Incidence and Mortality of Spontaneous Subarachnoid Hemorrhage in Hong Kong from 2002 to 2010: A Hong Kong Hospital Authority Clinical Management System Database Analysis

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Key words
- Chinese
- Hong Kong
- Incidence
- Mortality
- Subarachnoid hemorrhage

Abbreviations and Acronyms
CI: Confidence interval
CMS: Clinical Management System
HA: Hospital authority
IRR: Incidence risk ratio
SAH: Subarachnoid hemorrhage

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BACKGROUND: **Ninety-five percent of the Hong Kong population is Chinese, and no previous epidemiological study has focused on spontaneous subarachnoid hemorrhage (SAH) in Hong Kong. These data would have significant public health implications and can guide future resource allocations and service development in Hong Kong. The aim of this study was to investigate the local incidences of spontaneous SAH and 1-year mortality rates in Hong Kong, with the respective time trends in recent years.**

METHODS: **Data from the Clinical Management System database of the Hong Kong Hospital Authority were used to examine the incidence of SAH and 1-year mortality rates among the Hong Kong population for the 2002–2010 period. Age-standardized incidence rates were calculated by the direct method using the standard population given in World Health Organization World Standard Population 2000–2025.**

RESULTS: **Crude SAH incidences increased from 5.5 per 100,000 person-years in 2002 to 7.5 in 2010. Standardized SAH incidences increased from 4.1 per 100,000 person-years in 2002 to 5.6 in 2010. Crude 1-year mortality rates decreased from 43% in 2002 to 19% in 2010, and the standardized 1-year mortality rate decreased from 38% in 2002 to 19% in 2010.**

CONCLUSION: **The Hong Kong SAH incidence was 7.5 per 100,000 person-years in 2010, and an increasing trend over time was noted. The 1-year mortality rates decreased from 43% in 2002 to 19% in 2010, in accordance with the worldwide trend.**

INTRODUCTION

Evidence from developed countries suggests that 1 in 20 adults is affected by stroke (11, 16), and the incidence of acute cerebrovascular events (stroke and transient ischemic attack) currently exceeds the incidence of acute coronary heart disease (10, 23). This worldwide stroke epidemic and the well-recognized medicosocial consequences of stroke justify the need of worldwide stroke epidemiology, which will in turn advance our understanding of stroke frequency and determinants in various populations, enabling better health care planning (10). Although aneurysmal subarachnoid hemorrhages (SAHs) account for only 3%–5% of all strokes, the loss of productive life years is equal to that caused by ischemic strokes as a result of the devastating consequences and the propensity of SAHs to affect patients who are younger than 66 years of age. This remains the case, despite encouraging data showing a reduction in mortality during the last two decades (20, 21, 27). Recent studies have also shown that aneurysmal SAHs cause excess mortality for 12 months, after which other causes of death become dominant (14), and that there are geographical differences in case fatality rates (21). Locally, we also observed significant loss of cognitive function and reduction in quality of life in survivors after SAH (31, 33, 34).

The incidence of SAH has been estimated to be approximately 9 per 100,000 person-years, with geographic variations and association with age (9, 10, 15). A recent study suggested that the overall stroke incidence among Hong Kong Chinese (classified as a high-income country) was greater than in many similar countries and that the incidence of hemorrhagic stroke had increased among the young population (6).

The most reliable data on stroke incidence and case fatality come from population-based incidence studies. A systemic review of population-based incidence studies published in 2009 showed a divergent, statistical significant trend in stroke incidence rates during the past four decades (10). Although detailed epidemiologic data in the hospitalization of ischemic stroke are available in the literature, similar data are relatively few for SAH (17). Ninety-five percent of the Hong Kong population is Chinese, and no previous epidemiological study has focused on the incidences of SAH with regard to

age and time trends and on the 1-year mortality rates with regards to time trends in Hong Kong (18, 32).

AIMS

This study investigated the incidence of SAH and 1-year mortality rates in Hong Kong. These data are important components in understanding geographic differences of SAH incidence and mortality. They have significant public health implications and can guide future resource allocations and service development in Hong Kong.

