

Socioeconomic, ethnic and geographic disparities in renal cancer outcomes in England

Abstract

Introduction: Kidney cancer is the seventh most common cancer in England, with renal cell carcinoma accounting for most cases. Ethnicity and socioeconomic deprivation influence RCC diagnosis, treatment, and outcomes. Ethnic minority and socioeconomically disadvantaged populations often experience delayed diagnosis, reduced access to treatment, and poorer survival. This study examines socioeconomic, ethnic, and geographical disparities in RCC care in England to inform strategies for improving healthcare access and equity.

Methods: Patient-level data for primary and metastatic RCC (ICD-10: C64) were obtained from Hospital Episode Statistics (HES) between April 2019 and March 2024. Patients were stratified by Index of Multiple Deprivation quintile (most to least deprived) and ethnicity (Caucasian vs non-white). Outcomes included nephrectomy rates and prevalence of metastatic disease. Age, sex, and regional variation across NHS England were also assessed.

Results: A total of 54,535 patients were included. Of these, 18.2% were from the most deprived quintile and 20.8% from the least deprived, with a mean age of 62 years. Overall, 79.3% were Caucasian and 20.7% were non-white. Non-white patients were younger at diagnosis (57 vs 64 years) and had a lower prevalence of metastatic disease (29.6% vs 34.6%). Socioeconomic deprivation was associated with younger age at diagnosis (57 vs 64 years), lower nephrectomy rates (42.3% vs 43.6%), and higher metastatic disease prevalence (34.2% vs 31.1%). Metastatic disease prevalence increased with age but was less pronounced among non-white patients. Geographical variation was evident, with the Midlands showing the highest metastatic disease rate (37.4%), and North East & Yorkshire the highest nephrectomy rates (46.6%).

Conclusion: Socioeconomic deprivation, ethnicity, age, and geography significantly influence RCC diagnosis and treatment in England. Targeted interventions are required to improve early diagnosis and ensure equitable access to care.

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Introduction

Kidney cancer is the seventh most common malignancy in England, with renal cell carcinoma (RCC) accounting for approximately 80% of cases.¹⁻³ Although advances in imaging, surgery, and systemic therapy have improved outcomes, survival remains heterogeneous and strongly influenced by patient-level and system-level factors.³⁻⁵

Socioeconomic deprivation has consistently been associated with later-stage cancer diagnosis and poorer outcomes across multiple tumour types in England. In RCC, deprived populations are more likely to present with advanced disease and experience inferior survival, even within a universal healthcare system.^{6,7} These disparities are thought to reflect differences in access to early diagnostic pathways, comorbidity burden, and engagement with healthcare services rather than biological variation alone.⁸

Ethnic inequalities in cancer care have also been widely reported in the UK. Patients from ethnic minority backgrounds often experience delayed diagnosis and reduced access to specialist care, contributing to outcome disparities.⁹ However, evidence specific to RCC remains limited, and the interaction between ethnicity, deprivation, and regional healthcare delivery has not been fully explored at a national level.¹⁰

Geographic variation in cancer outcomes persists across NHS England, with differences in diagnostic access, surgical capacity, and referral pathways contributing to unequal care delivery.^{11,12}

Understanding how these regional factors intersect with socioeconomic and ethnic disparities is essential for informing targeted interventions.

Using national Hospital Episode Statistics (HES) data, this study examines patterns of RCC diagnosis and treatment across deprivation quintiles, ethnic groups, age categories, and NHS regions.¹³ By focusing on nephrectomy rates and metastatic disease prevalence, the study aims to provide clinically relevant insights into inequalities in RCC care within England

Methods

This was a retrospective observational cohort study using patient-level national Hospital Episode Statistics data collected between April 2019 and March 2024. Inclusion criteria comprised all adult patients recorded in Hospital Episode Statistics with ICD-10 code C64 (renal malignancy) between April 2019 and March 2024, including patients with localised and metastatic disease. Variables of interest included patient age, gender, ethnicity (categorised as White vs non-White), Index of Multiple Deprivation (IMD) quintile, and NHS England region. Outcomes of interest were nephrectomy rates and prevalence of metastatic disease at diagnosis or during follow-up.

