African and Asian ethnicity compared to White ethnicity. Prescribed statin, and ACEI (angiotensin inhibitor) or ARB (angiotensin-renin blocker) medications were associated with increased odds of CKD coding.

Conclusions: Our study found greater than 50% of CKD was uncoded and for these patients, quality of care was lower. Individuals with uncoded CKD were more likely to be of Black African, Black Caribbean or Asian ethnicity.

Keywords CKD coding ethnicity African Caribbean Asian CVD

How this fits in: Coding of CKD is associated with improved quality of care and CVD risk management. We found health inequalities with lower levels of coding in younger age-groups (under 50 years), Black Caribbean, Black African, Asian and Non-stated ethnic groups compared to White ethnicity, who would benefit from targeted improvement initiatives.

INTRODUCTION

Prevalence of CKD and associated risk factors

Chronic kidney disease (CKD) is a major cause of morbidity and mortality in patients with hypertension, diabetes and cardiovascular disease and a significant public health concern. Incidence and prevalence has substantially increased over the last decade with a global prevalence of around 12%. [1] More than 1.8 million people in England have diagnosed chronic kidney disease (CKD), the current total adult CKD Stage 3-5 prevalence is estimated as 6%, and rises with age. [2] Persistent albuminuria prevalence, (with normal eGFR) considered Stage 1 CKD is estimated as high as 10%. [3] Stage 1 and 2 CKD prevalence is estimated as 3-12% of adults aged 35 years or over. [3] In addition, approximately one million people in the UK have, based on their eGFR results, CKD 3-5 but are not coded. In UK primary care, the Quality and Outcomes Framework, QOF incentivises maintaining a CKD register which now includes classification of GFR categories “G3a to G5” (based on estimated glomerular filtration rate eGFR), but the BP targets, ACEI or ARB treatment and ACR testing have been removed. [4]

Cardiovascular disease (CVD) is the most common cause of mortality in later stage CKD. [5, 6] Recognised risk factors for CKD include age, sex, ethnicity, hypertension, diabetes, cardiovascular disease, smoking and NSAID use. [7]

In CKD, guidance includes BP management targets and statins for CVD prevention for all individuals with CKD Stages 3–5. [8,9] Systolic BP targets in CKD are below 140 mmHg (target range 120–139 mmHg) and the diastolic BP below 90 mmHg. For patients with Type 2 diabetes (T2DM) and/or urinary albumin creatinine ratio >70 mg/mmol BP targets are <130/80 mmHg. [8] A recent meta-analyses found GFR decline may be slowed with glycaemic and lipid lowering control, but lacked protective effect of antihypertensives, although studies were underpowered. [10]

Coding and management of disease

In the UK, General Practitioners (GPs) are responsible for management of CKD with QOF financial incentives for coding and management of conditions in primary care, updated annually. [4] Read and SNOMED CT clinical coding are used for recording of clinical information in primary care, [11] and include (i) diagnostic codes; (ii) measurements (laboratory test results, blood pressure, height and weight); (iii) drug prescriptions and (iv) socio-demographic items.

The importance of CKD clinical coding (i.e. formal diagnosis) in primary care was highlighted in the 2017 National CKD Audit, which recommended improved CKD coding. [12] Patients who have uncoded CKD may have disease that is undiagnosed or missed. [13] Since 78% of those with CKD are managed in primary care, the audit noted that, without coding, a significant number of people are at high risk of lack of monitoring and appropriate follow-up, with increased risk of poor outcomes. [12] However, presently ~ 70% patients with CKD are coded for CKD in primary care nationally, [14, 15] and evidence suggests there is a positive relationship between coding and patient management. [15] Other studies in different settings have also shown lower levels of CKD coding to be associated with poorer health outcomes including hospitalisation and blood pressure target achievement, [16, 17] and with lower hypertension and stroke recording. [18] We decided to repeat the National CKD audit (which comprised of largely White rural populations) in a multi-ethnic urban setting, [19] using more recent data.

Objectives:

1. To determine proportion of uncoded CKD based on eGFR values alone.
2. To identify determinants of receiving a ‘coded’ CKD diagnosis.
3. To identify differences in management and quality of care measures between coded and uncoded CKD.

METHODS

Study Design

Cross-sectional survey of people with CKD Read coding and/or reduced eGFR on the GP record.

We determined coding status, risk factors and measures of CKD management.

