Identifying the Cause of Lower Physical Recovery Rates in Female and African American Stroke Patients

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by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Stroke Survivors frequently face lifelong disabilities that can affect cognitive and physical function. Long term physical symptoms can include partial paralysis, muscle weaknesses, muscle spasms, and stiffness. As a result of these ailments, survivors may lose their ability to work and live independently, and may even require assisted living facilities. Long term disability disproportionately affects African American and female stroke patients. Prior research has studied demographic differences in survivors and found that, “women were functionally more disabled” (Kelly-Hayes, 2003), and “Physical impairment was significantly more severe in black than in white patients” (Horner, 1991). While this research dates back decades, there continues to be a lack of conclusive results identifying specific causes of the lower rehabilitation success rates in female and African-American patients. The multitude of factors that affect stroke recovery make it extremely difficult to compile a comprehensive list of causes. A 2022 study attempted to do so and found inequalities in the initial treatment and severity of strokes, but did not account for disparities in the subsequent rehabilitation process (Ikeme et al., 2022). In my attempt to find the causes of lower physical recovery rates for female and African American stroke patients, I utilize the Social Construction of Technology (SCOT) framework. This framework adopts the view that “technology, as well as science, can be understood as a social construct” (Bijker & Pinch, 1987), which has been useful in the study of previous medical devices and treatments. This framework is especially helpful in this scenario given the history of discrimination in the medical field that has been exposed in many treatments, which I will discuss at length.

To approach this research problem, I developed two leading hypotheses that prior research has led me to believe are likely causes of disparities in recovery for

female and African American patients. The first possibility is that these demographics were excluded from trials during the development of rehabilitation programs, leading to the programs having less optimal results for them. To compare stroke recovery with known cases of medical trial exclusion having harmful effects on demographics, I will look at two major case studies that have gained widespread attention: gender and ADHD medication, and race and pulse oximetry. I will also address the distrust caused by medical mistreatment of African American patients, specifically in a syphilis study. I will then look at published rehabilitation guidelines to determine the plausibility of this hypothesis. The second hypothesis is that rehabilitation facilities are less accessible in communities with larger African American populations. I consider both proximity to stroke rehabilitation centers and lack of health insurance and cost as barriers for accessibility. I evaluate these theories using document analysis and data analysis, to determine whether they are probable factors contributing to lower physical recovery rates.

Rehabilitation

The development of the modern stroke rehabilitation programs may have consisted of trials conducted with exclusively white male patients, causing the programs to be more effective for this demographic. Medical drug and device trials have a history of testing products solely on white male populations (Woods-Burnham et al., 2021). Analyzing the cases of ADHD medication and pulse oximetry will show the harmful effects of a lack of diversity during medical trials. I will also draw comparisons between these cases and stroke rehabilitation testing to find the likelihood that being excluded

from the development of rehabilitation guidelines has prevented optimization of treatments for female and African-American stroke patients.

ADHD in Females

The discovery, diagnosis, and treatment of conditions can contain biases, as seen with Attention Deficit Hyperactivity Disorder, or ADHD. The disorder was first identified in males, and even now, “the current diagnostic criteria used to evaluate ADHD have been developed on predominantly male samples” (Nussbaum, 2012). Symptoms of ADHD present differently in males and females, so females have been underdiagnosed with the male-based criteria. The drug development to treat the disorder was also focused on predominantly male populations.

Recent research surrounding Adderall and its effects on women has revealed the necessity of dosage differences dependent on gender that likely went unnoticed due to lack of representation during drug trials. Adderall is a stimulant, and is one of the most common medications taken to treat the symptoms of ADHD. It can be taken as a short acting dose or an extended release capsule for longer lasting effects. Because the different presentations of ADHD have been discovered, more women are being diagnosed and prescribed the drug for treatment. Female adderall users have reported more frequent and severe side effects than male users. Some commonly reported side effects include heart issues, dry mouth, weight loss, and hair loss (Tardner, 2022). The biological difference between sexes has been found to be a major cause of the difference in reactions to the drug, which reinforces the argument that the issue stems from the lack of female representation during drug trials. Due to the average female's lower body mass, “the amount of amphetamine a woman actually processed was

20-30% higher” (Editorial Staff, 2024), which exacerbates the negative side effects of the drug. In addition to the immediate side effects, the female reproductive system can be harmed by the drug, and can interact with the drug to worsen side effects during certain hormonal periods. Research has found links between female hormones and Adderall usage that show, “The effects of Adderall on the body in women may be heightened during estrogen-elevated periods, such as puberty, pregnancy, and menopause”(Tardner, 2022). Despite the negative and extreme side effects women experience with Adderall, it remains one of the most commonly prescribed drugs for ADHD treatment and management.

Utilizing SCOT to analyze stroke rehabilitation and Adderall as social constructs reveals a significant similarity between the development process and effects of each. Stroke trials have been shown to lack appropriate representation of women relative to the prevalence of stroke occurrences (Carcel & Reeves, 2021), a likely result of historic misogyny. Further testing for women taking Adderall has resulted in the discovery of increased negative side-effects that previous research overlooked due to exclusive trial cohorts. However, as of 2021, when the Carcel & Reeves study was conducted, the exclusion of women in stroke trials had yet to be rectified, stifling the discovery of disparities in the effectiveness of rehabilitation programs.

