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EDITORIAL COMMENT

Deprivation and kidney disease—a predictor of poor outcomes

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ABSTRACT

There is a growing body of evidence for the role of deprivation in a broad spectrum of diseases including renal disease. Deprivation has been demonstrated to be associated with poorer outcomes across a range of renal diseases including acute kidney injury (AKI), chronic kidney disease and transplantation. In this issue of *Clinical Kidney Journal*, Hounkpatin *et al.* describe the association of socioeconomic deprivation with incidence, mortality and resolution of AKI in a large UK cohort. Investigating deprivation as a factor influencing either incidence or outcome of disease is challenging due to variations in measures of deprivation used and other confounding factors that may be contributing to the observed differences. In this editorial, we review the current literature examining the role of deprivation in renal disease.

Keywords: AKI, chronic renal failure, deprivation, health inequalities, outcomes

Socioeconomic status is increasingly recognized as a key determinant of health outcomes including cardiovascular outcomes. In this month's *Clinical Kidney Journal*, Hounkpatin *et al.* [1] describe the association of socioeconomic status with the incidence, mortality and resolution of acute kidney injury (AKI) in a UK population.

The impact of inequality on health is not fully understood, with many postulated reasons such as differences in co-morbidities, health literacy and access to healthcare. Poverty-associated stresses are also known to be related to increased cortisol levels and oxidative stress, which have in turn been related to development of end-organ disease [2]. Certain lifestyle-related risk factors (such as smoking obesity and alcohol consumption) also correlate with socioeconomic deprivation. A key focus for current and future research is determining which of these are most significant in order to reduce risk and improve patient outcomes. Identifying at-risk groups can also be used to direct targeted interventions.

HOW IS DEPRIVATION MEASURED

Measures of socioeconomic deprivation can use both individual and area indicators. The National Statistics Socio-economic Classification [3] is used in all official surveys in the UK to classify people based on their type of work and level within their work. Other parameters used to define deprivation include income, years of education and ownership of various goods. The Individual Deprivation Score [4] is a score that defines deprivation along 16 parameters and is designed to be used primarily in the developing world.

Individual indicators are challenging to develop as it is fairly time and labour intensive to generate the questions that need to be asked and recorded systematically. There also needs to be linkage to the main dataset, which presents its own challenges.

Area indicators can be used to define deprivation within a geographic area. Hounkpatin *et al.* [1] used the Index of Multiple Deprivation (IMD), which uses data from 2015 to stratify the population of England into deciles. The IMD is derived from

seven domains including income, employment, education, health, crime, barriers to housing and services, and the local environment. There are many other scoring systems for deprivation, all of which have different domains and weightings, which makes it difficult to directly compare two populations where different indicators have been used.

Area indicators are usually time-specific, which limits direct comparisons between similar indicators at different times. Generally, the scoring system used results in stratification rather than a raw score, which can potentially cause difficulty when attempting to replicate the results of one study to another area (potentially with a different scoring system). They can also affect data due to heterogeneity within the area, as not all people in an area with high deprivation suffer from deprivation. Depending on the metrics and weightings used, the scoring system may over- or underestimate deprivation in urban or rural areas. There may also be differences in level of service that may relate to geography, such as the local hospital being a district general hospital with no access to onsite nephrology [5]. These are not necessarily caused by economic deprivation, but may well result in a disadvantage to that patient grouping in terms of access to healthcare.

SOCIOECONOMIC INEQUALITIES IN AKI

AKI is associated with significant morbidity and mortality. It is estimated to cost over £1 billion [6] within National Health Service (NHS) England alone. Hounkpatin *et al.* [1] have produced the first paper to demonstrate that socioeconomic deprivation is associated with worse outcomes in AKI even after correction for AKI associated co-morbidities such as chronic kidney disease (CKD), hypertension, diabetes, cardiovascular disease and heart failure. Increasing deprivation was associated with increased rate of AKI and mortality following AKI. Interestingly, there was no association found between deprivation and AKI severity or progression of AKI.

A Welsh study [7] has previously investigated the relationship between AKI and both deprivation and age. This study had a larger population with longer duration of data collection; however, the only comorbidity examined was CKD. This showed an association between increasing levels of deprivation and AKI. A subsequent analysis of the data [8] has shown that in patients aged >60 years, survival is lowest in the most deprived areas. This study also showed that CKD is seen more frequently in older (age ≥60 years) patients with incident AKI.

The Kidney Disease: Improving Global Outcomes (KDIGO) definition of AKI requires a baseline value that has to be taken within a defined timeframe before the event. In Hounkpatin *et al.*'s [1] study, only 53% of the total eligible population had a creatinine checked within the 12-month period of the study and only 40.6% of the population had two or more creatinine levels checked. This raises a challenge for researchers in that those patients who have not had blood tests are likely to differ from patients who have. Methods of addressing this include using a post-AKI nadir creatinine as a baseline or estimating an age-, sex- and race-appropriate creatinine, although these techniques are based on assumptions that may not be accurate and may misclassify AKI as CKD or vice versa.