Setting

Lambeth, South London, UK

Data sources

This study utilised a dataset derived from general practice electronic health records in one inner London borough, Lambeth DataNet (LDN), extracted in October 2013. LDN contains patient level clinical data, prescribing data, laboratory data, and demographic information, including ethnicity based on categories of the UK 2001 census, risk factors and co-morbidities. We investigated demographic factors, comorbidities and other quality of care measures in a multi-ethnic population identified as having CKD, based on eGFR. eGFR was calculated from laboratory serum creatinine values using the modified four-variable Modification of Diet in Renal Disease (MDRD) equation, adjusted for sex and ethnic group.

Study population

The study was carried out using anonymised data from adult patients (≥ 18 years) registered with 47/49 GP practices, in Lambeth, South London.

Identification of CKD coding status

Coded CKD status was determined using QOF CKD descriptive codes, plus codes for dialysis or renal transplantation (Supplementary Table 1), validated with biochemical evidence of CKD based on the latest two readings for eGFR levels < 60 ml/min/1.73m^2, ≥ 3 months apart. Non-coded CKD was defined as individuals who fitted the criteria for biochemical CKD without a corresponding Read code entry.

Covariates

We examined factors such as age, gender, ethnicity, deprivation (Index of Multiple Deprivation 15), and selected comorbidities likely to affect renal health outcomes including hypertension (HTN), Type 2 diabetes (T2DM) coronary heart disease (CHD) heart failure (HF) and serious mental illness, (SMI) using QOF registers at the time of the data extract (2013). [20] We selected SMI as this is common in CKD, [21] and studies report an association with increased CVD mortality and morbidity. [22] Other measured factors affecting CKD progression and/or health outcomes were: systolic and diastolic blood pressure control, statin, ACEI or ARB and NSAID prescribed medication and lifestyle factors such as smoking and obesity. Ethnicity was self-reported and aggregated into 7 categories: White, Black African, Black Caribbean, South Asian, Chinese, Other, and Non-stated. Systolic BP control was defined as <140 mmHg and diastolic <90 mmHg, [8] based on the average of two latest readings. Proteinuria measurements (a measure of renal damage) were incomplete and therefore not included.

Outcomes

We examined following metrics relevant to quality of care in CKD which included:

1. Proportion of uncoded CKD (based on eGFR).

2. Determinants of receiving a 'coded' CKD diagnosis.

3. Differences in management and quality of care measures between coded and uncoded, based on NICE guidance in CKD, demographic and patient factors and comorbidities.

Analysis

A cross-sectional assessment of people with biochemical CKD was used to assess factors associated with coding status in individuals with CKD using STATA 15.

Logistic regression analysis was used to determine the association of demographic factors, selected comorbidities, and CVD risk management measures with CKD coding status. Partly adjusted (adjusted for age-group and gender) and fully adjusted (adjusted for age-group, gender, and other covariates) analysis was conducted. The covariates adjusted for included ethnicity (White ethnicity as reference group), locally based deprivation quintile, smoking status, comorbidities and quality of care factors (CVD risk management; prescribing of statin, ACEI or ARB medication).

RESULTS

Descriptive characteristics of the study population

The population comprised of 286,162 adults in 47/49 GP practices in Lambeth.

Outcomes:

Coding of CKD

Of those identified with CKD, 4,239 (45.5%) had Read coded CKD diagnoses, and 5,086 (54.5%) were uncoded (validated with ethnicity corrected eGFR), yielding a total CKD population of 9, 325.

9,325/286, 162 (3.3%) individuals were identified as having CKD based on eGFR values (Figure 1). Of these the largest proportion was amongst those of Caribbean, African and Bangladeshi background, which remained after adjusting for age. The figures showing age-standardised rates, were produced using the Mid 2013 England and Wales population estimate. (Figures 2, 3). Figure 4 shows coding status by 10-year age-group. CKD coding rose sharply in those aged ≥ 60 years.

Table 1a summarises risk factors in 9,325 CKD patients according to coding status. The proportion of coded CKD was lower in younger age groups (below 50 years). Coded CKD shows ethnic inequalities: 54.3% of all CKD is coded in the White group but only 31.7% in the Black African and 40.9% in the Black Caribbean groups respectively. Table 1b shows quality of care, including BP control and pharmacotherapy. Prescribed diuretic, ACEI/ARB and statin use was lower and prescribed NSAID use higher in uncoded CKD patients.

Determinants of receiving a 'coded' CKD diagnosis

Partially adjusted analyses of those we identified with CKD stage 3-5 adjusted for age-group and gender are shown in Table 2.