Pulse Oximetry for African Americans

One device that has been at the center of the movement towards identifying and correcting these disparities is the pulse oximeter. Pulse oximeters are used in a variety of medical fields to test a patient's arterial oxygen saturation noninvasively. The device

clips onto the patient's finger, which has been a cause for curiosity regarding effects of skin pigmentation, nail polish, tattoos, and more.

Many researchers attempting to discover racial disparities in oxygen measurements reported that their findings were “of no clinical significance” or that “values did not differ between the 3 skin pigment groups” (Adler et al., 1998). When similar studies came out two decades later, they rebuked these claims and found that there is a significant error in pulse oximeter readings for more pigmented skin tones. A study conducted at the University of Michigan Hospital compared arterial oxygen saturation readings in cohorts that self identified as Black or White. The findings showed that the pulse oximeter was three times more likely to miss an occurrence of occult hypoxemia, “an arterial blood gas oxygen saturation of less than 88%” (Sjoding et al., 2020), in black patients. The initial rejection of these ideas in the late 20th century are an example of the racial biases in medical practices and research.

Disparities in the use of pulse oximeters on more pigmented skin tones were disregarded for years. Using the SCOT framework, racial bias in pulse oximetry can be viewed as a product of racism in society. The false claims of Adler in 1998 promoted the continued use of an ineffective technology and prevented accurate hypoxemia diagnoses for people of color. This example shows the severity of racial bias in medicine, and supports the plausibility that similar discrimination occurred during the development of stroke rehabilitation programs.

Syphilis in African American Males

In addition to the lack of representation, African American patients have experienced mistreatment throughout medical trials. One prominent example of this took place in the mid-1900's during a syphilis study. Penicillin, a known cure for syphilis, "was deliberately withheld from study participants to allow researchers the ability to observe the physiological demise due to syphilis in Black men specifically over a 40-year period" (Woods-Burnham et al., 2021). Unethical trials like this one in Tuskegee have created a distrust of medical professionals in African American communities. Current trials attempting to study treatments for African American patients face the challenge of overcoming this hesitance.

Lower stroke recovery rates in female and African American patients share similarities with the previously mentioned discrepancies in treatment of ADHD and hypoxia. Given that both demographics have a history of being overlooked in medical studies, it is reasonable to hypothesize that the current stroke rehabilitation guidelines are not optimal for female and African American stroke survivors.

Stroke Rehabilitation Exercise Guidelines

Updated guidelines for stroke rehabilitation are frequently published with minor changes, but do not address racial or gender disparities. Despite various versions of these publications, most contain the same core idea, that intense repetition of exercises is the key to regaining motor function. The *Exercise Training Guidelines for Multiple Sclerosis, Stroke, and Parkinson's Disease: Rapid Review and Synthesis* (Kim et al., 2019) is one of the many updated versions of these guidelines. To investigate the scale

of changes made over the years, I looked through the citations on several rehabilitation guidelines. The American Heart Association/American Stroke Association (AHA/ASA) published one set of guidelines in 2016 with dozens of references to research published before 2000 (Winstein et al., 2016). Similar guidelines from AHA/ASA were published again two years later containing a comparable number of citations from the late 1900's (Powers et al., 2018). While new versions feature the mention of tailoring exercises to an individual patient, several citations reference exercise studies from over twenty years ago. Additionally, these changes in guidelines do not require new training or practices for physical therapists. If biases were present in the stroke rehabilitation exercise programs developed in the past, the changes made in updated guidelines are not adequate to overcome them.

Accessibility of Medical Care

Access to medical care is a barrier that may disproportionately prevent African American patients attempting to undergo stroke rehabilitation. As mentioned earlier, physical rehabilitation from ischemic stroke relies on repetitive motion exercises. The goal of these exercises is to regain mobility and overcome any symptoms of paralysis or muscle weakness. In order for this therapy to be most effective, it must be conducted frequently and regularly in the days and months following the stroke incident. The best method of receiving this intensity of care is through an inpatient facility, which offers specialists and around the clock professional care (Winstein et. al, 2016). For the greatest chance of a full recovery, stroke patients must have access to an inpatient rehabilitation facility after being discharged from the hospital.

To investigate the correlation between accessible care and lower stroke recovery rates for African American patients, I gathered and analyzed relevant data in 20 major cities in the United States. The cities chosen were initially selected from a list of the largest U.S. cities, ranked by population, (World Population Review, 2024). The one hundred most populous cities were then ranked by African American population density based on data from the U.S. Census Bureau, (U.S. Census Bureau quickfacts, n.d.). Having selected cities with large populations helped to ensure available data. Three cities were ruled out due to a lack of published information. The ten cities with the highest densities, and the ten with the lowest densities, were chosen for analysis.