A further study [9] has examined risk factors for the development of AKI in patients over the age of 65 years with diabetes and community-acquired pneumonia. In contrast to the previous studies, AKI was identified by using clinical coding rather than using the KDIGO creatinine-based definition. This study did not demonstrate a link between AKI and deprivation. It was,

however, a smaller study and the population used was more homogenous in terms of age and comorbid conditions. Reliance on clinical coding for identification of AKI has been shown to underestimate AKI [10].

SOCIOECONOMIC INEQUALITIES IN CKD

CKD has a significant effect on mortality and healthcare costs. It is estimated to cost NHS England over £1.4 billion per year [11]. The link between CKD and socioeconomic deprivation has been established in a number of studies in multiple countries with varying levels of healthcare provision [12]. As with AKI, it is not entirely clear how much of this link represents an indirect measure of other risk factors and comorbidities rather than deprivation itself.

There are a number of different measures used to assess the link between deprivation and CKD and to both describe the nature of and mechanism for the link.

Association between higher socioeconomic status and improved blood pressure control in adolescents with CKD has been described, although this was not associated with slower progression of renal dysfunction [13]. Lower household income was shown to be associated with a higher probability of developing end-stage renal failure (ESRF), although the risk of developing CKD was not increased once adjustments had been made for other significant risk factors such as alcohol intake, smoking hypertension, diabetes and cholesterol. A study from the USA also demonstrated a link between lower levels of educational attainment and development of ESRF, but not CKD [14].

The Prevention of Renal and Vascular End-stage Disease study demonstrated a link between low educational attainment (felt to be a surrogate of deprivation) and progressive decline in renal function that was partially attenuated by correction for identifiable lifestyle factors such as smoking, raised body mass index (BMI), diabetes and hypertension in a cohort of patients from the Netherlands [15]. Interestingly, when comparing area measures of socioeconomic depression and renal outcomes, higher deprivation was associated with more significant proteinuria, higher risk of progressive decline in renal function and higher risk of ESRF [16]. The discrepancies between these studies may relate to differences in the populations studied, the measures used to judge deprivation and pressures on the clinical service in primary and secondary care.

Area measures of lower socioeconomic status have been shown to be linked to more advanced CKD at the point of referral to a nephrologist [17]. This could be due to a number of reasons including delayed presentation to medical professionals, increased primary care workload in deprived areas or regional variation in referral to secondary care. The 2017 audit of CKD in England did not find an association between area deprivation and coding of CKD, which would seem to indicate that this difference in management does not stem from a lack of recognition [18]. Using an area measure of deprivation, a link has been demonstrated between deprivation and biochemical markers of inflammation and hyperfiltration in adolescents with Type 1 diabetes, indicating a higher frequency of early diabetic nephropathy [19].

With regard to specific renal disorders and socioeconomic status, an 11-year analysis of native kidney biopsies from West and Central Scotland showed that patients residing in a deprived area were more likely to undergo a kidney biopsy. The indication for biopsy also differed, with patients residing in deprived areas more likely to undergo biopsy for significant proteinuria or nephrotic syndrome compared with other

indications than their peers living in more affluent areas [20]. The same study also showed that the most deprived patients were more likely to have glomerulonephritis on biopsy [with immunoglobulin A (IgA) nephropathy being twice as common compared with the least deprived group] and that diabetic nephropathy was a more common biopsy finding in this group of patients. Another study from a Scottish population with biopsy-proven glomerulonephritis demonstrated an increase in mortality in patients from the most deprived areas. This is most marked in focal segmental glomerulosclerosis and IgA nephropathy, with no apparent increased mortality risk in membranous nephropathy [21].

An emerging research topic of significant importance is health literacy—the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions [22]. Health literacy has been demonstrated to be strongly related to socioeconomic deprivation in populations both in the UK [23] and the USA [24]. It has also been related to poorer glycaemic control in patients with diabetes [25]. A review of online dietetic advice found that there were significant differences between online sources of information regarding diet for renal patients. Written material tended to be accurate but challenging to access with limited health literacy. This contrasted with video information, which tended to be less accurate but far more accessible to patients with poor health literacy [26]. This represents a two-fold challenge with part of the role of the clinician being to help the patient 'unlearn' suboptimal habits.

Low health literacy has been associated with increased mortality in a multivariable analysis of chronic haemodialysis patients with the only significant difference biochemically being a slightly lower albumin in the low health literacy group. There were no differences in their dialysis adequacy, calcium, phosphate or iron parameters [27].