In the fully adjusted analyses, of those identified with CKD stage 3-5, being in an older age group was associated with an increased odds of CKD being coded: adjusted odds ratio (95% CI) 50-59 years 1.26

(1.01-1.57), 60-69 years 1.86 (1.50-2.30), 70-79 years 2.89 (2.36-3.56), 80-89 years 3.88 (3.13-4.81) and >90 years 4.06 (3.04-5.43), compared to those aged <50 years. Lower levels of coding were associated with all levels of deprivation (compared to least deprived quintile), Black African 0.56 (0.48-0.66) and Black Caribbean 0.61 (0.54-0.70), Asian ethnicity 0.81 (0.66-0.99) and Non-stated ethnicity 0.58 (0.41-0.81) compared to White ethnicity.

Some comorbidities including hypertension, heart failure, and serious mental illness, were associated with increased odds of CKD being recognised and coded (Table 2).

Management and quality of care measures

Quality of care factors were associated with increased odds of CKD coding: prescribed statin 1.38 (1.23-1.55), and ACEI or ARB medications 2.24 (1.97-2.54). CKD coding was associated with lower use of prescribed NSAIDs, OR 0.79 (0.71-0.89). In a separate analysis, target systolic BP control was also associated with increased likelihood of being coded for CKD OR 1.16 (95% CI 1.04-1.30).

DISCUSSION

Summary

In this study of participants from ethnically diverse populations, we found 54.5% of CKD was uncoded (i.e. not formally recognised) and, for these patients, quality of care was lower.

We found younger adults under 50 years with CKD are less likely to be coded and therefore may be at risk of adverse CVD outcomes, consistent with the National CKD Audit data. The age-adjusted burden of CKD showed the largest proportion of cases in Caribbean, mixed White and Black Caribbean, African and Bangladeshi ethnic groups. We found that the participants of Black Caribbean, Black African and Asian ethnicity were also less likely to be coded for CKD, which may reflect physician recording bias. The finding of lower associated coding for these ethnic groups is important as it shows a clear health inequality in this group, which remained after adjusting for deprivation.

CKD coding was associated with comorbidities including hypertension, heart failure, and serious mental illness. For individuals coded for CKD, associated quality of care factors, prescribed statin, and ACEI or ARB medications were more likely. We found CKD coding was associated with lower use of prescribed NSAIDs, likely due to prescriber practice (less likely to prescribe NSAIDs due to concerns about renal toxicity). This study reports an uneven prevalence of comorbidities (e.g. stroke, CHD, heart failure) between those coded and uncoded for CRF. This may be due to under-coding in the non-coded CKD population, however diseases such as stroke and CHD are likely to be coded irrespective of CKD coding status due to QOF incentives. We suggest that as CKD coding is linked to QOF incentives around BP targets and pharmacotherapy, comorbidities and risk factor management are likely to improve, in individuals who are coded for CKD.

Strengths & Limitations

Our study examined a number of coding determinants in a socioeconomically diverse and relatively young adult population, and assessed CKD quality of care. 47/49 (96%) general practices in Lambeth, south London were included in this study, with a high representation of Black and minority ethnic

groups (42.9% compared with the rest of England & Wales 14.0%, [23]), who are at increased risk of CKD and associated co-morbidities.

The limitations apply to those found with observational data and include misclassification, missing data and unmeasured confounders, including GP Practice factors. As >98% patients are registered with a GP, data capture is high. We were unable to ascertain effect and direction of bias due to missing data, introducing possible bias for BP control and BMI for non-coded vs. coded CKD patients. Studies however have shown *higher* levels of BP recording in BAME groups, compared with White ethnic groups, [19]. Other limitations include selection (due to comorbidities and QOF coding) and survivor bias. In Lambeth, the population is younger and more deprived compared to the rest of the UK, and we would expect higher levels of CKD in an older population. MDRD eGFR equation may be less sensitive for estimating CKD in other ethnic groups, however this was the standard laboratory reported measure of renal function in the UK, at the time the study was undertaken. It is likely that levels of hypertension are underdiagnosed, based on QOF disease registers, and BP recording was lower in non-coded CKD. Drug usage was based on prescribed medications although data on adherence was not available. Finally, we did not study long term outcomes such as mortality.

