

# Towards an Understanding of Racial Differences in Post-stroke Disability

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**Abstract** Due to the aging of the baby boomer generation, the number of stroke survivors is expected to increase from seven million to over ten million in 2030. Stroke survivorship will be particularly important for African-Americans who have a higher incidence of strokes compared to non-Hispanics whites and greater post-stroke disability. Current evidence suggests that the most prominent racial differences in post-stroke disability emerge in the post-stroke period. Further work, with a focus on modifiable factors, is needed to understand which factors in the post-stroke period lead to racial differences in post-stroke disability.

**Keywords** Stroke survivors · Disability · Race

## Introduction

Each year, about 800,000 Americans have a stroke, of which 75 % occur among those 65 and older [1, 2]. Currently, there are seven million US stroke survivors, and this number is projected to increase to ten million by 2030 given the aging of the population [3, 4]. Because most people survive their stroke, disability is the greatest challenge facing survivors and their families: About a third of stroke survivors have a severe/moderate disability and another third have a mild disability

[5, 6]. Not surprisingly, stroke is a leading cause of disability in the USA [2].

Non-Hispanic Black/African-American (AA) adults have a higher stroke incidence than non-Hispanic white (NHW) adults (AA-NHW age sex-adjusted IRR for all strokes was 1.51 (95 % CI, 1.26–1.81)), and racial disparities in stroke incidence have worsened over time [7••, 8•]. Racial difference in stroke incidence is most pronounced among the working age population [9]. Given that case fatality does not markedly differ by race [10], AAs thus have the highest stroke prevalence of any US racial/ethnic group and the prevalence is expected to increase by over 25 % by 2030 [3, 11]. The purpose of this paper is to provide an update on existing knowledge regarding the existence of racial differences in post-stroke disability. We propose a conceptual framework of racial differences in post-stroke disability spanning the pre-stroke to the community living period and discuss relevant factors that may contribute to racial differences in disability in each period.

## Post-stroke Disability Among African-Americans

Studies of post-stroke disability have generally found a trend towards more severe disability among AAs, but results have varied, depending on the specific population and outcomes studied. One recent study of community-dwelling stroke survivors with a caregiver found that AA stroke survivors had more severe disability (greater activity limitations as measured by the Barthel Index and portions of the Stroke Impact Scale) than NHWs 1 year after their stroke [12]. Another study of patients who underwent inpatient rehabilitation showed that AAs had lower functional independence measure scores (more limitations in activities) at admission and at discharge from inpatient rehabilitation than NHWs [13]. Conversely,

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two population-based studies found no differences in disability by race. The Greater Cincinnati/Northern Kentucky Stroke Study found no racial differences in post-stroke disability measured by the modified Rankin Scale at 3 months and 4 years post-stroke [14]. The Northern Manhattan stroke study also found no racial difference in post-stroke disability measured by the Barthel Index at 6 months and among long-term stroke survivors [15]. There are various limitations to these studies including lack of national representativeness, use of dichotomous outcome measures limiting the power to detect small difference [15], reliance on selected populations [12, 13], and considerable loss to follow-up [12, 14].

A recent study using nationally representative cross-sectional data from the National Health and Aging Trends Study (NHATS) found substantially more severe disability in elderly AA adults than in NHW adults with self-reported stroke [16]. NHATS is an annual study of over 8000 Medicare beneficiaries ages 65 and older who undergo face-to-face interviews in their place of residence. NHATS oversamples AAs and people in older age groups. Disability was defined as receiving assistance with a given task among each of the seven self-care and mobility activities (eating, bathing/showering, toileting, dressing, getting out of bed, getting around within one's home, and leaving one's home) and five household activities (doing own laundry, grocery shopping, making hot meals, handling bills/banking, and administering medications). AA stroke survivors were found to have, on average, 25 % more limitations in self-care, mobility, and household activities than NHWs. These racial differences persisted after accounting for age, sex, comorbidities, education, and marital status.

### The Emergence of Racial Differences in Post-stroke Disability

Understanding when racial differences in post-stroke disability emerge and what is driving them is essential to eliminating racial disparities in stroke survivors. Racial differences in post-stroke disability may reflect pre-stroke racial differences in disability or may arise in the acute stroke, early recovery, or community living periods. Different factors are likely to drive disability during each of these periods (Fig. 1).

