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Brief communication

Neighbourhood disadvantage and self-reported type 2 diabetes, heart disease and comorbidity: a cross-sectional multilevel study

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ABSTRACT

Purpose: This study examines associations between neighborhood socioeconomic disadvantage and self-reported type 2 diabetes and heart disease, occurring separately and concurrently at a single time point (comorbidity).

Methods: This study included 11,035 residents from 200 neighborhoods in Brisbane, Australia. Respondents self-reported type 2 diabetes and heart disease as long-term health conditions. Neighborhood socioeconomic disadvantage was measured using a census-derived composite index. Individual socioeconomic position was measured using education, occupation, and household income. Data were analyzed using multilevel multinomial mixed-effects logistic regression using Markov chain Monte Carlo simulation.

Results: Compared with the most advantaged neighborhoods, residents of the most-disadvantaged neighborhoods were more likely to report type 2 diabetes (odds ratio [OR] = 2.21, 95% credible interval [CrI] = 1.55–3.15), heart disease (OR = 1.72, 95% CrI = 1.25–2.38), and comorbidity (OR = 4.38, 95% CrI = 2.27–8.66). This relationship attenuated after adjustment for individual-level socioeconomic position, but remained statistically significant for type 2 diabetes (OR = 1.81, 95% CrI = 1.15–2.83) and comorbidity (OR = 3.00, 95% CrI = 1.49–6.13).

Conclusions: Studies of neighborhood disadvantage that fail to include individual-level socioeconomic measures may inflate associations. Establishing why residents of disadvantaged neighborhoods are more likely to experience the co-occurrence of heart disease and type 2 diabetes independent of their individual socioeconomic position warrants further investigation.

Background

Type 2 diabetes and cardiovascular disease are two of the most prevalent chronic diseases in Australia [1], and they constitute a significant burden for both individuals [2] and society; in 2008–09, cardiovascular disease cost the Australian economy $7.7 billion [3] and type 2 diabetes $1.5 billion [4], representing 10.4% and 2.3% of total disease expenditure, respectively.

Although living with a single chronic condition presents significant individual and societal burden, living with two or more chronic conditions concurrently, or "comorbidity", is more challenging. Comorbidity is associated with an increased risk of impaired functional status or quality of life and greater health care utilization, including more hospital admissions, longer stays in hospital [2], and greater frequency of visits to GPs and specialists [5,6]. Comorbidity is compounded by the fact that shared risk factors between these diseases promote co-occurrence and strengthen the association between them;while these risk factors also promote disease progression and increase the risk of complications [3].

A number of studies have found that the prevalence of type 2 diabetes [4,7,8] and heart disease [9] increases with area-level disadvantage. However to date, few studies have examined associations between neighborhood disadvantage and chronic disease comorbidity. Those that have, find positive associations between increasing area-level disadvantage and disease prevalence [4,10,11]. Typically these studies do not consider individual-level socioeconomic position (SEP) [4,10–12]. Those that do, have included measures of occupational class [13] and levels of education and income [14,15]. Neighborhood studies that do not include

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individual-level measures of socioeconomic disadvantage fail to disentangle the relative contribution of socioeconomic factors at the individual and neighborhood levels. Moreover, the inclusion of measures of individual-level socioeconomic indicators that do not adequately cover all dimensions of socioeconomic status (i.e., only occupation or education) may inflate estimates of area-level disadvantage effects on chronic disease [16].

This study attempts to address these limitations by examining associations between neighborhood socioeconomic disadvantage and comorbidity for type 2 diabetes and heart disease, independent of the three most commonly used individual-level measures of SEP in health research [17]; namely education, occupation, and household income. It is hypothesized that those living in more disadvantaged neighborhoods will be more likely to report a single chronic disease and comorbidity, independent of their SEP.

Methods

Sample design and neighborhood-level unit of analysis

This study used data from the How Areas in Brisbane Influence healTh And acTivity (HABITAT) project. Details about HABITAT's sampling design have been published elsewhere [18]. Briefly, a multistage probability sampling design was used to select a stratified random sample ($n = 200$) of Census Collector's Districts (CCD—hereby referred to as neighborhoods) from the Australian Bureau of Statistics. Within each neighborhood, randomly selected adults aged 40–65 years were mailed a self-administered questionnaire between May and July 2007. Of 16,128 surveys mailed to eligible Brisbane residents, 11,035 (68.4% response rate) usable surveys were returned. Residents were representative of the general Brisbane population. The HABITAT study was approved by the Human Research Ethics Committee of the Queensland University of Technology (Ref. no. 3967H).