Comparison with existing literature

We identified lower levels of CKD coding (45.5%) than the National CKD Audit (70%), [15] but similar levels to a recent study in Oxfordshire, OxRen which found 44.0% of (largely White) individuals living with CKD are undiagnosed without screening. [24] This may reflect selection bias in participating GPs in the National CKD Audit, whereas our study may be more reflective of busy urban practices. In contrast studies have shown higher prevalence of BP recording in African and Caribbean populations in the same Lambeth population. Older age (>70 years), male sex, diabetes and hypertension are associated with CKD coding, and CKD coding is associated with receiving key primary care interventions recommended for CKD, including systolic BP control and pharmacotherapy. [15] Studies have shown hypotensive medication to be prescribed unequally among ethnic groups for any given range of blood pressure control. Studies in individuals with hypertension (both with and without CKD adjusted by age and sex and clustered by practice), found that achievement of target blood pressure (< 140/90 mmHg) was better in South Asian (OR 1.43, 95% CI 1.28 - 1.60) and worse in Black African groups (OR 0.79, 95% CI 0.74 - 0.84) compared to White patients. [25] A systematic review of BP management in CKD populations including ethnic minorities showed quality-improvement interventions can be effective in lowering blood pressure and potentially in reducing cardiovascular disease risk and slowing progression in CKD. [26]; and modest improvements in SBP control (2.6mm Hg) were achieved through an audit education programme. [27] People of ethnic minorities are overrepresented on renal replacement therapy, RRT and this may be due to some of the inequalities highlighted here. The awareness of CKD coding in SMI is important as this group are at increased risk of increased CVD mortality.[22]

Implications for research and practice

Our study found that over 50% of CKD was uncoded and for these patients quality of care was lower. Demographic factors associated with uncoded CKD were age <50 years, Black African, Black Caribbean or Asian ethnicity. Patients with uncoded CKD were less likely to have pharmacotherapy for improved

CVD risk factor management, including ACEI/ARB medication. The association between uncoded CKD and African and Asian ethnicity is important as it demonstrates an ethnic health inequality, which remained after adjusting for deprivation.

Our study has highlighted the importance of CKD coding for improved disease management, and health inequality which may benefit from targeted initiatives to improve management in vulnerable groups (Black African, Black Caribbean and Asian ethnic groups), such as diagnostic coding support or automated CKD recording based on adjusted eGFR results.

Ethical approval: Access to LDN was granted by the LDN Steering Group and the Information Governance Committee at NHS Lambeth CCG (NHS Lambeth CCG).

COI: None stated

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Figure 1:

