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CHANGE IN POSITIVE EMOTION AND RECOVERY OF FUNCTIONAL STATUS FOLLOWING STROKE REHABILITATION IN OLDER ADULTS

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CHANGE IN POSITIVE EMOTION AND RECOVERY OF FUNCTIONAL STATUS FOLLOWING STROKE REHABILITATION IN OLDER ADULTS

by

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Dissertation

Presented to the Faculty of the Graduate School of

The University of Texas Medical Branch

In Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas Medical Branch

August, 2010

Acknowledgements

I am grateful for the help and encouragement I received from the dissertation committee which consisted of Dr. Glenn Ostir, Dr. Beatriz Abreu, Dr. Kenneth Ottenbacher, Dr. Yong-fang Kuo, and Dr. Timothy Elliott. I am particularly grateful for the time and guidance provided me by Dr. Glenn Ostir, chair of my committee. Dr. Ostir allowed me use of his extensive stroke data set, and shared his knowledge and expertise in the area of psychological well-being. I also thank my wife, Mary Jo, who was my biggest supporter and whose patience, encouragement and feedback were invaluable. Finally, I thank all others who in any way participated in the research project, either through their knowledge or support.

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Publication No. _____

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Stroke is a leading cause of disability in the United States and represents a major public health challenge. Recovery of functional status following stroke is a primary focus for rehabilitation, and is an important health outcome linked to independence, life satisfaction and quality of life. Among factors associated with recovery of functional status following stroke is positive emotion. In elderly populations, positive emotion has been shown to be protective of stroke and has been associated with functional recovery following stroke. However, most studies examining the relationship between positive emotion and recovery of functional status evaluate positive emotion at a single time point, and over relatively brief follow-up periods. Some studies report positive emotion may be a dynamic process and can change over brief periods of time. Not clear is whether positive emotion continues to change over longer time periods and whether change in positive emotion can influence recovery of functional status post stroke.

The purpose of this study was to examine change in positive emotion over a 12-month follow-up period and to determine whether change in positive emotion was associated with recovery of functional status following rehabilitation for first time stroke in an elderly, ethnically diverse patient population. This secondary analysis of data was collected on 990 older adults with first time stroke admitted to one of 20 acute medical rehabilitation facilities in the United States between 2005 and 2006. Data were examined at discharge from acute

medical rehabilitation, and at 3-month and 12-month follow-up. The 12-month follow-up sample was comprised of 684 non-Hispanic whites, non-Hispanic blacks, and Hispanics aged 55 or older with first time stroke.

Key findings of this study included: 1) positive emotion changed over the 12-month follow-up period with the majority of change occurring between discharge and 3-month follow-up, 2) of the patients who demonstrated change in positive emotion, more demonstrated an increase in positive emotion over the 12-month follow-up as compared to no change or a decline, 3) change in positive emotion was significantly associated with recovery of functional status post stroke after controlling for important sociodemographic characteristics and clinical measures known to impact recovery after stroke, including depressive symptoms.

Change in positive emotion can occur over relatively long periods of time (i.e., 12 months) and this change is associated with recovery of functional status post stroke.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

BACKGROUND

Cerebrovascular accident (also known as stroke) is a serious health problem in the United States. According to figures recently published by the American Heart Association, approximately 780,000 strokes occur each year (Rosamond, et al., 2008). While stroke is the third leading cause of death in the United States, age-adjusted deaths due to stroke declined significantly between 1999 and 2005 (Kung, et al., 2008). Advances in stroke management may account, in part, for increased survival. Stroke is also a leading cause of serious disability. Presently, about 4.7 million Americans live with a long-term disability stemming from stroke (Rosamond, et al., 2008). The economic burden associated with stroke is substantial, estimated at $65.5 billion in 2008 for medical, rehabilitation, and other costs related to care.

Those who survive stroke often experience physical, cognitive, and emotional problems that limit the performance of activities of daily living (ADL's), restrict participation in significant societal roles, and prevent successful re-entry into the community (i.e., community integration). These changes in functional status following stroke require rehabilitation, and/or continued care (Sacco, et al., 1991; Patel, et al., 2000). Recovery of functional status after stroke is an important rehabilitation outcome linked to independence, life satisfaction and quality of life (Ahlsio, et al., 1984; Indredavik, et al., 1998; Beckley, 2006). Recovery of functional status following a significant medical event, such as stroke, is also an important national health priority. One of the overarching goals

of Healthy People 2020 (Department of Health and Human Services, 2008) is identifying determinants of health, including personal factors that prevent disease, slow functional declines, improve the ability to live independently, and participate in daily activities and take part in the community.

