European Journal of Internal Medicine 25 (2014) 853–859

Contents lists available at ScienceDirect

European Journal of Internal Medicine

journal homepage: www.elsevier.com/locate/ejim

Original Article

End stage renal disease risk and neighbourhood deprivation: A nationwide cohort study in Sweden

Delshad Saleh Akrawi [a,*], Xinjun Li [a], Jan Sundquist [a,b], Kristina Sundquist [a,b], Bengt Zöller [a]

[a] *Center for Primary Health Care Research, Lund University/Region Skåne, Malmö, Sweden*
[b] *Stanford Prevention Research Center, Stanford University School of Medicine, Stanford, CA, United States*

ARTICLE INFO

Article history:
Received 19 June 2014
Received in revised form 13 September 2014
Accepted 22 September 2014
Available online 5 October 2014

Keywords:
Neighbourhood deprivation
Socioeconomic factors
End stage renal disease
Risk factors

ABSTRACT

Background: Chronic kidney disease has been associated with socioeconomic disparities and neighbourhood deprivation. We aimed to determine whether there is an association between neighbourhood deprivation and end stage renal disease (ESRD), and whether this association is independent of individual-level sociodemographic factors and comorbidities.
Methods: National Swedish data registers were used. The entire Swedish population aged 20–69 years was followed from January 1, 2001 until December 31, 2010. Data were analysed by multilevel logistic regression, with individual-level sociodemographic factors (age, marital status, family income, education level, country of birth, urban/rural status, and mobility) and comorbidities at the first level and neighbourhood deprivation at the second level.
Results: Neighbourhood deprivation was significantly associated with ESRD (age-adjusted odds ratio [OR] 1.45, 95% confidence interval [CI] 1.34–1.56 in men and OR 1.59, 95% CI 1.44–1.75 in women). The ORs for ESRD in men and women living in the most deprived neighbourhoods remained significantly increased when adjusted for age and individual-level sociodemographic factors (OR 1.25, 95% CI 1.15–1.35 in men and OR 1.30, 95% CI 1.17–1.44 in women). In the full model, which took account of sociodemographic factors and comorbidities, the ORs for ESRD remained significantly increased (OR 1.17, 95% CI 1.07–1.27 in men and OR 1.18, 95% CI 1.06–1.31 in women).
Conclusion: Neighbourhood deprivation is independently associated with ESRD in both men and women irrespective of individual-level sociodemographic factors and comorbidities.

1. Introduction

Chronic kidney disease (CKD) is a worldwide health problem associated with poor outcomes, high costs, and increased risk of cardiovascular mortality and morbidity [1]. Factors associated with CKD are old age, diabetes mellitus, hypertension, obesity, cardiovascular disease (CVD), ethnicity, family history, and socioeconomic status (SES) [2,3]. Individual-level SES, such as household income, education level, wealth, and occupation, has been associated with lower levels of glomerular filtration [4–8]. In addition to individual-level SES, neighbourhood-level factors may also increase the risk of CKD [9–16]. However, few studies have determined whether neighbourhood deprivation is a risk factor for end stage renal disease (ESRD), independent of individual-level sociodemographic factors, including SES, and comorbidities. In the Atherosclerosis Risk in Communities (ARIC) study only white men had an independent increased risk of progressive CKD in lower SES neighbourhoods [13]. White women, black women, and black men living in lower SES neighbourhoods had no increased risk of CKD compared to their counterparts in higher SES neighbourhoods [13]. In a study by McClellan et al., household but not community poverty was independently associated with CKD [17]. In US people aged above 65 years a significant association was found between living in a poor neighbourhood and CKD, independent of individual-level SES, lifestyle factors, diabetes, and hypertension [18]. In the ARIC study of life-course socioeconomic conditions, after adjustment for diabetes and hypertension, individual-level SES was independently associated with CKD, but neighbourhood-level SES was not [19].

These studies suggest that the associations of individual-level SES and neighbourhood-level SES with CKD and ESRD are complex. Moreover, it is not clear whether comorbidities influence these associations. We aimed to determine, in a large nationwide study, whether there is an association between neighbourhood deprivation and ESRD, and whether this association is independent of individual-level sociodemographic factors, including SES (age, marital status, family income, education level, country of birth, urban/rural status, and mobility) and comorbidities.

* Corresponding author at: Center for Primary Health Care Research, CRC, Building 28, Floor 11, Entrance 72, Skåne University Hospital, SE-205 02 Malmö, Sweden. Tel.: +46 70 9396117(cell); fax: +46 40 391370.
E-mail address: delshad.akrawi@med.lu.se (D.S. Akrawi).

http://dx.doi.org/10.1016/j.ejim.2014.09.016
0953-6205/

2. Methods

2.1. Study design

Data used in this study represent information on all individuals registered as residents of Sweden and aged between 20 and 69 years at the start of the follow-up (January 1, 2001). The data included individual-level information on age, sex, education, occupation, geographic region of residence, hospital diagnoses, and dates of hospital admissions in Sweden, as well as date of emigration, and date and cause of death. The data sources were several national Swedish data registers, including the Swedish National Population and Housing Census, the Total Population Register, the Multi-Generation Register, the Swedish Cancer Registry, and the Swedish Hospital Discharge Register and Outpatient Register, and were provided to us by Statistics Sweden (the statistics bureau owned by the Swedish government) and the National Board of Health and Welfare [20–22]. The dataset includes ESRD events for the entire population, as well as information on individual-level SES and neighbourhood-level SES [23–25]. We used the main diagnoses of ESRD recorded in the Hospital Discharge Register and Outpatient Register and surgical codes for renal transplantation and dialysis. Linkages were carried out to national census data to obtain data on individual-level SES and geographical region of residence; to the national Cause of Death Register to obtain date of death; and to the Migration Register to obtain date of immigration or emigration. All linkages were performed using the individual national identification number that is assigned to each person in Sweden for their lifetime. This number was replaced by a serial number in order to ensure anonymity. The follow-up period started on January 1, 2001 and proceeded until diagnosis of ESRD, death, emigration, or the end of the study period (December 31, 2010).