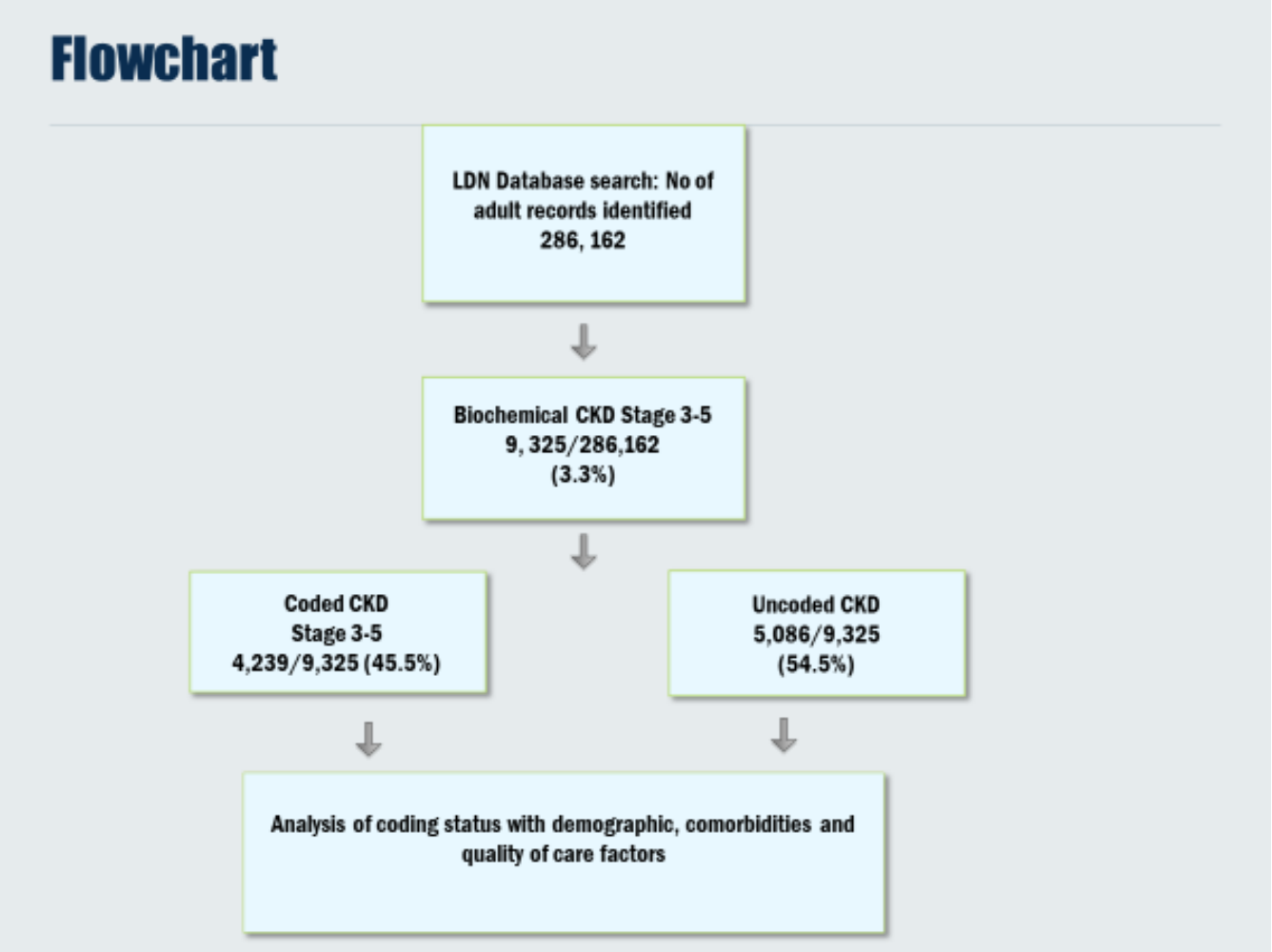

Flowchart
LDN Database search: No of adult records identified 286, 162
Biochemical CKD Stage 3-5 9, 325/286,162 (3.3%)
Coded CKD Stage 3-5 4,239/9,325 (45.5%)
Uncoded CKD 5,086/9,325 (54.5%)
Analysis of coding status with demographic, comorbidities and quality of care factors

Table 1a: Numbers and percentages with CKD Read codes amongst an adult population with biochemical CKD 3-5 (n=9, 325) according to selected clinical characteristics

Variables		Non-Coded CKD		Coded CKD		*p*-value
		N	Row %	N	Row %	
CKD≥3		5, 086	54.5	4,239	45.5	
	Female	2,858	53.8	2,454	46.2	
	Male	2,228	55.5	1,785	44.5	P=0.10
Age (yrs)	**<50**	956	81.9	211	18.1	
	50-59	1,077	73.6	387	26.4	
	60-69	942	59.9	632	40.2	
	70-79	1,130	45.2	1,372	54.8	
	80-89	783	37.0	1.334	63.0	
	>90	198	39.5	303	60.5	
Ethnicity (% coded)	**White**	1,758	45.7	2,089	54.3	**P<0.001**
	Black African	984	68.3	456	31.7	
	Black Caribbean	1,297	59.1	899	40.9	
	South Asian	260	48.1	280	51.9	
	Chinese	30	48.4	32	51.6	
	Other ethnicity	98	57.3	73	42.7	
	Non-stated	129	62.6	77	37.4	
	Missing (column %)	530	10.4	333	7.9	
IMD Quintile (% coded)	**1 (least deprived)**	1,193	53.0	1,059	47.0	P=0.42
	2	1,102	55.1	898	44.9	
	3	886	55.4	714	44.6	
	4	968	55.6	773	44.5	
	5 (most deprived)	932	54.0	794	46.0	
	Missing (column %)	5	0.10	1	0.02	
	Previous stroke	293	43.2	385	56.8	**P<0.001**
	Coronary Heart Disease, CHD	500	36.0	889	64.0	**P<0.001**
	Hypertension	2,873	45.5	3,445	54.5	**P<0.001**
	Type 2 Diabetes	1,079	42.5	1,458	57.5	**P<0.001**
	Heart Failure	243	32.4	508	67.6	**P<0.001**
	Serious mental illness, SMI	225	52.2	206	47.8	P=0.32

Abbreviations: HT = hypertension; BMI = body mass index; CHD = coronary heart disease.