Recovery of functional status following stroke is associated with a number of factors, including age (Kugler, et al., 2003), stroke type and severity (Chae, et al., 1996; Adams, et al., 1999), and time to initiate treatment following stroke (Bhandari, et al., 2005). Previous research indicates younger individuals, those who experience ischemic infarcts (versus hemorrhagic strokes), who experience mild (versus moderate to severe) strokes, and who enter rehabilitation soon after stabilizing medically generally demonstrate better functional recoveries following stroke.

Racial/ethnic disparities may exist relative to recovery of functional status following stroke. Some studies indicate minorities (i.e., non-Hispanic blacks and Hispanics) recover at a slower rate and not as completely as compared to whites (Stansbury, et al., 2005).

Emotional problems, particularly depression, are associated with recovery of functional status post stroke (Hermann, et al., 1998). Depression frequently occurs within the first year following stroke, and has been associated with poorer functional outcomes and reduced survival (Lewis, et al., 2001; Hackett, et al., 2005).

While numerous studies have focused on the impact of negative emotion on recovery of functional status following stroke (Hermann, et al., 1998; Hackett,

et al., 2005), the role of positive emotion has yet to be thoroughly explored. Positive emotion (such as happiness, optimism, and hopefulness) has been associated with decreased disability, better health, and increased survival in some populations (Pressman and Cohen, 2005). The World Health Organization recognizes these preferred health outcomes are not a consequence of the absence of negative emotion, but may be due to the presence of positive emotion or well-being, and encourage a public policy focus on achieving greater public mental health (Friei, 2009).

In the elderly, positive emotion has been shown to be protective of stroke (Ostir, et al., 2001). High levels of positive emotion have been reported by a relatively large percentage of adults in the initial months after stroke (Ostir, et al., 2008b). Positive emotion has been shown to change over short periods of time, and has been associated with recovery of functional status following stroke (Ostir, et al., 2008a). Ostir and colleagues (2008a) examined the relationship between positive emotion at discharge and functional status at 3-month follow-up for a cohort aged 55 years or older that received inpatient medical rehabilitation following stroke. Higher positive emotion at discharge was associated with increased cognitive and motor status at 3-month follow-up.

PROBLEM STATEMENT

Change in positive emotion and its relationship to recovery of functional status post stroke has not been widely studied. The studies examining the association between positive emotion and recovery of functional status post stroke have assessed positive emotion at only one or two points in time, and

have been of relatively short duration (i.e., 3-month follow-up). Not known is how positive emotion may change over longer periods of time (i.e., one year) and whether change in positive emotion can influence recovery of functional status following stroke.

PURPOSE

The purpose of this proposed research project is two fold. First, to examine change in positive emotion in an older, ethnically diverse patient population with a diagnosis of first-time stroke admitted to one of 20 inpatient medical rehabilitation facilities in the United States between 2005 and 2006. Secondly, to evaluate the associations between change in positive emotion and recovery of functional status over a 12-month follow-up period in persons with first time stroke.

SPECIFIC AIMS

The specific aims of this research project are intended to address the previously identified gaps in studies examining the relationship between change in positive emotion and recovery of functional status in older adults diagnosed with first time stroke, recent research and public policy priorities identified by the World Health Organization (WHO) and Healthy People 2020, and contribute to the limited information on positive emotion as a predictor of functional status recovery following a significant change in health status, such as stroke. The specific aims and representative hypotheses are as follows:

Specific Aim 1

Describe and examine the sociodemographic characteristics, clinical measures, and functional status of older non-Hispanic white (white), non-Hispanic black (black), and Hispanic adults with first time stroke admitted to acute medical rehabilitation. Sociodemographic characteristics include race/ethnicity, age, gender, marital status, and education. Clinical measures include length of stay, stroke type, number of co-morbidities, therapy after discharge, and depressive symptoms. Measures of functional status include cognitive, motor, and total Functional Independence Measure (FIM Instrument) ratings at discharge from acute medical rehabilitation.

Representative Hypotheses

1.a. Blacks and Hispanics will be younger than whites at stroke onset.

1.b. Blacks and Hispanics will experience hemorrhagic strokes (versus ischemic strokes) more often as compared to whites.

1.c. Whites will have fewer medical co-morbidities as compared to blacks and Hispanics.

1.d. Whites will be better educated (i.e., more years of school) as compared to blacks and Hispanics.

1.e. Whites will have higher discharge motor, cognitive, and total FIM ratings as compared to blacks and Hispanics

Specific Aim 2

Examine trajectories of change in positive emotion and recovery of functional status for white, black, and Hispanic persons with first time stroke over a 12-month following-up period after discharge from acute medical rehabilitation.

