Mortality in people with epilepsy: A statewide retrospective cohort study

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ABSTRACT

Rationale: People with epilepsy (PWE) have a higher risk of mortality than the general population, because of disparities in the receipt of appropriate epilepsy care, which may be affected by socioeconomic status, race/ethnicity and insurance coverage. Increased epilepsy prevalence has been associated with black race, low educational attainment, unemployment, and low income levels. Rural/urban residence may affect health through individual or environmental factors. Health disparities seen in rural residents are likely amplified in rural PWE because of limited access to specialized care. This analysis aims to examine the risk of mortality attributable to rural residence in the statewide population of South Carolina (SC) after adjusting for potential confounders.

Methods: This statewide retrospective cohort study of PWE seen in SC non-federal hospitals and emergency departments from 2000 to 2013 describes the hazard of mortality by rural/urban residential status in addition to other demographic and clinical characteristics. Differences in proportions were assessed by comparison of 95% confidence intervals. The association of rural/urban residence with mortality was further evaluated with Cox proportional hazard regression controlling for demographic and clinical covariables.

Results: 62,794 PWE were identified, of whom 21,451 (25.7%) had died. Deceased PWE were more likely to be rural residents, black, older than age 45, Medicare insured, in the middle income group, and have 5 or more comorbid conditions compared with living PWE. After adjustment for all other covariables, the risk of mortality attributable to rural/urban residence did not differ by rural/urban residence. Blacks had a weak but significantly higher risk than whites (hazard ratio (HR) = 1.14; 95% confidence interval (CI) = 1.11, 1.18) while PWE of other races had a slightly lower risk of mortality (HR = 0.79; 95% CI = 0.67, 0.93). Male PWE had higher hazard as did Medicare, Medicaid or commercially insured PWE, those living in zip codes with annual median incomes less than $36,000, and those with 2 or more comorbid conditions.

Conclusions: While other covariables were more strongly associated with mortality after adjustment (older age, insurance coverage, income level of zip code, and number of comorbidities), the finding of a higher hazard in black PWE than white PWE after adjustment for rural/urban residence and other demographic and clinical covariables is a concern. Further, the increased risk of mortality with higher numbers of comorbid conditions warrants regular management of these conditions.

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1. Introduction

The quality of and access to health care has been the focus of rural health research; however, health disparities can involve a complex interaction of factors including race/ethnicity, age, sex, educational level, income level, insurance status and place of residence (Burneo et al., 2009; Hartley, 2004; Johnson et al., 2008; Marmot, 2005; Scott and Wilson, 2011; Smedley et al., 2001; Szaflarski, 2014) Healthy People 2020 lists geographic region

(rural/urban residence) as an important social determinant of health (Healthy People 2020, 2015) Rural/urban residence may affect health through individual (use of self-care, no routine source of care, lifestyle and behavior) or environmental (poverty, income inequality, access to care, health care shortages) factors (James, 2014).

Rural residents tend to be older, report poorer health, take limited physical activity, be overweight/obese, have higher rates of smoking, fewer health care visits and are more likely to see a general practice physician rather than a specialist (Bethea et al., 2012; Chan et al., 2006; Meit et al., 2014) Rural counties have the lowest numbers of active specialty physicians or dentists per 100,000 population; 65% of rural counties in the U.S. are considered health professional shortage areas (HPSA) (Meit et al., 2014; Probst et al., 2004) In the Southern U.S., 22% of rural residents live below the poverty line (Meit et al., 2014). An analysis of mortality from 1969 to 2009 found increasing disparities in mortality by rural/urban residence with higher mortality seen in rural areas after adjusting for poverty (Singh and Siahpush, 2014a) Further, rural residents with chronic diseases requiring long-term care have shown increased mortality (Eberhardt and Pamuk, 2004; Hill et al., 2014; Kulshreshtha et al., 2014; Terashima et al., 2014).

Health disparities, both in healthcare access and outcomes have been documented in people with epilepsy (PWE). Incidence and prevalence of epilepsy are higher in blacks (Faught et al., 2012; Kroner et al., 2013; Theodore et al., 2006) and higher epilepsy prevalence is associated with indicators of low socioeconomic status (SES) such as low educational attainment, unemployment, and low income levels (Elliott et al., 2009, 2008; Ferguson et al., 2008; Geerts et al., 2011; Heaney et al., 2002; Hesdorffer et al., 2005; Kobau et al., 2004, 2006, 2007; Konda et al., 2009; Kroner et al., 2013; Li et al., 2008; Ottman et al., 2011; Pickrell et al., 2015; Sillanpaa, 2004; Steer et al., 2014; Wiebe et al., 2009). Worldwide, epilepsy prevalence appears to be higher in rural areas, especially in underdeveloped countries (Camfield and Camfield, 2015; Gourie-Devi et al., 2004). PWE, especially those with remote symptomatic or intractable epilepsy, are acknowledged to have a higher risk of premature mortality than the general population, especially in the first years after diagnosis (Forsgren et al., 2005; Gaitatzis et al., 2004; Hitiris et al., 2007; Lhatoo et al., 2001; Morgan et al., 2000; Neligan et al., 2011; Nevalainen et al., 2014; Selassie et al., 2014; Theodore et al., 2006; Trinka et al., 2013; Wiebe et al., 2009). Disproportionate mortality in subpopulations of PWE may result from disparities in the receipt of appropriate epilepsy care, which has shown to be affected by income status (Begley et al., 2011; Gresenz et al., 2000), racial/ethnic group (Kelvin et al., 2007; McClelland et al., 2010; Schiltz et al., 2013), and insurance coverage (Baca et al., 2013; Halpern et al., 2011; Hauptman et al., 2013a; Schiltz et al., 2013). Health disparities associated with rural residency are likely amplified in PWE because of barriers to education and employment (Steer et al., 2014).