Table 1b: Numbers and percentages with CKD Read codes amongst an adult population with biochemical CKD 3-5 according to selected quality of care characteristics

Variables		Non-Coded CKD		Coded CKD		*p*-value
		N	Column %	N	Column %	
	Mean Systolic BP <140mmHg	1,411	27.7	1,720	40.6	P=0.80
	Missing	2868	56.4	1550	36.6	
	Mean Diastolic BP <90 mmHg	2,012	39.6	2,535	59.8	**P<0.001**
	Missing	2868	56.4	1550	36.6	
BMI (kg/m^2)	**BMI >25kg/m²**	3,262	71.9	2, 945	74.0	**P=0.03**
	Missing	547	10.8	258	6.1	
History of comorbidities	**Current or ex-smoker**	702	13.9	458	10.8	**P<0.001**
	Missing	21	0.4	3	0.1	
	Prescribed					
	NSAID	1,394	27.4	884	20.9	**P<0.001**
	Diuretic	1,523	29.9	2,066	48.7	**P<0.001**
	ACEI/ARB	2,210	43.5	3,183	75.1	**P<0.001**
	Statin	2,157	42.4	2,849	67.2	**P<0.001**

Abbreviations: BP=blood pressure; BMI = body mass index; NSAID = non-steroidal anti-inflammatory drug use; ACEI = angiotensin-converting-enzyme inhibitor use; ARB = angiotensin receptor blockers.

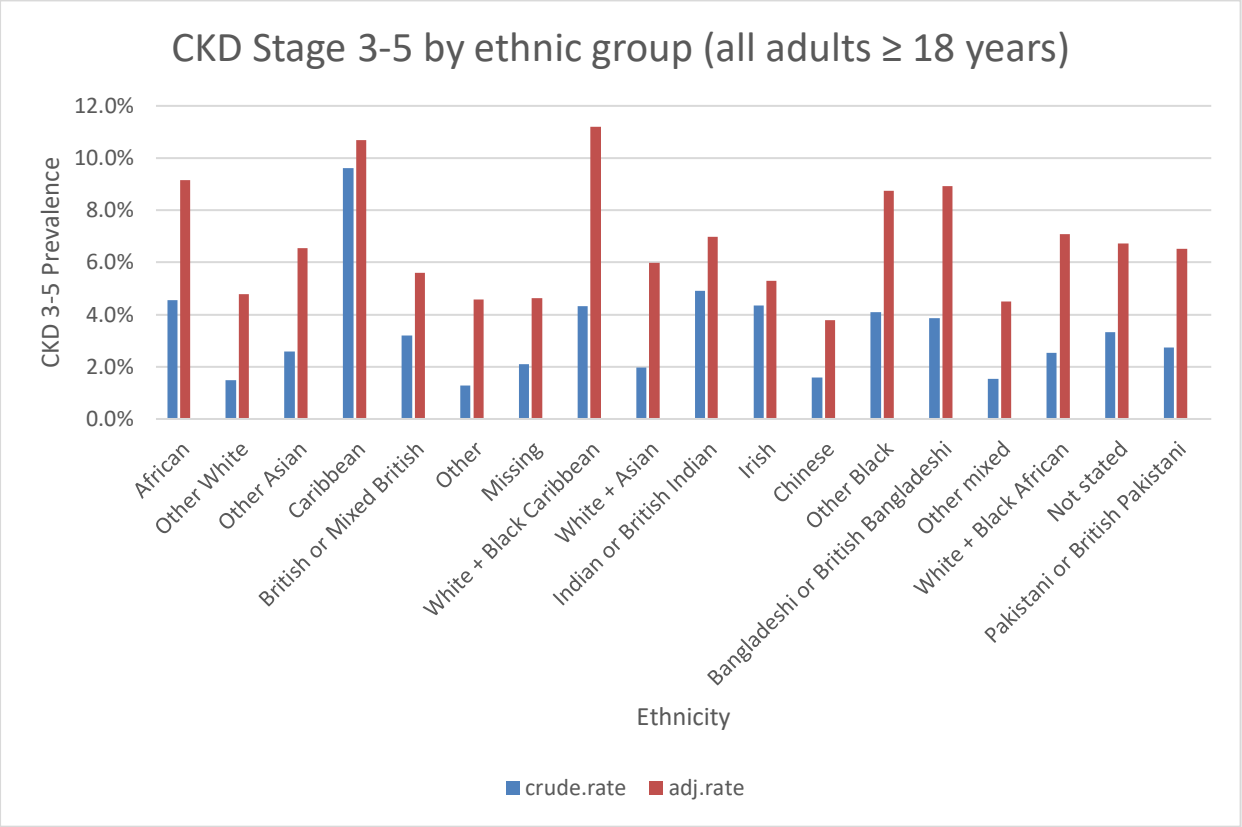
Table 2: Partially and fully adjusted logistic regression analysis of the odds of being Read-coded for CKD in an adult population with biochemical CKD 3-5