#### Pre-stroke

Medical comorbidities and cognitive function may play a role in post-stroke disability as pre-stroke disability is a well-known predictor of post-stroke disability [17]. A study of older Americans participating in the Health and Retirement Study (HRS) found that pre-stroke racial differences in instrumental activities of daily living (IADL) narrowed at the time of the stroke [18]. In contrast, a recent analysis using the Panel

Study of Income Dynamics (PSID), a nationally representative US panel survey of families and their descendants, found no pre-stroke racial differences in activities of daily living (ADL) limitations [19]. Racial differences arose in the incident stroke wave (between 0 and 2 years from incident stroke) when AAs had more ADL limitations than NHWs (2.2 vs. 1.5,  $p=0.048$ ). This racial difference persisted after accounting for age, sex, and comorbidities. This study also showed small pre-stroke racial differences in IADL limitations that widened at the time of the stroke and persisted. Thus, differences in pre-stroke disability may be less important for racial differences in post-stroke disability than previously suggested.

#### Acute Stroke

The acute period has been studied extensively and has not offered obvious explanations for racial differences in post-stroke disability. Biological differences in stroke do not appear to account for racial differences in post-stroke disability. AA stroke patients have fewer cardioembolic, a severe type of stroke, than NHWs [20, 21]. Stroke severity is the most important predictor of post-stroke disability [22] and data from population-based studies [23–25], a nationwide registry [26] and the VA [27] all find that there is no difference in stroke severity by race. Similarly, AA stroke patients receive comparable quality of acute stroke care compared to NHWs. To the extent that any differences in quality of care do exist, they are too small to account for the magnitude of described racial differences in disability [28].

#### Post-stroke: Early Recovery Period

The post-stroke period is comprised of two distinct time intervals. In the first 6–12 months after a stroke, we term this as the early recovery period given that stroke survivors will improve during this time. After this period, stroke survivors' recovery has often plateaued and they are re-integrated into their community. We term this period as the community living period. Differences in the patterns of longitudinal post-stroke disability likely differ by race, but are poorly characterized. AAs have greater overall mortality from strokes than NHWs mostly due to the increased stroke incidence among AAs [7•]. However, AAs have equal or lower case fatality than NHWs largely due to their younger age at the time of stroke [10]. Thus, there are two primary, non-exclusive, hypotheses related to the development of racial differences in post-stroke disability, as depicted in Fig. 2. First, compared to NHWs (black line), AA stroke survivors may have less improvement in the early recovery period (long-dashed dark grey line), leading to lower community living baseline function. Second, there may be no racial differences in post-stroke disability after the early recovery period, but then Black stroke survivors may decline more rapidly (short-dashed light grey line) than Whites during the

