# The Influence of Neighborhood Unemployment on Mortality after Stroke

Michael Unrath, MSc,* Jürgen Wellmann, PhD,* Claudia Diederichs, PhD,* Lisa Binse, MSc,† Marianne Kalic, PhD,* Peter Ulrich Heuschmann, MD,‡§‖ and Klaus Berger, MD*

*Background:* Few studies have investigated the impact of neighborhood characteristics on mortality after stroke. Aim of our study was to analyze the influence of district unemployment as indicator of neighborhood socioeconomic status (SES-NH) on poststroke mortality, and to compare these results with the mortality in the underlying general population. *Methods:* Our analyses involve 2 prospective cohort studies from the city of Dortmund, Germany. In the Dortmund Stroke Register (DOST), consecutive stroke patients (N = 1883) were recruited from acute care hospitals. In the Dortmund Health Study (DHS), a random general population sample was drawn (n = 2291; response rate 66.9%). Vital status was ascertained in the city's registration office and information on district unemployment was obtained from the city's statistical office. We performed multilevel survival analyses to examine the association between district unemployment and mortality. *Results:* The association between neighborhood unemployment and mortality was weak and not statistically significant in the stroke cohort. Only stroke patients exposed to the highest district unemployment (fourth quartile) had slightly higher mortality risks. In the general population sample, higher district unemployment was significantly associated with higher mortality following a social gradient. After adjustment for education, health-related behavior and morbidity was made the strength of this association decreased. *Conclusions:* The impact of SES-NH on mortality was different for stroke patients and the general population. Differences in the association between SES-NH and mortality may be partly explained by disease-related characteristics of the stroke cohort such as homogeneous lifestyles, similar morbidity profiles, medical factors, and old age. **Key Words:** Epidemiology of stroke—ischemic stroke—hemorrhagic stroke—TIA—mortality—neighborhood deprivation—unemployment—socioeconomic status.


From the *Institute of Epidemiology and Social Medicine, University of Muenster, Muenster, Germany; †German Stroke Foundation, Gueterssloh, Germany; ‡Institute of Clinical Epidemiology and Biometry, University of Wuerzburg, Wuerzburg, Germany; §Comprehensive Heart Failure Center, University of Wuerzburg, Wuerzburg, Germany; and ‖Clinical Trial Center Wuerzburg, University Hospital Wuerzburg, Wuerzburg, Germany.

Received October 29, 2013; revision received December 17, 2013; accepted December 20, 2013.

Data collection in the Dortmund Health Study was supported by the German Migraine and Headache Society and by unrestricted grants of equal share from Almirall, Astra Zeneca, Berlin Chemie, Boehringer, Boots Health Care, Glaxo-Smith-Kline, Janssen Cilag, McNeil Pharma, MSD Sharp, and Dohme and Pfizer to the University of Muenster. The Dortmund Stroke Register was supported by the Dortmund Stroke Action Group (Schlaganfall-Hilfe Dortmund e.V.). The project received financial support from the Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung) within the framework of the research alliance "Health in Old Age" (01ET0723).

Address correspondence to Michael Unrath, MSc, Institute of Epidemiology and Social Medicine, University of Muenster, Albert-Schweitzer-Campus 1, Gebäude D3, 48149 Münster, Germany. E-mail: unrathm@uni-muenster.de.