Descriptive statistics were used to summarise patient demographics, tumour characteristics, and treatment patterns for the overall cohort and stratified by Index of Multiple Deprivation (IMD) quintile, ethnicity, age group, and NHS England region.

Results

A total of 54,535 patients with RCC were identified between April 2019 and March 2024. Of these, 9,935 (18.2%) were from the most deprived quintile and 11,330 (20.8%) from the least deprived quintile. (Table 1). The overall mean age of the cohort was 62 years, but this varied significantly by deprivation and ethnicity. Patients in the most deprived quintile had a mean age of 57 years, compared to 64 years in the least deprived quintile, suggesting earlier onset of disease among deprived groups (Table 2,3).

Table 1 Baseline characteristics by deprivation quintile

IMD quintile	Patients	Nephrectomy (%)	Metastatic (%)	Mean age
Q1 Most deprived	9,935	42.3	34.2	57
Q2	10,770	42.9	32.8	–
Q3	11,770	42.9	33.9	–
Q4	12,045	42.6	34	–
Q5 Least deprived	11,330	43.6	31.1	64

Table 2 RCC outcomes by ethnicity

Ethnicity	Patients	Nephrectomy (%)	Metastatic (%)
White	43,290	40.2	34.6
Non-White	14,235	48.1	29.6

Table 3 Regional variation in RCC outcomes

Region	Patients	Nephrectomy (%)	Metastatic (%)
Midlands	10,310	43.3	37.4
North East & Yorkshire	9,425	46.6	30.8
South East	8,745	43.5	33.4
North West	7,530	43.4	32.1
East of England	6,560	46.4	32.5
South West	6,165	42.8	33.0
London	5,960	43	31.1

Ethnic composition revealed that 79.3% of patients were White, while 20.7% were from non-White backgrounds. Non-White patients were younger at diagnosis (mean age 57 years) compared to White patients (mean age 64 years). They also had lower prevalence of metastatic disease (29.6% vs 34.6%) and higher nephrectomy rates (48.1% vs 40.2%). These findings highlight both biological and systemic factors influencing outcomes in minority populations.

Socioeconomic deprivation correlated with treatment access and outcomes. Nephrectomy rates were lowest among the most deprived quintiles (42.3%) compared to 43.6% among the least deprived quintile. (Figure 1). Although the absolute difference appears modest, these disparities are significant given the large patient population. Metastatic disease prevalence was also higher in more deprived groups (34.2%) compared with the least deprived (31.1%), indicating possible delays in diagnosis or reduced access to curative interventions. (Figure 2).

Age was a strong determinant of outcomes. Younger patients (≤ 44 years) had the highest nephrectomy rates (67.7%) and the lowest metastatic prevalence (24.1%). Patients aged 45–74 had intermediate outcomes, while those ≥ 75 years had substantially lower nephrectomy rates (23.2%) and the highest metastatic burden (34.6%).

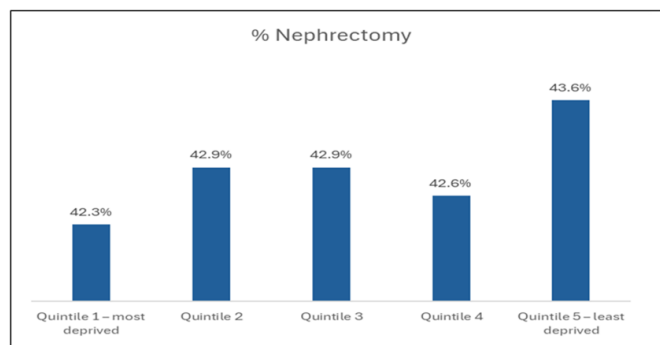


Figure 1 Nephrectomy and deprivation.