The Commission on Accreditation of Rehabilitation Facilities, or CARF, is a nonprofit organization that reviews rehabilitation facilities and issues certifications and accreditations for quality care. The CARF website includes a feature that allows users to search accredited and certified care centers in different areas. Utilizing this feature, I documented the number of rehabilitation facilities that specialize in stroke recovery within a 10 mile radius of the 20 selected cities. This number was divided by the population listed by the World Population Review to create a standard per capita value for each city, then multiplied by 100,000 to scale the results, making them easier to read. It should be noted that this data is an estimate. The populations given by each source were slightly different, but generally varied by less than 20,000 people. Population data is difficult to collect, so this difference may be a result of the collection method or date.

Table 1

CARF Stroke Rehabilitation Facilities in Cities with Higher African American Population Densities

City	Population	African American Population Density	Facilities within 10 mi	Facilities per capita * 100,000
Washington D.C., DC	677,827	44.30%	6	0.8851816171
Memphis, TN	611,204	64.40%	2	0.3272229894
Detroit, MI	604,794	77.80%	11	1.818801112
Baltimore, MD	555,831	61.20%	10	1.799108002
Atlanta, GA	512,047	47.60%	6	1.171767435
New Orleans, LA	355,121	57.00%	6	1.689564965
Cleveland, OH	354,043	46.60%	6	1.6947094
Newark, NJ	301,408	47.00%	2	0.6635523941
St. Louis, MO	272,610	43.90%	7	2.567770808
Richmond, VA	232,981	44.00%	2	0.8584391002

Table 2

CARF Stroke Rehabilitation Facilities in Cities with Lower African American Population Densities

City	Population	African American Population Density	Facilities within 10 mi	Facilities per capita * 100,000
San Jose, CA	950,767	2.90%	4	0.4207129612
Albuquerque, NM	556,808	3.20%	2	0.3591902415
Anaheim, CA	341,035	2.60%	3	0.8796751067
Irvine, CA	330,863	2.00%	1	0.3022398999
Santa Ana, CA	307,025	1.10%	1	0.3257063757
Reno, NV	280,294	3.40%	1	0.3567682505
Laredo, TX	256,771	0.50%	0	0
Scottsdale, AZ	243,590	2.10%	8	3.284207069
Boise, ID	233,860	1.50%	2	0.8552125203
Spokane, WA	231,132	2.60%	1	0.4326532025

The data above shows that cities with higher African American population densities were found to have more stroke rehabilitation centers with CARF certifications and accreditations. After adjusting for population size, the average number of facilities per capita was approximately twice as large in cities with greater African American population densities than in those with smaller densities. The results shown through this

data do not support the hypothesis that rehabilitation facilities are less common in primarily African American cities.

Given the findings of the demographic research above, proximity is an unlikely accessibility barrier. Another common issue that is faced when seeking any medical treatment is cost. Health insurance in the United States helps with covering medical bills to varying extents depending on the plan. More expensive plans generally provide coverage for a wider range of treatments and medications. Those who cannot afford insurance are at risk of facing massive medical bills for any health issue. In the case of a stroke, initial hospital care is extremely expensive. If someone is struggling to pay the hospital bills already, they will not be able to seek out additional long term care. Disparities in health insurance coverage may relate directly to increased rates of long-term disability post-stroke.

The ability to purchase a healthcare plan requires substantial income and knowledge of the U.S. healthcare system. These resources are not equally available to all socioeconomic groups or races/ethnicities. One study compared the lack of health insurance in cohorts of Asian, Black, Latino/Hispanic, and White individuals (Mahajan et al., 2021). The study compared coverage for these groups in 1999 and 2018. While the prevalence of uninsured individuals decreased across the board, people of color continued to show lower rates of health insurance coverage than the white cohort. The study also looks at the prevalence of individuals who have dismissed healthcare in the past 12 months due to cost. This data shows that over the course of the study more

people in each demographic delayed or dismissed care due to cost. (Mahajan et al., 2021). The racial gaps for these findings were very similar to those in the lack of insurance data. The results from this study conclude that people of color struggle with higher prevalence of lack of insurance. This barrier when seeking medical care may be deterring African American stroke patients from receiving adequate follow-up care, and contributing to the lower rates of full physical recovery.

The issue of lower physical recovery rates for female and African American stroke patients is a complex issue and there may be several contributing factors. Lack of inclusion in medical testing has been exposed for many treatments, and is the result of cohort standards for trials in the past only including white males. The theory that this may be one of the causes of disparities in stroke recovery rates remains plausible. Widely adopted guidelines for stroke physical therapy are based on studies from the early 2000's, increasing the probability of bias and exclusion in the trials. While accessibility of rehabilitation based on location was not supported as a cause by this research, the barrier of insurance is shown to affect African Americans disproportionately.

The time constraints on this research led to a narrow approach, evaluating only two main hypotheses. Several other factors should be addressed in future studies. Some of these include stroke severity, response and treatment time of initial stroke, and community support. Improvements that can be made based on the results of this research can be generalized to many other medical issues. New studies should be conducted with diverse patient populations to establish new medical treatments and replace those that are discriminatory. Healthcare should be made equally accessible for

all races and socioeconomic classes. Lastly, more research should be conducted to discover the causes of known inequalities in healthcare. Taking these steps will help to bridge the gap in health and quality of care for all demographics.

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