1052-3057/$ - see front matter

http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2013.12.038

## Introduction

Stroke is a frequent disease with far-reaching consequences for the individual functioning as well as for the health system.[1] In Germany, with about 260,000 first plus recurrent cases every year, stroke is the third-leading cause of death and the leading cause of disablement in adults.[2] Acute stroke care has considerably changed in several important aspects of the care process during the past decade. These changes relate to the level of hospital infrastructure (eg, by implementation of stroke units) and to available treatment options with the introduction of thrombolysis and thrombectomy. However, despite all these changes, stroke remains a disease with a high case fatality. In the South London Stroke Register, for example, the case fatality 1 month after the stroke varied between 23% and 26% for patients of Caucasian origin. After 3 months, it had increased to 33%.[3-5] Sociodemographic and socioeconomic characteristics that may influence poststroke mortality and/or functional outcome have been frequently examined on the level of the individual patient,[3-9] but research on the impact of neighborhood characteristics has been scarce. From other diseases and studies in the general population, it is known that socioeconomic deprivation of the neighborhood is associated with mortality. This association seems to be independent of individual socioeconomic characteristics and health-related behaviors.[10-14] For stroke, only a few results are published, most of which refer to cause-specific mortality from stroke instead of mortality after stroke.[15-18]

Neighborhood characteristics may influence the occurrence of stroke as well as the occurrence of complications, including stroke recurrence or death. Results from the Dijon stroke registry [19] and a recent US American study by Brown et al.[20] suggest that the influence of neighborhood characteristics on poststroke mortality may emerge in the long run, after discharge from acute stroke treatment. This may be due to a high degree of standardization in modern stroke treatment, which creates similar conditions for all patients initially. On their return home patients are faced with quite diverse living environments, which may be more or less beneficial for health. Few studies have shown an inverse association between neighborhood socioeconomic status and poststroke mortality. In a Canadian study, a higher socioeconomic status in terms of the median neighborhood income decreased the risk of stroke patients' death after 1 year.[21] Another study found an inverse association between air pollution and survival after stroke in London, England.[22] Finally, the study by Brown et al. with stroke cases from four US American communities (N = 806) reported a higher mortality risk 1 year after a stroke for those individuals living in the neighborhoods with the lowest socioeconomic status as measured by a 6-item index.[20] It is not known if these results can be transferred to stroke patients in other regions or countries.

The aim of our analyses was to examine the impact of neighborhood socioeconomic status (SES-NH) on long-term mortality after stroke in a large German city and to compare these results with the mortality of the underlying source population from the same city.

## Materials and Methods

We used 2 cohort studies that were independently conducted in the city of Dortmund, which is part of the urban Ruhr area in the West of Germany. The city had 585,000 inhabitants in 2005 and is divided into 62 statistical districts, which were used to define neighborhoods. Both studies included participants' informed consent and approval by the local ethics committee of the medical faculty at the University of Muenster.

### *Dortmund Stroke Register*

Between January 2004 and June 2006, patients 18 years and older admitted for stroke or transient ischemic attack (TIA) were recruited from all hospitals involved in the acute treatment of stroke patients in Dortmund (n = 8).[23] The aim of the Dortmund Stroke Register (DOST) was to evaluate the course of the disease and its consequences for everyday life over a course of 12 months. All hospitals participated in the "Stroke Register Northwest Germany,"[24] a register for quality assurance in stroke care by providing a benchmark for participating hospitals and a database for health services research. Patients were recruited by trained study nurses. Patients who died during hospitalization or did not provide informed consent or sufficient address information were not enrolled. Patient participation in DOST was 80%, yielding 1883 stroke patients. Basic sociodemographic and clinical information were assessed by the study nurses by means of a standardized data form.

### *Dortmund Health Study*

The aim of the Dortmund Health Study (DHS) was to determine the frequency of headache types and other chronic conditions in an urban German population and to analyze consequences of these conditions for the daily life of affected people.[25] For this purpose, a sex- and age-stratified random sample (N = 3820) was drawn from Dortmund's population register in fall 2003. Of this sample, 395 individuals were not eligible because they had died, had moved away, or did not have sufficient German language skills. A total of 2291 of the invited 3425 individuals participated in the study (response proportion 66.9%); 1312 took part in an interview and examination in the study center, and 979 responded to a mailed questionnaire with a reduced set of questions from the interview. For both groups, basic sociodemographic information was collected as well as information on education, health-related behavior, existing diseases, and subjective