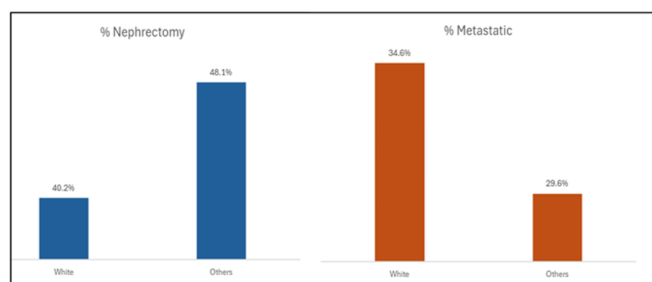


Figure 2 Nephrectomy and metastatic disease in relation to ethnicity.

These results suggest that both clinical decision-making and biological progression contribute to age-related disparities (Figure 3).

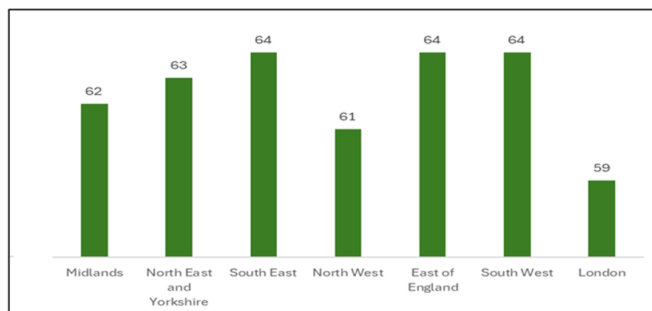


Figure 3 Age and geographical region.

Regional variation was marked. The Midlands had the highest metastatic disease rate (37.4%), while the North East & Yorkshire (30.8%) and London (31.1%) had the lowest (Figure 4). Nephrectomy rates were highest in North East & Yorkshire (46.6%) and lowest in the South West (42.8%) and London (43.0%). Such regional disparities likely reflect differences in referral pathways, diagnostic access, and surgical capacity across NHS regions (Table 3).

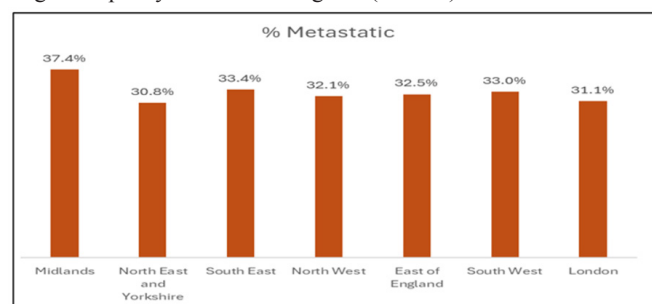


Figure 4 Metastatic disease and geographical region.

Overall, the results demonstrate consistent patterns of inequality: deprived and older populations experience lower surgical intervention rates and higher metastatic burden, while ethnic minority patients are younger at diagnosis and more likely to undergo nephrectomy but face potential systemic barriers in long-term care. Geographic differences underscore the importance of NHS regional capacity and resource allocation in shaping patient outcomes.

Discussion

This population-based analysis demonstrates that renal cancer outcomes in England are strongly influenced by socioeconomic deprivation, ethnicity, age, and geographic region. Despite universal healthcare provision, substantial inequalities persist in access to curative surgery and stage at presentation.^{6,11}

Patients from more deprived areas were diagnosed at a younger age but were less likely to undergo nephrectomy and more likely to present with metastatic disease. This pattern suggests delayed diagnosis and reduced access to early intervention in deprived communities. Similar associations between deprivation and advanced-stage cancer presentation have been reported across multiple malignancies in England.^{7,14} Structural barriers, including reduced access to diagnostic imaging, higher comorbidity burden, and differences in healthcare engagement, are likely contributors.^{8,15}

Ethnic disparities were also evident. Non-White patients were diagnosed at a younger age and had higher nephrectomy rates with a lower prevalence of metastatic disease. Earlier age at diagnosis may partly explain these findings, as younger patients are more likely to be eligible for surgery. However, previous studies have shown that ethnic minority patients may still face barriers to ongoing cancer care, including access to systemic therapies and follow-up services.^{9,16} These results highlight the need to interpret surgical outcomes within the broader treatment pathway.¹⁷