The few studies of geographic disparities in PWE have focused on healthcare factors including access to and use of epilepsy providers, diagnostic tools (e.g., EEG), and treatments (e.g., AEDs and surgery). In a study of pediatric epilepsy surgery patients in California, the time from seizure onset to epilepsy surgery evaluation was shorter for those living closer to the treating facility (Hauptman et al., 2013b). In a Canadian study, rural PWE used emergency department services more frequently and dental services less frequently than those in more heavily populated regions (Wiebe et al., 2009).

The risk of mortality in PWE is likely to be influenced by a cumulative effect of SES over the lifetime (Hesdorffer et al., 2005); adjustment for one or two indicators of SES may not account for the complex relationship of these determinants of health (Lawlor et al., 2005). This analysis aims to examine the risk of mortality attributable to rural residence in the statewide population of South Carolina (SC) after adjusting for potential confounders.

2. Methods

2.1. Data sources

Data analyzed in this study derive from hospital discharge and emergency department (ED) visit datasets (including hospital-based outpatient department (OPD) visits) from all non-federal hospitals in SC. SC health care providers are required to submit these data to the SC Revenue and Fiscal Affairs Office, Health and Demographics (H&D) section which assigns a unique ID to each individual, allowing linkage across various datasets (Weis et al., 2006). Since these data are required for billing, data completeness is over 98% (Varma et al., 2010). Additional data on mortality was obtained from death certificate information maintained by the SC Public Health Statistics and Information Services. The Medical University of South Carolina Institutional Review Board approved this study.

2.1.1. Study design and case ascertainment

The design is a retrospective cohort study of mortality in PWE in SC. All individuals with hospital, ED, or OPD visits from January 1, 2000 to December 31, 2013 with International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) diagnosis codes for epilepsy (ICD-9-CM 345.0, 345.1, 345.4–345.6, 345.8, or 345.9) or "seizure, not otherwise specified" (ICD-9-CM 780.39) were identified (American Medical Association, 2009). Diagnoses assigned by clinical providers are coded by certified health information specialists operating under the standard coding guideline of National Center for Health Statistics and the Center for Medicare and Medicaid Services. Case ascertainment was based on the aforementioned ICD-9-CM coded diagnoses of epilepsy or unspecified seizures using an operational version (Fig. 1) of a decision algorithm (Appendix A) developed for the South Carolina Epilepsy Surveillance System that uses clinical and diagnostic criteria of epilepsy to increase the probability of identifying "true" epilepsy (Selassie, 2012). Briefly, a case of epilepsy had to satisfy one of the following requirements: (1) at least two visits with a diagnosis code for epilepsy during the study period; (2) a single visit coded for epilepsy PLUS a prior visit coded for unspecified seizure; (3) two or more visits coded for unspecified seizure within one year or (4)
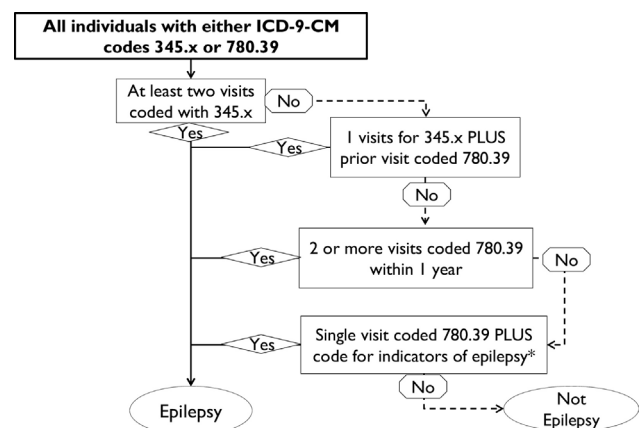
*Indicators include: codes for vagal nerve stimulator implantation, epilepsy surgery, ketogenic diet in children, video EEG.

Fig. 1. Operational algorithm for classifying epilepsy based on diagnosis codes.