Representative Hypotheses

2.a. Greater change in positive emotion (i.e., increase or decrease) will occur between discharge and 3-month follow-up, and will plateau between 3-month and 12-month follow-up for the entire study sample.

2.b. A larger proportion of the study sample will experience an increase in positive emotion over the follow-up period (verses a decline).

2.c. Older patients (i.e., > 75) will report higher levels of positive emotion as compared to younger patients (< 75).

2.d. A greater amount of functional recovery (both cognitive and motor) will occur between discharge and 3-month follow-up, and will plateau between 3-month and 12-month follow-up for the entire study sample.

2.e. Younger patients (i.e., < 75) will demonstrate better recovery of functional status (both cognitive and motor) as compared to older patients (> 75).

2.f. Whites will demonstrate better recovery of functional status (both cognitive and motor) than blacks and Hispanics at both follow-up time points.

Specific Aim 3

Determine independent and interactive effects of change of change in positive emotion (positive change, negative change, or no change) sociodemographic characteristics (i.e., race/ethnicity, age, gender, marital status, and education) and clinical measures (i.e., length of stay, stroke type, medical co-morbidities, therapy after discharge, and depressive symptoms), and recovery of functional status over a 12-month follow-up period for whites, blacks, and Hispanics with first time stroke.

Representative Hypotheses

3.a. Age, race/ethnicity, stroke type, number of co-morbidities, and depressive symptoms will be significantly and independently associated with recovery of functional status.

3.b. Change in positive emotion will be associated with recovery of functional status independent of negative emotion (i.e., depressive symptoms).

3.c. Increases in positive emotion between discharge from acute medical rehabilitation and 12-month follow-up assessment will be significantly associated with better recovery of functional status as compared to no change or a decline in positive emotion.

Conceptual Model

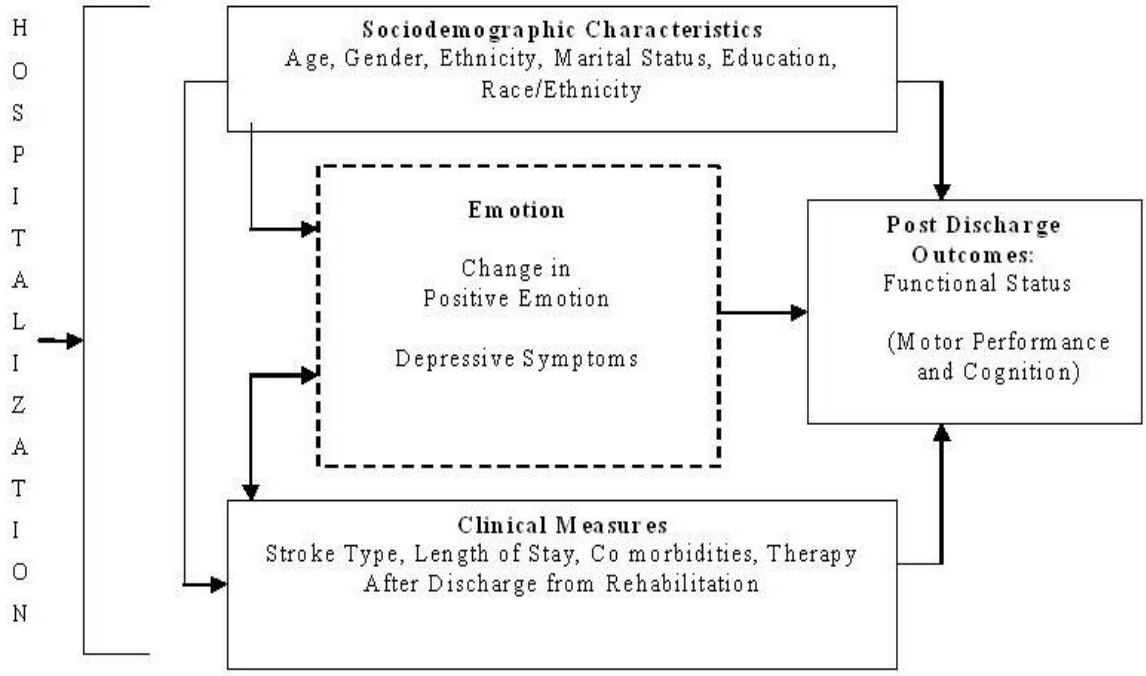
The primary objective of this study is to conduct hypothesis-driven analyses examining the associations between change in positive emotion, sociodemographic characteristics and clinical measures, and recovery of

functional status following first time stroke in an elderly, ethnically diverse population. The study has three primary aims. First, to describe and examine the sociodemographic characteristics, clinical characteristics, and functional status (motor and cognitive function) for older white, black, and Hispanic adults diagnosed with first time stroke admitted to acute medical rehabilitation. Second, to examine trajectories of change in positive emotion and recovery of functional status (motor and cognitive functioning) for the study sample. Lastly, to examine independent and interactive effects of change in positive emotion and other variables known to contribute to outcome following stroke (i.e., race/ethnicity, age, gender, marital status, education, length of stay, stroke type, medical co-morbidities, therapy after discharge from rehabilitation, and depressive symptoms) and recovery of functional status over a 12-month follow-up period.

