The Effect of Being Found with Stroke Symptoms on Predictors of Hospital Arrival

Mellanie V. Springer, MD, MSc, and Daniel L. Labovitz, MD, MS

Background: Studies examining predictors of delay in hospital arrival after stroke symptom onset have not accounted for patients who are found with their symptoms and cannot seek help independently. Our objective is to show that inclusion of patients who are "found down" in studies of prehospital delay biases the estimated association of sociodemographic and clinical variables with time of hospital arrival. *Methods:* We performed a retrospective analysis of sociodemographic and clinical characteristics of patients with acute ischemic stroke presenting to a tertiary care hospital in the Bronx, New York. *Results:* Compared with all other patients with acute ischemic stroke (N = 1784), patients who were found down (N = 120) were more likely to be older (75 ± 13 years versus 68 ± 14 years, $P < .0001$), female (68% versus 53%, $P = .003$), Caucasian race ($P < .001$), have higher socioeconomic status ($P = .001$), more severe stroke deficits ($P < .0001$), use emergency medical services ($P < .001$), and arrive to the hospital more than 3 hours after symptom onset ($P < .001$). Inclusion of patients who were found down in a model predicting delay in hospital arrival decreased the strength of the association between the predictors and the outcome. *Conclusions:* Being found with stroke symptoms confounds the association of sociodemographic and clinical variables with time of hospital arrival. Studies of predictors of prehospital delay should therefore exclude patients who are found down. **Key Words:** Stroke—delay—emergency medical services—time.

Introduction

Treatments for acute ischemic stroke are time-sensitive. Patients must arrive to the emergency department (ED) within 3 hours to be eligible to receive tissue plasminogen activator (tPA), and delayed arrival is the most common reason patients are not eligible for tPA.[1-6] Rapid hospital arrival is also important for mechanical thrombectomy (clot extraction) for acute ischemic stroke as the amount of unsalvageable brain tissue increases with time. Previous studies have identified predictors of delay in hospital arrival, including failure to use emergency medical services (EMS), African-American race, age (young or old), gender (female or male), and less severe stroke.[2-6] Research has been ongoing to identify patients at risk of arriving late. Identification of the clinical and demographic predictors of prehospital delay is crucial so that education about the importance of early arrival can be appropriately targeted. Many studies of prehospital delay have excluded or adjusted for patients who have no control over their time of hospital arrival (e.g., patients who awake with their symptoms or patients transferred from other hospitals). However, studies have not accounted for patients who are "found down." That is, patients who are alone at the time of symptom onset and are unable to seek help on their own due to their neurologic deficits. Hospital arrival of these patients depends on the time

From the Department of Neurology, Montefiore Medical Center, Albert Einstein College of Medicine, Bronx, New York.

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Address correspondence to Mellanie V. Springer, MD, MSc, Department of Neurology, Montefiore Medical Center, Albert Einstein College of Medicine, 3316 Rochambeau Ave, Bronx, NY 10467. E-mail: mspringe@montefiore.org.

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that someone else finds them with their symptoms. If being found down is associated with clinical and demographic predictors of hospital arrival, then including patients who are found down would bias the estimated association of these variables with time of hospital arrival.

The objective of this study is to evaluate whether being found down confounds the relationship of clinical and demographic variables with time of ED arrival after stroke symptom onset.

Methods

Population

We conducted a retrospective analysis of patients with acute ischemic stroke hospitalized at an urban academic hospital in Bronx, New York, from January 1, 2012, to December 31, 2015. Patients over 17 years of age who were hospitalized for ischemic stroke were ascertained by discharge ICD 9/ICD 10 code, which was then confirmed by chart review. Demographic and clinical information was obtained through hospital records. Patients residing in a health-care facility, transferred from an outside hospital, awoke with their symptoms, or who had a stroke while hospitalized were excluded. Patients who identified as a race or ethnicity other than Hispanic, Caucasian, or African-American were excluded from the sample as they comprise only a small proportion of the total patient population. The project was deemed exempt from the need to obtain patient consent.

Definition of Exposure of Interest

Patients who were found down with stroke symptoms were defined as patients who had unwitnessed stroke onset and could not seek help on their own. Reasons for being unable to seek help included falling at stroke onset with inability to get up from the floor due to weakness or pre-existing disability, aphasia, or neglect resulting in the inability to communicate or recognize the need for help, or severe baseline cognitive deficit impeding the ability to seek help independently. These patients were identified by review of the prehospital events as described in the patient's medical record.

Variables of Interest

Sociodemographic and clinical variables were included if they have been associated with time of hospital arrival in prior studies. The sociodemographic variables were age in years, self-reported race or ethnicity (African-American, Caucasian, or Hispanic), gender, and socioeconomic status (SES). To facilitate comparison with previous studies, Hispanic white and Hispanic black were categorized as Hispanic. SES was a variable that used census block information to determine (1) log of median household income; (2) log of median value of housing units; (3) the percentage of households receiving interest, dividend, or net rental income; (4) the percentage of adults 25 years of age and older who completed high school; (5) the percentage of adults who completed college; and (6) the percentage of employed individuals in executive, managerial, or professional positions. A z-score for each of the 6 variables was created using the New York State average as the comparison group. The 6 z-scores were combined to generate a single z-score representing the patient's SES status.[7] The z-scores for the population were divided into quartiles, with increasing quartiles representing higher SES.

Clinical variables included use of EMS for hospital transport and stroke severity as measured by the National Institutes of Health Stroke Scale (NIHSS). The NIHSS is scored from 0 to 42, with higher numbers indicating more severe stroke signs. It is documented in the electronic medical record by the neurology resident who examines the patient upon hospital arrival. If the NIHSS was not documented, it was calculated post hoc by chart review of the patient's documented neurologic examination upon hospital arrival.[8] Time between stroke symptom onset and hospital arrival was dichotomized into less than 3 hours versus greater than or equal to 3 hours. A cutoff of 3 hours was chosen because the Food and Drug Administration–approved time window for tPA administration is within 3 hours of stroke symptom onset. The time of symptom onset was originally obtained by the neurology physician who first interviewed the patient and was documented in the electronic medical record. The time the patient was last known to be well was used if the time of onset was not known. Hospital arrival time was the time at which the patient is triaged in the emergency department.

Statistical Analysis

Data analysis was performed using STATA software, version 14 (StataCorp LLC, College Station, Texas). Missing data were excluded from analyses.

Bivariate associations between being found down and each independent variable were assessed. The relationship between a continuous independent variable and being found down was assessed with a *t* test when the assumptions of normality and equal variances were met. If the continuous independent variable did not appear normally distributed, the Mann–Whitney *U* test was used. The relationship between categorical independent variables and being found down was assessed with the chi-square test. Statistical significance was set at a *P* value of less than .05.

The independent variables were simultaneously entered into a logistic regression model predicting delayed hospital arrival, which excluded patients who were found down (model 1). A separate logistic regression model included all patients, regardless of whether they were found down (model 2). The magnitude of the association between each independent variable and delayed hospital arrival was compared between the models.