Socioeconomic Disadvantage Is Associated with a Higher Incidence of Aneurysmal Subarachnoid Hemorrhage

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Background and Purpose: Aneurysmal subarachnoid hemorrhage (aSAH) incidence is not well studied. Varied definitions of "subarachnoid hemorrhage" have led to a lack of clarity regarding aSAH incidence. The impact of area-level socioeconomic disadvantage and geographical location on the incidence of aSAH also remains unclear. Using a population-based statewide study, we examined the incidence of aSAH in relation to socioeconomic disadvantage and geographical location. *Methods:* A retrospective cohort study of nontraumatic subarachnoid hemorrhages from 2010 to 2014 was undertaken. Researchers manually collected data from multiple overlapping sources including statewide administrative databases, individual digital medical records, and death registers. Age-standardized rates (ASRs) per 100,000 person years were calculated using the 2001 Australian population. Differences in incidence rate ratios were calculated by age, sex, area-level socioeconomic status, and geographical location using Poisson regression. *Results:* The cohort of 237 cases (mean age, 61.0 years) with a female predominance of 166 (70.04%) included 159 confirmed aSAH, 52 community-based deaths, and 26 probable cases. The ASR for aSAH was 9.99 (95% confidence interval [CI], 8.69-11.29). A significant association between area-level socioeconomic disadvantage and incidence was observed, with the rate of aSAH in disadvantaged geographical areas being 1.40 times higher than that in advantaged areas (95% CI, 1.11-1.82; $P = .012$). *Conclusion:* This study uses a comprehensive search of multiple data sources to define a new baseline of aSAH within an Australian population. This study presents a higher incidence rate of aSAH with socioeconomic variations. As a key risk factor that may explain this paradox, addressing socioeconomic inequalities is important for effective prevention and management interventions.
Key Words: Aneurysm—subarachnoid hemorrhage—incidence—socioeconomic position—epidemiology—cerebrovascular disease—stroke.

Introduction

Known for catastrophic outcomes and preponderance in younger individuals, aneurysmal subarachnoid hemorrhage (aSAH) shares many of the risk factors associated with ischemic stroke including modifiable health-related risk factors and socioeconomic disadvantage.[1] Defined as an extravasation of blood in the subarachnoid space[2] and classified as a hemorrhagic stroke, subarachnoid hemorrhage can occur secondary to a traumatic event or an infectious process, or following a ruptured cerebral aneurysm, where it is referred to as an aSAH.

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In contrast to the decreasing trend in the incidence of ischemic stroke,[3,4] there is a lack of consensus as to whether the incidence of both aneurysmal and nontraumatic hemorrhages is decreasing,[5,6] stable,[4,7] or increasing.[8,9] There are also wide variations in the estimated incidence of aSAH, ranging from .6 per 100,000 person years in Iran[10] to 140.1 per 100,000 person years in a Texas study,[11] with consistently higher rates reported in some countries, including Japan and Finland.[6]

Comparing aSAH incidence studies is challenging due to differences in case recruitment, cohort inclusion, and the use of the term "subarachnoid hemorrhage," which does not distinguish aneurysmal from nonaneurysmal hemorrhages. While technological advances in diagnostic imaging have enabled aSAH cases to be differentiated from other nontraumatic causes, this degree of differentiation is not consistently included in administrative databases, the main data source for epidemiological studies in this field. The lack of clarity in defining and differentiating aneurysmal versus nonaneurysmal hemorrhages is a potential explanation for the wide variation in incidence. Hence, there is a need for studies that accurately define aSAH incidence and use manual searches of multiple overlapping sources in well-defined regions to achieve unbiased estimates of incidence.

The hemorrhagic nature of aSAH has resulted in its exclusion from stroke epidemiological studies. This means that for aSAH there is less knowledge about the established associations for risk factors, such as socioeconomic status.[1,12] Knowledge pertaining to area indicators is also limited, with a dearth of literature concerning geographic location and associated social determinants of health.[13] In contrast to individual risk and socioeconomic factors, area-level socioeconomic indicators utilize aggregated data on factors such as housing, income, levels of educational attainment, and access to private transport. Understanding the association between areal socioeconomic disadvantage and the incidence of aSAH is essential to ensuring that health policy interventions are targeted and translate into a decline in incidence.

Geographical location alone has not been significantly associated with an increased incidence of aSAH.[14,15] However, associations between rurality and the incidence of stroke suggest geographical location to be interrelated with socioeconomic factors.[12,16] This suggests a more complex relationship than simple geographical distance, with place of residence potentially playing a more important role than rural location itself. We aim to address the known gap in applying a multidimensional approach to aSAH research.[17]

This study aims to define a new baseline of the incidence and temporal trends of aSAH within an Australian population. We aim to describe aSAH incidence in relation to the associated intrinsic morphology, analyzing the influence of socioeconomic and geographical determinants using a statewide retrospective population-based incidence study.

Methods

Study Setting

This study is set in Tasmania, an island state in the southeast of Australia. Tasmania's population of 511,200 (2011) is relatively decentralized with 65% of individuals residing in inner regional areas, 33% in outer regional areas, and 2% in remote and very remote areas, making Tasmania with its overall low population density (7.24 people per square kilometer) and only 1 of 2 Australian states without a metropolitan (major) city. Tasmania has a single public neurosurgical unit with all regional and private aSAH admissions referred to this unit, limiting the potential for missed cases and reducing referral bias.

Participants

We used multiple overlapping data sources to manually identify all nontraumatic subarachnoid hemorrhage cases using a statewide hospital administrative data search of all hospital admission, discharge, and emergency databases over the period of 2010-2014. Databases were searched using the International Classification of Diseases version 10 codes I60.0-I60.9, I67.1 and I69.0. Community-based deaths included as incident cases were identified through 2 methods. The first was through a manual search of Tasmanian residents with known unruptured or inoperative aneurysms who died during the study period. In addition to this, data linkage with the Registry of Births, Deaths and Marriages identified deaths coded as nontraumatic subarachnoid hemorrhages that occurred during the study period that were not admitted to hospital and were missed during our initial administrative and medical record searches.

We accessed individual medical records to verify and code diagnosis with all non-Tasmanian residents excluded. A neurosurgical registrar and a neurosurgical nurse reviewed the exact aneurysm morphology to verify cases with consensus obtained following additional review of medical records and radiological scans. Cases were classified as either confirmed or probable, with this second category including both delayed and futile presentations that were associated with limited imaging and/or digital records.

Risk factor information was extracted primarily from neurosurgical admission records and, if not available there, was taken from emergency admissions or allied health records. Health behaviors and risk factors were self-reported. Smoking was defined as nonsmoker or current and/or history of smoking. Alcohol consumption was categorized as nondrinker/social drinker or current excessive consumption. Hypertension, diabetes mellitus, and