Neighborhood disadvantage

Neighborhood socioeconomic disadvantage was derived using a weighted linear regression, using scores from the Australian Bureau of Statistics′ Index of Relative Socioeconomic Disadvantage [19] (IRSD) from each of the previous six censuses' from 1986 to 2011. The derived socioeconomic scores from each of the HABITAT neighborhoods were then quantized as percentiles, relative to all of Brisbane. The 200 HABITAT neighborhoods were then grouped into quintiles with Q1 denoting the 20% ($n = 40$) least disadvantaged areas relative to the whole of Brisbane and Q5 the most disadvantaged 20% ($n = 40$).

Chronic disease

Self-reported type 2 diabetes and heart disease

Participants responded to the question "Have you ever been told by a doctor or nurse that you have any of the long-term health conditions listed below? (please only include those conditions that have lasted, or are likely to last, for six (6) months or more)." Type 2 diabetes and heart/coronary disease were two of eight conditions listed, and respondents were asked to indicate "yes" (coded 1) or "no" (coded 0) for each condition. Comorbidity in this study is the presence of both type 2 diabetes and heart disease for the same participant. Self-reported measures of chronic conditions have been shown to be valid [20]; whereas this question has been used extensively in previous Australian health research [21].

Covariates

Education

Participants were asked to provide information about their highest educational qualification attained. A participant's education was subsequently coded as: (1) bachelor degree or higher (including postgraduate diploma, master's degree, or doctorate), (2) diploma (associate or undergraduate), (3) vocational (trade or business certificate or apprenticeship), and (4) no postschool qualifications.

Occupation

Participants who were employed at the time of completing the survey were asked to indicate their job title and then to describe the main tasks or duties they performed. This information was subsequently coded to the Australian Standard Classification of Occupations [22]. The original 9-level Australian Standard Classification of Occupations classification was re-coded into five categories: (1) managers/professionals (managers and administrators, professionals, and paraprofessionals), (2) white-collar employees (clerks, salespersons, and personal service workers), and (3) blue-collar employees (tradespersons, plant and machine operators and drivers, and laborers and related workers), (4) home duties, (5) retired, and (6) missing/NEC (not easily classifiable - permanently unable to work, students or other).

Household income

Participants were asked to estimate the total pre-tax annual household income using a single question comprising 13 income categories. For analysis, these were re-coded into six categories: (1) ≥AU \$130,000, (2) AU \$129,999–72,800, (3) AU \$72,799–52,000, (4) AU \$51,999–26,000, (5) ≤AU \$25,999, and (6) missing (i.e. left the income question blank, ticked "Don't know" or "Don't want to answer this").

Statistical analysis

Participants who had missing data for either type 2 diabetes, heart disease, or education were excluded ($n = 413$), and two participants were dropped who were beyond the scope of the study at the time of the survey. The final analytical data set was $n = 10{,}620$ (96.2% of the total sample—Table 1).

The analysis was informed by postulated relationships between the socioeconomic indicators. Education, occupation, and household income were conceptualized as common prior causes (confounders) of neighborhood disadvantage and chronic disease; in addition to other potential confounders (age and sex). These relationships are depicted in a directed acyclic graph (Fig. 1). Multilevel multinomial logistic regression was undertaken with self-reported type 2 diabetes, heart disease, and comorbidity as an unordered categorical dependent variable (neither condition-reference group = 0; both conditions = 1; type 2 diabetes only = 2; and heart disease only = 3). The models undertaken for analysis were model 1—neighborhood disadvantage and chronic disease adjusted for age and sex; and model 2—model 1 plus further adjustment for education, occupation, and household income. The highest socioeconomic category was used as the reference group in each model. Each regression analysis used marginal quasi-likelihood iterative generalized least square methods as the base estimates for Markov chain Monte Carlo (MCMC) simulation (burn in = 500, chain = 100,000). The MCMC estimation procedure uses a Bayesian sequential learning approach that combines prior information for a parameter (incorporated via a prior distribution) with the likelihood function produced from the collected data to make inferences about the unknown model parameters. These