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Bed-to-nurse ratios, provision of basic nursing care, and in-hospital and 30-day mortality among acute stroke patients admitted to an intensive care unit: Cross-sectional analysis of survey and administrative data

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ABSTRACT

Background: The literature reports inconsistent evidence of the effects of nurse staffing on mortality despite continuing examination of this association.
Objective: To examine differences in provision of basic nursing care and in-hospital and 30-day mortality by nurse staffing of ICUs and general wards among acute stroke patients admitted to ICUs during hospitalization.
Design: A cross-sectional design that included survey and administrative data.
Settings and participants: The study included 6957 patients with hemorrhagic and ischemic stroke who were admitted to ICUs of 185 Korean hospitals.
Methods: Nurse staffing of ICUs and general wards was graded based on the bed-to-nurse ratios of each hospital. Provision of basic care was measured by whether five activities, such as bathing and feeding assistance, were fully provided by ICU nursing staff without delegation to patient families. Hospitals were categorized into low, middle, and high mortality groups for in-hospital and 30-day mortality based on *z*-scores that indicated standardized difference between observed and expected mortality after controlling for patient characteristics.
Results: In 83.8% of hospitals, basic care was provided fully by ICU nursing staff. The overall in-hospital and 30-day mortality rates were 21.9 and 25.4%, respectively. Hospitals with higher ICU staffing were more likely to fully provide basic care. Better ICU and general staffing tended to be associated with lower in-hospital and 30-day mortality. Compared with in-hospital mortality, 30-day mortality had a more distinct increase as nurse staffing became worse.
Conclusion: The findings provide evidence that nurse staffing may impact provision of basic care and patient mortality and suggest the need for policies for providing adequate nurse staffing.

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What is already known about the topic?

- Acute stroke patients have high risk for physiological changes and thus, physiological assessment and interventions provided by nurses are essential to decrease patient mortality and disability.

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- The literature reports inconsistent evidence of the effects of nurse staffing on hospital mortality despite continuing examination of this association.

What this paper adds

- Hospitals with higher ICU staffing were more likely to fully provide basic nursing care.
- Better ICU and general ward staffing tended to be associated with lower in-hospital and 30-day mortality.
- Compared with in-hospital mortality, 30-day mortality had a more distinct increase as nurse staffing became worse.

Stroke is the second leading cause of death in the world, accounted for 9.7% of all deaths in 2004, and is estimated to increase to 12.1% of deaths worldwide by 2030 (World Health Organization, 2008). In most developed countries, stroke is the third commonest cause of death (Sarti et al., 2000) and in Korea, is the second leading cause of deaths, accounting for 12.3% of total deaths in 2006 (Korea National Statistical Office, 2007). Stroke is also 1 of 10 leading diseases in the global disease burden that increases years of life lost due to mortality and years of life lived with disability (Lopez et al., 2006). The burden of stroke is expected to rise, especially in low-income and middle-income countries (Strong et al., 2007).

The high mortality and morbidity of stroke indicates that nationally and internationally nurses encounter stroke patients quite frequently and have been taking care of them across the spectrum of stroke care from prevention to rehabilitation. In particular, acute stroke patients have high risk for physiological changes that can result in adverse patient outcomes. Therefore, nurse-led physiological assessment (e.g., blood pressure, oxygen saturation, blood glucose, and body temperature) and subsequent interventions are essential to decrease patient mortality, neurological impairment, and disability (Jones et al., 2007). The literature also reports that 'skilled nursing care' is one of the characterizing features of stroke units, which are known to be more effective in reducing post-stroke morbidity and mortality than conventional wards (Langhorne and Pollock, 2002; Burton et al., 2009). Given that stroke patients require extensive and highly skilled nursing care, the outcomes of stroke patients may be more sensitive to nursing care than those of other clinical populations or overall patient groups.

To provide stroke patients with high quality nursing care and prevent avoidable death and disability, a safe and adequate work environment for nurses should be maintained in hospitals and care units. One aspect of the nursing work environment, nurse staffing (e.g., patient-to-nurse ratios and bed-to-nurse ratios), has been examined as one of the critical factors that could influence nursing care quality and patient outcomes. Despite accumulating empirical research, however, the literature reports inconsistent evidence of the association between nurse staffing and patient outcomes (Clarke, 2007). Examining stroke patients, whose outcomes are assumed to be particularly sensitive to nursing care, may elucidate the linkage between nurse staffing and patient outcomes.

1. Background

The quality of stroke care has been examined by using patient outcomes including pathophysiological parameters, death, impairment, and activity limitation (Duncan et al., 2000). Among those outcomes, mortality is the most frequently used outcome and can be further specified into in-hospital death, 30-day and 3-month mortality, etc. The Agency for Healthcare Research and Quality (AHRQ) proposed 'acute stroke mortality rate' as one of 32 inpatient quality indicators that measure hospital quality of care using hospital administrative data (AHRQ, 2007). The acute stroke mortality rate was defined as the number of deaths in the hospital out of all discharges of age 18 years and older, and with the principal diagnosis code for stroke (AHRQ, 2008). In-hospital mortality, however, can lead to information bias because in-hospital deaths are influenced by the lengths of stay of hospitals, and also many stroke deaths occur after the initial acute hospitalization (AHRQ, 2007). Therefore, data linkage to death records to track deaths after discharge is recommended, and 30-day mortality, defined as deaths within 30 days of hospital admission, can be a complementary measure to in-hospital mortality. The Organisation for Economic Co-operation and Development (OECD) also suggested 'in-hospital mortality rate within 30 days of hospital admission for stroke' in the Health Care Quality Indicators Project (Armesto et al., 2007). This indicator, proposed as a proxy for true 30-day fatality without requiring tracking patients after discharge should be lower, however, than true 30-day mortality (Mattke et al., 2006).

Among factors influencing patient outcomes, nurse staffing has been an interest of nurses and nursing researchers. However, the literature reports inconsistently on the effect of nurse staffing on patient outcomes across studies (Clarke, 2007). Kane et al. (2007) concluded from their systematic review and meta-analysis that increased RN staffing was associated with lower hospital related mortality in intensive care units (ICUs). Two systematic reviews reported the literature offered minimal support for the staffing-outcome association, and the estimates of nurse staffing effects were unreliable (Lang et al., 2004; Lankshear et al., 2005). A systematic review of ICU studies reported a weak relationship between nursing resources and mortality (West et al., 2009). Other reviews on ICU studies also reported no association of nurse staffing and hospital mortality and concluded that hospital mortality might not be sensitive enough to detect the consequences of low nurse staffing in ICUs (Carmel and Rowan, 2001; Numata et al., 2006). However, most ICU studies selected in these systematic reviews evaluated only in-hospital mortality, excluding mortality after discharge (e.g., 30-day mortality). The inconsistent evidence and lack of consideration of post-discharge mortality suggest that ongoing research is needed to investigate the effect of nurse staffing on 30-day mortality as well as in-hospital mortality.

Staffing-outcomes research faces common methodological challenges, including staffing measurement, risk adjustment, and statistical modeling (Mark, 2006; Clarke and Donaldson, 2008). In measuring nurse staffing, one

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