Renal disease is a challenging concept even for health professionals to engage with. As nephrologists, we ask a lot of our patients in terms of taking medications, and dietary and fluid restriction. Medicine, in general, has moved from a paternalistic model of the doctor–patient relationship to the more collaborative approach of shared decision-making. The ability of patients to process information (i.e. health literacy) is critical in shared decision-making.

Choosing a renal replacement modality is a complicated decision that is made based on factors relating to the patient, and their environment, support network and clinical team. Maintaining quality of life and avoidance of disruption to a normal lifestyle are seen as important factors in making these decisions [28]. The personalized nature of these considerations requires that the patient is able to understand the impact of the renal replacement modality and work it around their life (or vice versa). The perception of healthcare professionals is often that patients understand their health more fully than they do, with a large patient survey showing that over half of all patients who had either recently started or due to start renal replacement therapy were not aware of conservative care as an option [29].

SOCIOECONOMIC INEQUALITIES IN TRANSPLANTATION

Transplantation results in the best outcomes for patients with ESRF, and living-related donations have the best outcomes for transplant. Socioeconomic deprivation has been investigated with regard to access to transplantation (in terms of transplant listing, time to transplant and likelihood of living donation) and outcomes following transplantation (in terms of recipient survival and graft survival).

The likelihood of a patient with ESRF being transplanted is strongly linked with socioeconomic deprivation. Patients with an income of less than $30 000 waited longer to be referred for transplant but once referred did not wait significantly longer for a transplant, with a similar pattern for poor health literacy [30].

Access to living donor transplantation is even more strongly correlated with deprivation. The Access to Transplantation and Transplant Outcome Measures study in the UK found that unemployment, lower educational attainment and being a non-homeowner were associated with markedly reduced odds ratio of living donor transplantation [31]. A similar-sized study in the Netherlands found that the likelihood of receiving a living donor transplant increased with postal code housing value [32].

There is no clear reason for this, although a survey of patients found several themes that differed between high and low deprivation groups in interviews discussing living donation [33]. These themes were disempowerment (not feeling involved in shared decision-making), a lack of social support (lacking people to approach regarding living donation) and short-term focus. Notably, the interviewees from low deprivation groups were more likely to have concerns regarding financial issues. This difference in concerns indicates that there are significant variations both in how physicians approach patients and how patients approach their disease, which is likely to contribute to differences in practice and outcomes throughout all areas of the patient journey.

There is mixed evidence regarding socioeconomic deprivation and recipient outcomes in kidney transplantation. The largest study followed the outcomes of 19 103 transplants performed in England between 2001 and 2012. This compared the survival at 1 and 5 years post-transplant and showed that deprivation was associated with increased mortality at both 1 and 5 years [34], although graft survival was not assessed other than failure within 90 days. A study performed in a Welsh cohort measuring the likelihood of rejection in 621 renal transplants found that patients from deprived areas were more likely to experience a rejection episode and of those who experienced acute rejection, patients from deprived areas were less likely to have a surviving graft at 5 years [35]. Patient survival was not examined. Outcomes were analysed for 705 patients transplanted >10 years in the West of Scotland. This found no relationship between deprivation and either patient or graft survival [36].

The European Deprivation Index was used to establish the relationship between deprivation and transplant outcomes for 8701 patients in France. Using two different models, it was found that the hazard ratio of death was higher in the most deprived patients compared with the least deprived [37]. This was true for patients who received a kidney from a deceased donor but not a living donor, although living donors made up a small minority of patients. In contrast to the Welsh study, there was no identifiable link between deprivation and transplant failure.

Accounting for the differences between the studies presents a challenge. The fact that all area measures of deprivation are relative represents one possible reason. If there is a wider range of inequality within the cohort used to generate the deprivation index then there will be a larger difference between the quartiles or quintiles. This would then accentuate any apparent effect that deprivation has on outcomes.

Differences in transplantation practice between transplant centres could also generate differences between outcomes. There is considerable heterogeneity between centres in terms of criteria for potential transplant recipients being activated on the transplant list including BMI and pre-operative assessments [38]. There are also differences in practice relating to living donor transplantation resulting in a significantly higher living donation rate in Northern Ireland [31]. If a transplant centre performs simultaneous kidney/pancreas or kidney/islet transplant, it will affect their survival data.

Access to healthcare is less of an issue in the UK and other countries where healthcare is free at the point of delivery. Lack of private healthcare insurance has been linked to poorer outcomes after transplant in US populations [39, 40].

Hounkpatin et al. [1] have demonstrated a strong link between both AKI prevalence and outcome with socioeconomic deprivation. This is in line with other work on AKI, CKD and transplantation. Further work needs to be done to determine which aspects of deprivation are the most significant when it comes to AKI and how to address these inequalities.

CONFLICT OF INTEREST STATEMENT

None declared.

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