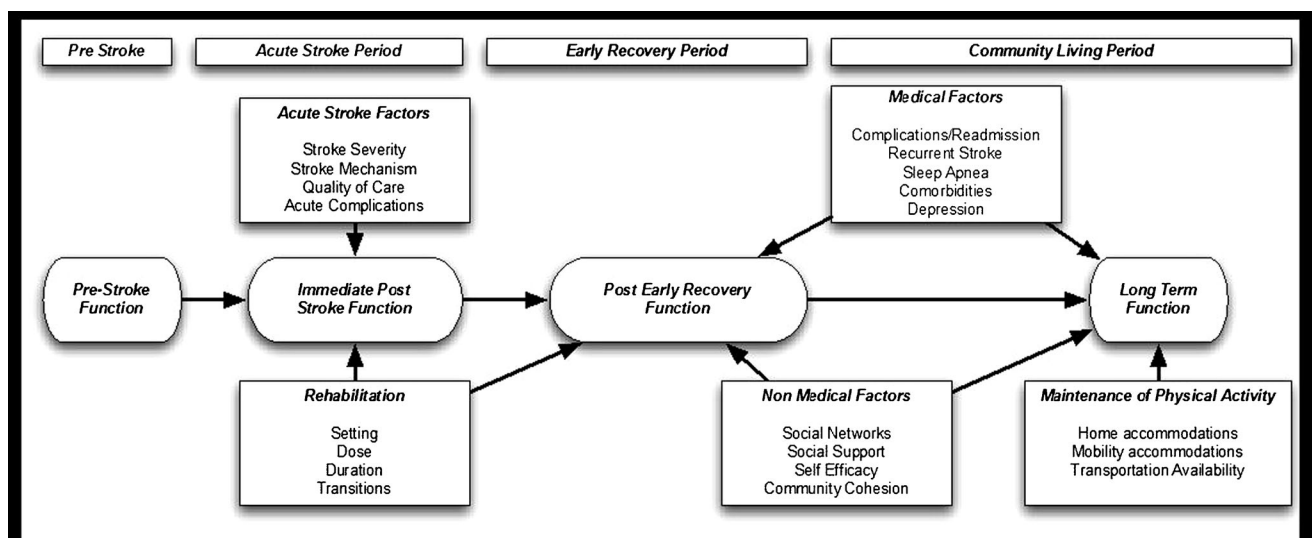


Fig. 1 Conceptual model of the stroke survivor

community living period. Alternatively, given their younger age of stroke onset [9] and the equal or lower case fatality [10], it may be that AAs live longer after their stroke and although the slope of the decline in function is the same, the duration is longer for AAs, leading to the observed differences in disability in cross-sectional studies. Given that different factors would likely underlie these temporal patterns, a better understanding of racial differences in longitudinal outcomes after stroke may inform both the causes of racial differences and offer guidance for how to eliminate these differences.

The early recovery period is important for understanding long-term outcomes after stroke as one unique aspect of disability caused by stroke is the tremendous potential for

recovery. Unlike other neurologic diseases, such as dementia, which are characterized by a progressive decline in function, stroke survivors are often at their maximal disability during their hospital stay and then improve during the following 6–12 months [29]. Thus, racial differences in the early recovery period including post-acute care, medical and non-medical (e.g., social, behavioral, and personality) factors may be important modifiable risk factors associated with race differences in post-stroke disability.

Post-acute care, in the form of rehabilitation, reduces post-stroke disability [30–32]. Rehabilitation occurs in a range of settings, from home health agency therapy in private residences, to outpatient rehabilitation, to institutions which

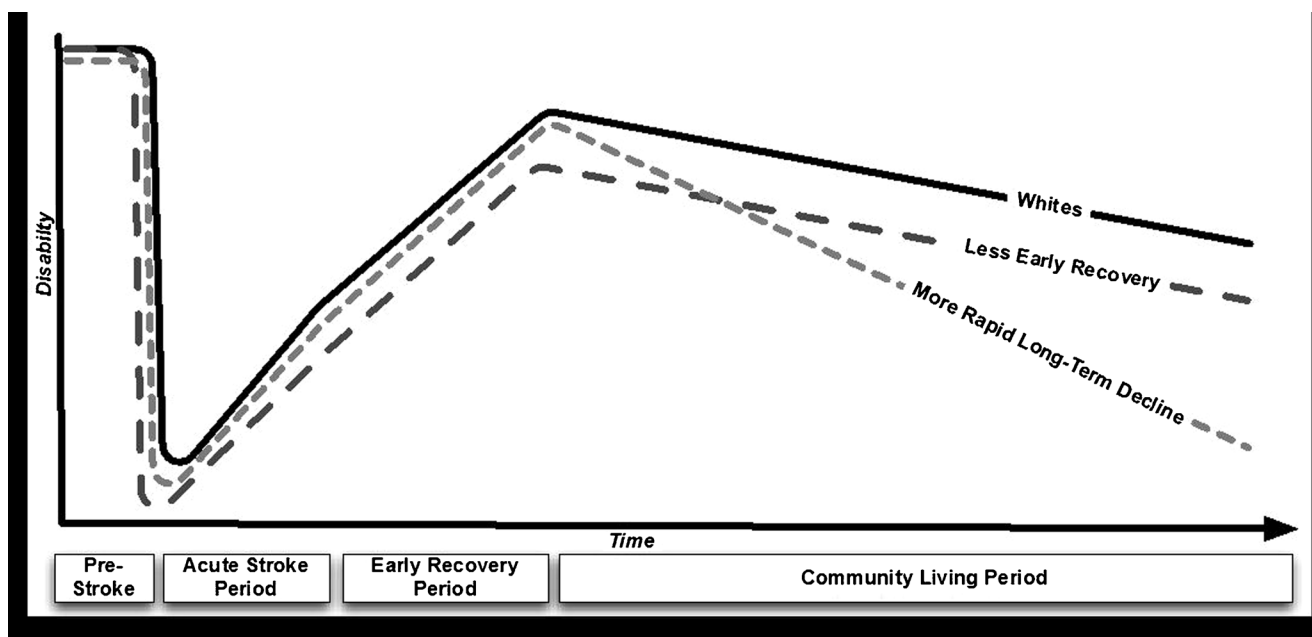


Fig. 2 Potential explanations for when racial differences in long-term outcomes after stroke arise