	Partially adjusted OR, 95% CI[1]	**Fully adjusted OR, 95% CI**[2]	***p*-value MVR**
Age group (yrs)			
<50	ref	ref	
50-59	**1.63 (1.35-1.97)**	**1.26 (1.01-1.57)**	**0.04**
60-69	**3.05 (2.55-3.65)**	**1.86 (1.50-2.30)**	**<0.001**
70-79	**5.52 (4.66-6.53)**	**2.89 (2.36-3.56)**	**<0.001**
80-89	**7.76 (6.53-9.24)**	**3.88 (3.13-4.81)**	**<0.001**
>90	**7.00 (5.54-8.84)**	**4.06 (3.04-5.43)**	**<0.001**
Gender			
Male	1.05 (0.96-1.14)	0.97 (0.88-1.07)	0.54
Ethnicity			
White	ref	ref	
Black African	**0.66 (0.58-0.76)**	**0.56 (0.48-0.66)**	**<0.001**
Black Caribbean	**0.71 (0.63-0.79)**	**0.61 (0.54-0.70)**	**<0.001**
Asian	0.99 (0.82-1.20)	**0.81 (0.66-0.99)**	**0.04**
Chinese	0.97 (0.58-1.64)	0.81 (0.46-1.42)	0.46
Other	0.92 (0.66-1.29)	0.83 (0.58-1.17)	0.29
Non-stated	**0.57 (0.42-0.77)**	**0.58 (0.41-0.81)**	**0.001**
IMD Quintile			
1.00 least deprived	ref	ref	
2.00	0.88 (0.77-1.00)	**0.83 (0.72-0.97)**	**0.02**
3.00	**0.80 (0.70-0.92)**	**0.76 (0.65-0.89)**	**0.001**
4.00	**0.78 (0.69-0.89)**	**0.79 (0.67-0.92)**	**0.002**
5.00 most deprived	**0.77 (0.68-0.89)**	**0.76 (0.65-0.89)**	**0.001**
Hypertension	**2.40 (2.17-2.65)**	**1.43 (1.25-1.64)**	**<0.001**
T2DM	**1.59 (1.44-1.75)**	1.08 (0.96-1.22)	0.21
Stroke	**1.22 (1.04-1.44)**	0.93 (0.77-1.12)	0.46
Serious Mental Illness, SMI	1.05 (0.86-1.29)	**1.26 (1.00-1.64)**	**0.05**
Heart failure	**2.00 (1.70-2.36)**	**1.34 (1.11-1.62)**	**<0.001**
CHD	**1.67 (1.47-1.89)**	1.09 (0.94-1.26)	0.27
Statin prescribed	**2.03 (1.85-2.23)**	**1.38 (1.23-1.55)**	**<0.001**
ACEI or ARB prescribed	**3.16 (2.88-3.47)**	**2.24 (1.97-2.54)**	**<0.001**
NSAID prescribed	**0.80 (0.72-0.89)**	**0.79 (0.71-0.89)**	**<0.001**
BMI >25kg/m2	**1.28 (1.15-1.41)**	1.07 (0.95-1.20)	0.26
Current smoker	1.00 (0.88-1.15)	1.03 (0.88-1.21)	0.71