Age was a major determinant of management. Older patients had markedly lower nephrectomy rates and higher metastatic burden. While this may reflect appropriate clinical caution related to frailty and comorbidity, there is evidence that older patients are sometimes undertreated beyond what clinical factors alone would justify.^{4,18} As the population ages, balancing oncological benefit with equitable access to treatment will become increasingly important in RCC care (19).¹⁹

Regional variation in outcomes was pronounced. Higher metastatic disease rates in the Midlands suggest potential delays in diagnostic or referral pathways, whereas higher nephrectomy rates in North East and Yorkshire may reflect greater surgical capacity or more efficient service organisation. Geographic variation in cancer outcomes has been consistently reported within the NHS and is often linked to differences in workforce distribution and service configuration (9,17).^{12,11}

Our findings are consistent with international evidence demonstrating that socioeconomic disadvantage is associated with delayed diagnosis, lower access to curative surgery, and poorer renal cancer outcomes (26,27).^{20,21} In the United States, Patel et al. reported that patients from deprived communities were significantly more likely to present with advanced-stage renal cancer and had lower overall survival rates (26). Similarly, European population-based studies have shown that socioeconomic inequalities persist despite universal healthcare systems, suggesting that barriers to healthcare access, health literacy, and comorbidity burden contribute substantially to disparities in renal cancer care.^{21,22}

Ethnic disparities observed in our study are also supported by international literature. Studies from the United States demonstrated that Black and Hispanic patients often present at younger ages and experience differences in treatment pathways and survival outcomes compared with White populations.^{23,24} Although some minority groups may undergo surgery more frequently because of younger age at diagnosis, disparities remain in long-term oncological care, systemic therapy access, and follow-up services.^{16,17,24} These findings highlight the multifactorial nature of healthcare inequalities in renal cancer management.

Geographical variation identified across NHS regions has also been described internationally. Canadian and Australian studies reported that rurality and regional healthcare capacity significantly influence access to specialist cancer services and nephrectomy rates.^{25,26} Differences in referral pathways, surgical workforce distribution, and diagnostic infrastructure may therefore explain regional outcome variation observed in England.^{11,12}

Overall, these findings reinforce the concept that RCC outcomes are shaped by the interaction of social determinants and healthcare system factors. Inequalities in early detection and surgical access remain key drivers of outcome variation and represent modifiable targets for intervention.^{6,21}

Policy implications

The findings of this study have clear implications for NHS cancer strategy. Targeted outreach in deprived communities, improved referral pathways, and expansion of surgical and diagnostic capacity is needed to reduce delays. Enhancing cultural competence and language support within healthcare can reduce barriers faced by ethnic minority patients. Strengthening regional cancer networks and ensuring equitable resource allocation will help address geographic disparities. Beyond the healthcare system, intersectoral collaboration addressing social determinants of health is essential to reduce renal cancer inequalities.

Strengths and limitations

A major strength of this study is the use of comprehensive national HES data, capturing over 54,000 cases across England. The large sample size enabled subgroup analyses by deprivation, ethnicity, age, and region. However, limitations include data suppression rules that may obscure small subgroup patterns, lack of detailed clinical staging data, and reliance on administrative coding. Survival outcomes were not available, limiting longitudinal assessment of disparities.²⁷⁻³³

Conclusion

Renal cancer outcomes in England are significantly shaped by socioeconomic deprivation, ethnicity, age, and geography. Deprived patients and ethnic minorities are diagnosed at younger ages yet face systemic barriers that limit access to surgery and increase metastatic disease risk. Addressing these inequities requires multifaceted strategies encompassing healthcare delivery, policy reform, and social equity interventions. Ensuring fair and timely access to diagnosis and treatment is essential to improving renal cancer outcomes across all groups.

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None.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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