include both inpatient rehabilitation facilities (IRFs) and skilled nursing facilities (SNFs). Among stroke survivors with Medicare, about 20 % are discharged to an IRF, 25 % are discharged to a SNF, and 12 % receive home health [33]. The intensity of rehabilitation varies from at least 3 h of rehabilitation per day in an IRF to variable amounts of less frequent rehabilitation in a SNF (less than 1 h a day) to rehabilitation 1–2 times per week via home health or outpatient physical therapy [34, 35]. Higher intensity rehabilitation leads to better outcomes in stroke patients. Randomized controlled trials have shown that more intense rehabilitation settings [36], higher intensity rehabilitation in comparable settings [37], and the use of outpatient and home therapy [38] reduce disability compared to less intense rehabilitation. High-quality observational data suggests that admission of stroke survivors to an IRF rather than a SNF leads to decreased disability, institutionalization, and mortality [39–42]. Whether rehabilitation intensity varies by race nationally is unknown. Such variation may well exist as regional data suggests that AA stroke survivors who are discharged to institutional rehabilitation are more likely to be discharged to less intense rehabilitation settings (SNF vs. IRF) compared to NHWs [43]. Given the efficacy of higher intensity rehabilitation and that disabled acute stroke survivors are overwhelmingly discharged to institutional rehabilitation [39, 44], determining if racial differences in rehabilitation intensity and setting exist nationally and the extent to which they lead to racial differences in post-stroke disability is needed. Importantly, access to post-acute care is readily modifiable by both clinical policy (guidelines or practice improvement) and public policy (optimizing insurance coverage for rehabilitation and disability accommodations) [45].

### Post-stroke: Community Living

Finally, racial differences in post-stroke disability may be associated with community living factors. Disability accommodations refer to the changes a stroke survivor makes to their life to overcome decreased functional capacity and to continue to perform activities. These range from performing activities more slowly to using assistive devices, such as canes/walkers, to changes in the home environment (grab bars, hand rails, and ramps), and to requiring personal assistance [46, 47]. These accommodations enhance the ability of stroke survivors to perform activities and may reduce the need for help with activities [48, 49]. However, in a nationally representative sample of stroke survivors, there were no racial differences in disability accommodations among elderly stroke survivors, suggesting that these do not play a role in racial differences in post-stroke disability [50].

Additional early recovery and community living factors may also contribute to racial differences. Limited data suggest that medical factors in the post-stroke period such as recurrent stroke [22, 51, 52] and hospital readmission for post-stroke complications [53] may be associated with racial differences in post-stroke disability, but these have not been studied directly. In addition, social/psychological factors such as social networks [54, 55], self-efficacy [56], and resilience [56] may have important roles in post-stroke disability, but have been inadequately studied. Similarly, neighborhood cohesion is associated with reduced post-stroke mortality particularly among white stroke survivors, but little is known about racial differences [57]. In addition, little is known about the environment where stroke survivors reside including food store availability, safety, toxin exposure, and their possible association to racial differences in post-stroke disability.

### Conclusion

Further work is needed to explore factors contributing to racial difference in post-stroke disability, with particular attention to the early recovery period. Longitudinal studies are needed to understand that both factors lead to post-stroke disability, and when during the post-stroke period, they may contribute. Cohort studies with measures of pre-stroke disability and repeated measures of disability over time such as REasons for Geographic And Racial Differences in Stroke (REGARDS), Cardiovascular Health Study (CHS), and NHATS are all well-positioned to address many of these questions. In addition to race differences, recent studies have identified increased post-stroke disability among Hispanics who also have a higher stroke incidence compared to NHWs for which further study is needed [15, 58, 59]. In conclusion, evaluation of modifiable factors that are associated with racial differences in post-stroke disability including medical, rehabilitation, social/psychological, environmental, and improved study designs is needed to address this important area.

### Compliance with Ethics Guidelines

**Conflict of Interest** LE Skolarus and JR Burke both declare no conflicts of interest.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.



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