[1] adjusted for age and gender

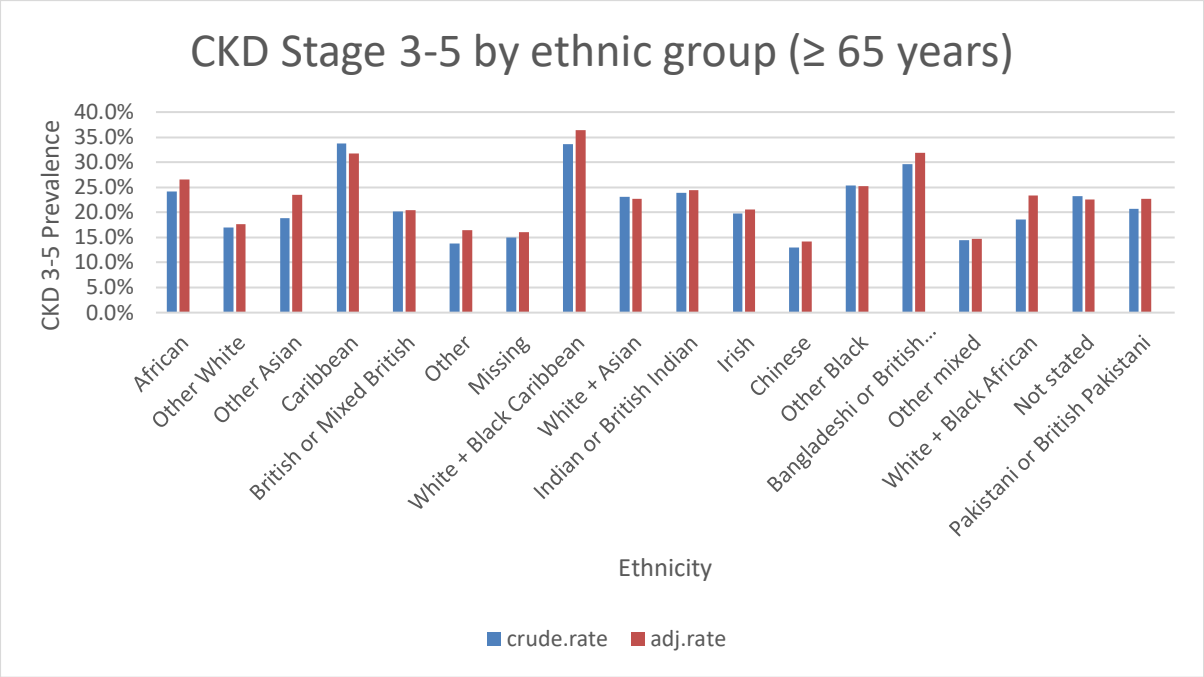
[2] adjusted for all covariates in the table

Figure 2: CKD Stage 3-5 (coded and uncoded) prevalence by ethnic group in all adults ≥18 years, Lambeth DataNet



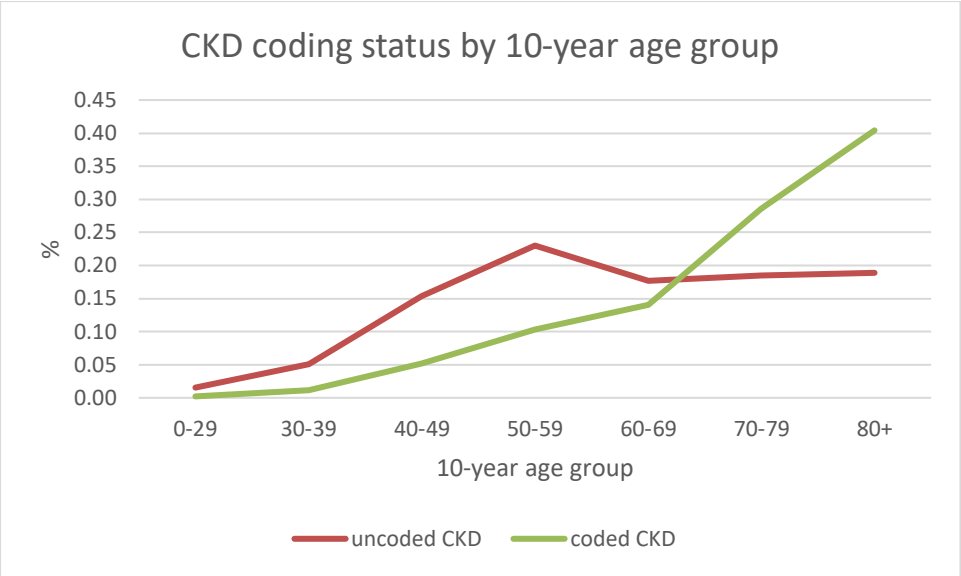
* age adjusted data for the population using the Mid 2013 England and Wales adult population estimate.

Figure 3: CKD Stage 3-5 (coded and uncoded) prevalence by ethnic group in adults ≥ 65 years, Lambeth DataNet



*age adjusted data for the population aged 65 years and over, using the Mid 2013 England and Wales population estimate.

Figure 4: CKD Stage 3-5 coding status by 10 year age-group in Lambeth DataNet (all adults ≥18 years)



% denominator is total for uncoded and coded groups

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