METHODS

Data

Data from the Clinical Management System (CMS) database of the Hong Kong Hospital Authority (HA) were used to examine the incidence and mortality rates among the Hong Kong population from 2002 to 2010. The CMS is a computerized system for all aspects of clinical management that was implemented by the HA in 1995. Since 1999, it has been used by all hospitals run by the HA. The diagnoses for hospital admissions were coded by *International Classification of Diseases*, 9th Revision, Clinical Modification and verified by experts in the HA. Patients with severe stroke who died before arrival at HA hospitals also were included in our dataset. More than 90% of all hospital admissions for stroke were to hospitals run by the HA (12); the HA admission data used in this study, therefore, provided a good reflection of the stroke cases in Hong Kong. Nevertheless, the incidence rate was probably slightly underestimated in our dataset (6). The study was approved by the joint ethics committee of the Chinese University of Hong Kong and Hospital Authority of Hong Kong.

Definitions

For this study, spontaneous (nontraumatic) SAH was defined as any case given the *International Classification of Diseases*, 9th revision code 430 as a principal diagnosis during the first admission within an episode (26). Admissions that had the same principal diagnosis as the previous discharge were considered the same episode. Age, sex, and 1-year mortality were retrieved.

Statistical Analyses

SPSS for Windows Version 15.0 (SPSS Institute, Chicago, Illinois, USA) and MedCalc Version 12.2.1.0 (MedCalc, Ostend, Belgium) were used for statistical analyses. Statistically significant difference was defined as a $P < 0.05$. The Bonferroni correction for multiple comparisons was applied to age-specific incidence risk ratio analyses.

The numbers of SAH episodes each year between 2002 and 2010 were recorded. Incidence rates were presented as episodes per 100,000 person-years with a 95% confidence interval (CI). Age-specific SAH incidence rates (0–24, 25–34, 35–44, 45–54, 55–64, and ≥65 years) were calculated by the use of age-specific population sizes from the Hong Kong Census and Statistical Department. These rates were broken down by year of occurrence (grouped as 2002–2004, 2005–2007, and 2008–2010) (22). Age-standardized incidence rates were calculated by the direct method using the World Health Organization World Standard Population 2000–2025 as the standard population (1). Poisson regression models were used to examine the time trends in SAH incidence. Incidence risk ratios (IRRs) were estimated from the model. An IRR >1 indicated association with greater incidence, and vice versa.

Logistic regression was used to quantify the relation between the 1-year mortality and the year of occurrence. The results were calculated as the percentage change in the 1-year mortality rate per calendar year increase with corresponding 95% CIs. Variables for adjustment were sex and age.

RESULTS

Overall Distribution

From 2002 to 2010, there were 3759 episodes (from 356 to 517 episodes per year) of hospital admissions of spontaneous SAH, unrelated to trauma, identified from the CMS database in Hong Kong; 2373 (63%) of the patients were female. Age (mean ± SD) was 59 ± 14 years.

Incidence and 1-Year Mortality Rates

Crude SAH incidence increased from 5.5 per 100,000 person-years in 2002 to 7.5 in 2010, and standardized SAH incidences increased from 4.1 per 100,000 person-years in 2002 to 5.6 in 2010 (**Table 1**). The crude SAH incidence between 2008 and 2010 was significantly greater than the

Table 1. Incidence of SAH and 1-Year Mortality Rates in the 2002–2010 Period

Calendar Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
SAH episodes	368	356	396	413	389	374	440	506	517
Crude SAH Incidence	5.5 (4.9–6.1)	5.3 (4.8–5.9)	5.9 (5.3–6.5)	6.2 (5.6–6.8)	5.7 (5.1–6.3)	5.4 (4.9–6.0)	6.4 (5.8–7.0)	7.4 (6.7–8.0)	7.5 (6.9–8.2)
Standardized SAH incidence	4.1 (3.6–4.6)	3.8 (3.4–4.3)	4.3 (3.8–4.8)	4.5 (4.1–5.1)	4.1 (3.6–4.6)	4.0 (3.5–4.5)	4.7 (4.2–5.3)	5.4 (4.8–6.0)	5.6 (5.0–6.2)
One-year mortality	148	81	99	81	92	102	101	102	110
Crude mortality rate	43 (36–50)	23 (18–28)	27 (22–33)	20 (16–24)	24 (19–29)	27 (22–33)	23 (19–28)	20 (16–24)	19 (16–24)
Standardized mortality rate	38 (31–47)	22 (17–29)	25 (19–31)	18 (14–24)	23 (18–29)	27 (21–34)	23 (18–29)	20 (15–25)	19 (15–24)

Values are 95% confidence intervals in parentheses.
Incidence per 100,000 person-years; rate as 100 persons.
Standardization: World Health Organization World Standard Population 2000–2025.
SAH, subarachnoid hemorrhage.