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Case study

Clusters of maternal depressive symptoms in South Western Sydney, Australia

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ABSTRACT

The purpose of this study is to explore the spatial distribution of perinatal depressive symptoms in South Western Sydney, Australia, and to identify any clusters that could inform subsequent qualitative, ecological and multilevel studies and local public health interventions. A routine survey of mothers with newborn infants was commenced in 2000. The survey included the Edinburgh Postnatal Depression Scale (EPDS). Mothers (n = 15,389) delivering in 2002 and 2003 were assessed at 2–3 weeks after delivery for risk factors for depressive symptoms. The binary outcome variables were EPDS > 9 and EPDS > 12. EPDS > 9 and EPDS > 12 was mapped for 101 suburbs using likelihood standardised morbidity ratios (SMRs) and Bayesian log-normal models with conditional autoregressive (CAR) components. Open domain software SaTScan™ was used to test for the presence of clusters. The Bayesian methods identified clusters of depressive symptoms in north-east, north-west and southern areas of the study region. The northern clusters were statistically significant using SaTScan™. There were two high risk clusters of EPDS > 9 (radius 4.3 and 5.6 km, both $p < 0.001$) and two high risk clusters of EPDS > 12 (radius 1.8 km $p = 0.003$ and radius 3.97 km $p = 0.012$). The clusters were in regions known to be socially disadvantaged and with high rates of non-English speaking migrants. The study findings will be used to inform future qualitative and epidemiological research, and to plan interagency early intervention services for women, children and their families.

1. Introduction

We have previously reported on individual level psychosocial predictors of perinatal depression in South Western Sydney (Eastwood et al., 2011). We proposed that the findings of that study were consistent with group-level socioeconomic deprivation, neighbourhood environment, social capital and ethnic diversity having causal effects on postnatal depressive symptomatology and other perinatal outcomes. Social and physical environmental adversity and measures of social capital have previously been found to be associated with maternal stress, and poor pregnancy outcomes, including: prematurity, low-birth weight and infant mortality (Buka et al., 2003; Morenoff, 2003). The detrimental and protective impact of these societal-level influences on perinatal depression is less well studied with much of the emphasis to date being on individual-level psychosocial factors. With the exception of an ecological

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study of poverty and postpartum psychosis (Nager et al., 2006) we found no previous published ecological studies of perinatal depression.

Ecological studies make use of maps and spatial statistical tools to explore and analyse aggregated individual-level data (i.e. disease rates) and data directly derived from the group-level (i.e. pollution levels). Such exploratory spatial data analysis (ESDA) has a strong tradition (Haining, 2003). The most basic exploratory spatial data analysis method is the visualisation of spatial data using maps. Standardised ratios, such as standardised mortality or morbidity ratios (SMRs) are commonly used to map disease distribution. This likelihood approach compares the observed cases with the "expected" cases within small geographical areas (i.e. suburbs or Census tracts). The expected cases are estimated by applying a regional average to the small areas. The calculated SMR is an estimate of the relative risk within each small area (Lawson et al., 2003).

The crude maps developed using the likelihood method described above often feature large outlying relative risks in areas where the population is small. Hence those maps usually show high uncertainty and the SMRs can vary greatly (Johnson, 2004). They also fail to catch the similarity of relative risks in nearby or adjacent areas. To address these problems different methods of smoothing have been developed all based on the phenomenon that observations close together in space are more likely to share similar properties than those that are far apart.

Bayesian hierarchical approaches to spatial autocorrelation are one such method and are currently used as a standard in epidemiology and environmental health literature. Unlike the conventional statistical inference which derives the average estimates of parameters, hierarchical Bayesian modelling produces parameter estimates for each individual analysis unit by borrowing information from all analysis units. This is known as the Bayesian "borrowing of strength" effect (Zhu et al., 2006). The Bayesian approach will enable more accurate visualisation of variations in the distribution of aggregated maternal depressive symptoms and any likely clusters. For statistical testing for the presence of clusters the open domain software SaTScan™ distributed by the National Cancer Institute is available (Kulldorff et al., 1998). SaTScan™ assumes that the number of cases of interest in each geographic region is Poisson distributed. The method then tests the null hypothesis that the risk of having the outcome in a suburb is the same as in all suburbs combined.

2. Methods

2.1. Study design

The study reported here is part of an exploratory ecological study of aggregated rates of postnatal depressive symptoms in South Western Sydney Area Health Service from 2002 to 2003. The analysis included: descriptive analysis, cluster analysis, factor analysis, mapping, visualisation, likelihood ecological linear regression, and Bayesian spatial and multi-level analysis. The results of the mapping of aggregated maternal depressive symptoms and spatial cluster analysis are presented here.

2.2. Study setting

The setting is all suburbs in four local government areas (LGAs) in New South Wales, Australia. The individual-level datum available for study was coded by suburb of residence. The suburb of residence was chosen as the closest group-level administrative unit to naturally occurring local neighbourhood environments. The limitations of using administratively defined areal units are well described (O'Campo, 2003; Diez Roux, 2004). There were 101 suburbs available to study using the 2001 Census maps.

2.3. Outcome variable

From 2000 a routine survey of mothers with newborn infants was commenced. The Ingleburn baby information system (IBIS) included the Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987), which has been widely used to study individual maternal perinatal depressive symptoms. The EPDS was administered at the time of first well baby visits. The EPDS is a scale from 0 to 30. This study reports on two individual-level binary outcome variables, namely for EPDS > 9 and EPDS > 12. Both EPDS > 9 and EPDS > 12 are supported by previous studies as screening cut-off points in English-speaking populations (Buist et al., 2002; Cox et al., 1987). Buist et al. (2002) noted that using EPDS > 12 was a sound option for reducing false positive diagnosis of depressive illness. The original authors recommended using the EPDS > 9 as a community screening cut-off point as many women experiencing considerable dysfunction, but not meeting diagnostic criteria for formal illness, might otherwise be missed. Those women also merit recognition of their distress and the provision of psychological or social assistance (Brown et al., 2001; Buist et al., 2002).

2.4. Statistical analysis

We calculated standardised ratios (SMRs) of the observed EPDS counts divided by the expected counts. The expected count for each suburb was computed using the observed EPDS > 9 or EPDS > 12 rates for the South Western Sydney region multiplied by the number of mothers surveyed in that suburb. The number of women surveyed in each suburb may not have represented the true distribution of women who might have been surveyed. We therefore also undertook standardisation using "women of child bearing age" (WCBA). The rates standardised by numbers surveyed was highly correlated with the standardisation by WCBA and we therefore used SMRs based on the numbers surveyed.

Bayesian hierarchical methods were used as described by Lawson et al. (2003). A basic log-normal model with a conditional autoregressive (CAR) component was used in WinBUGS Version 1.4 (Spiegelhalter et al., 2003) to derive the smoothed EPDS relative risks. The model inputs were the same observed and expected EPDS counts as for the SMR analysis. For the CAR component of the model a file