2.2. Outcome (dependent) variable

The outcome variable, ESRD, was based on the 10th revision of the International Classification of Diseases (ICD) or the Classification of Surgical Procedures. ESRD was defined as N18.5 (i.e. CKD stage 5), T82.4, Y84.1, Z49, Z94.0, and Z99.2 (ICD-10 codes for ESRD, dialysis or transplantation), and V9211, V9212, V9200, V9531, V9532, V9507, KAS00, KAS10, KAS20, KAS40, KAS50, KAS60, KAS96, KAS97, JAK10, TJA33, TJA35, and TKA20 (surgical codes for transplantation or dialysis). The frequencies of the different diagnoses for ESRD at presentation are shown in Supplementary Table 1.

2.3. Individual-level variables

The individual-level variables were sex, age at the start of the study, marital status, family income, education level, country of birth, urban/rural status, mobility, and comorbidities [23–25].

Sex: male or female.

Age ranged from 20 to 69 years and was used as a continuous variable in the models.

Marital status: individuals were classified as married/cohabitating or never married/widowed/divorced.

Family income by quartile: information on family income in 2001 came from the Total Population Register, which was provided by Statistics Sweden. Income was categorised into quartiles: low income, middle–low income, middle–high income, and high income.

Education level was classified as completion of compulsory school or less (≤9 years), practical high school or some theoretical high school (10–12 years), and theoretical high school and/or college (>12 years).

Country of birth: Born in 1) Sweden (reference), 2) Finland, 3) Western countries, 4) Eastern European countries, 5) Middle Eastern countries, and 6) other countries.

Urban/rural status: residence in large cities (Stockholm, Gothenburg, and Malmö), middle-sized towns, and small towns/rural areas.

Mobility: length of time lived in neighbourhood, categorised as <5 years (moved) or ≥5 years (not moved).

Comorbidity was defined as the first diagnosis (main or additional diagnosis) during the follow-up period of: 1) chronic lower respiratory diseases (J40-J49), 2) obesity (E65-E68), 3) alcoholism and alcohol-related liver disease (F10 and K70), 4) hypertension (I10-I15), 5) diabetes mellitus (E10-E14), 6) ischemic heart disease (I20-I25), and 7) acute kidney failure (N17).

2.4. Neighbourhood-level SES

The home addresses of all Swedish individuals have been geocoded to small geographical units that have boundaries defined by homogeneous types of buildings. These neighbourhood areas, called small area market statistics, or SAMS, have an average of 1000 people each and were created by Statistics Sweden. SAMS were used as proxies for neighbourhoods, as in previous research [26,27]. SAMS with fewer than 50 people aged 25–64 were excluded (n = 1053 SAMS), as were individuals whose addresses could not be geocoded to a neighbourhood area (n = 83,230 individuals, 13% of the sample). The final sample included 8372 SAMS.

A summary index was calculated to characterise neighbourhood-level deprivation [28]. The neighbourhood index was based on information on women and men aged 20–64 who lived in the neighbourhood because people in this age group are the most socioeconomically active, that is, as a population group they have a stronger impact on the socioeconomic structure of the neighbourhood than children, younger women and men, and retirees. The neighbourhood index was based on four items: low education level (<10 years of formal education), low income (income from all sources, including that from interest and dividends, defined as less than 50% of the median individual income), unemployment (excluding full-time students, those completing compulsory military service, and early retirees) and receipt of social welfare. The index was categorised into the following three groups (higher scores reflect more deprived neighbourhoods): low neighbourhood deprivation (more than 1 SD below the mean), moderate neighbourhood deprivation (within 1 SD of the mean), and high neighbourhood deprivation (more than 1 SD above the mean) [28].

2.5. Statistical analysis

Age-adjusted cumulative incidence rates were calculated by direct age standardisation using 10-year age groups, with the entire study population of women or men in 2001 as the standard population. Multilevel (hierarchical) logistic regression models with incidence proportions (proportions of adults who became cases among those who entered the study time interval) were used to calculate the outcome variable. Multi-level logistic regression models are a good approximation of Cox proportional hazards models under certain circumstances such as ours (large sample size, low incidence, and risk ratios of moderate size) [29]. The analyses were performed using MLwiN version 2.27. First, a neighbourhood model including only neighbourhood-level deprivation was created to determine the crude odds of ESRD by level of neighbourhood deprivation. A second model included neighbourhood-level deprivation and age; a third model also included the other individual-level sociodemographic variables (added simultaneously to the model). The full model tested whether neighbourhood-level deprivation was significantly associated with ESRD after adjustment for individual-level sociodemographic factors as well as comorbidity [30]. In the Atherosclerosis Risk in Communities (ARIC) study, white men but not women had an independent increased risk of progressive CKD in lower SES neighbourhoods [13]. Men and women were therefore analysed in separate models. Interaction tests (for both men and women) examined whether the effects of neighbourhood-level deprivation on ESRD rates differed across individual-level SES (income and education) categories, that is, they tested for effect modification.