The conceptual model that served to guide this research illustrates the potential associations between the domains of positive emotion, sociodemographic characteristics and clinical measures for older adults with first time stroke (see Figure 1 – Modified Ostir Model).

Previous research assumed relatively straightforward relationships between sociodemographic characteristics (i.e., age, gender, etc.), some clinical measures (i.e., negative emotion), and positive emotion (Diener and Biswas-Diener, 2008). However, an appreciation now exists for the complexity of the relationships between these background variables and positive emotion (Mroczek and Kolarz, 1998).

Figure 1. Modified Ostir Model illustrating the potential associations of sociodemographic characteristics, clinical measures, emotion and functional status post discharge among older patients admitted to an in-patient medical rehabilitation facility following stroke.



Gender is a sociodemographic characteristic that has been associated with differential outcome following stroke. Generally, women tend to have poorer functional outcomes as compared to men. However, there is a complex relationship between gender and other variables known to affect recovery of functional status following stroke, including both age and negative emotion. For example, women tend to be older at the time of stroke onset and report higher levels of depressive symptoms (Pinquart and Sorensen, 2001; Reeves, et al., 2008).

Age is an important risk factor for stroke and is associated with recovery of functional status post stroke (Kugler, et al., 2003). As people age their ability to

perform activities of daily living (i.e., self-care, physical activities) is compromised. Guralnik and colleagues (1993) report a decline in functional status in the elderly for every increasing decade of life. The relationship between age and recovery of functional status following stroke is not straightforward. While numerous studies show a significant negative relationship between age and recovery of functional status post stroke, some studies indicate the relationship is small, and that self-care status (i.e., performance of ADL's) at admission to rehabilitation is a better predictor of functional status recovery. That is, functional abilities at admission to rehabilitation, not necessarily age alone, better predicts recovery of functional status post stroke.

The number of medical co-morbidities is a risk factor for stroke and influences recovery of functional status post stroke. Persons with one or more chronic conditions (i.e., diabetes, hypertension, etc.) are more likely to experience stroke and have poorer functional outcomes post stroke (Rosamond, et al., 2008). A relationship has been demonstrated between race/ethnicity and co-morbid conditions. Minorities (i.e., blacks and Hispanics) tend to have co-morbid conditions such as diabetes and hypertension more often as compared to whites, while whites tend to have heart arrhythmias and atherosclerosis more often than minorities (Stansbury et al., 2005). This same complex relationship exits between race/ethnicity and stroke type and severity (Chae, et al., 1996). Blacks tend to have hemorrhagic strokes more often and experience more severe strokes as compared to whites.

The association between positive emotion, health, and recovery from illness is also multifaceted and complex, involving health behaviors, coping with stress (i.e., resilience), and biological pathways (Ryff, et al., 2004; Pressman and Cohen, 2005).

DESIGN OVERVIEW

The present study utilized a descriptive, longitudinal design. Data were collected from a sample of 990 diverse and cognitively competent adults 55 years of age and older with a diagnosis of first time stroke admitted to one of 20 inpatient medical rehabilitation facilities in the United States between 2005 and 2006. The longitudinal 12-month follow-up sample was comprised of 684 participants who had complete information on key variables of interest at discharge from acute medical rehabilitation, and at 3 and 12-month follow-up interviews. This study is a secondary analysis of those data.

DEFINITION OF RELEVANT TERMS

Sociodemographic characteristics included race/ethnicity, age, gender, marital status, and years of education. Clinical measures included length of stay, stroke type, co-morbidities, therapy after discharge, and depressive symptoms (depressive symptoms was defined as the sum of the 16 negative affect items from the Center for Epidemiologic Studies Depression Scale – CESD). Functional status was defined as the cognitive, motor and total ratings on the Functional Independence Measure (FIM Instrument). The FIM Instrument is a standardized measure including 18 items covering six domains: self-care, sphincter control, transfers, locomotion, communication, and social cognition.

Positive emotion is a complex construct and has many synonyms including positive affect, happiness, optimism and subjective well-being. Positive emotion encompasses not only pleasant emotions, but also cognitions (i.e., interpretations of life events or particular circumstances), and specific actions or behaviors (i.e., exercise, expressing gratitude, etc.) that promote health and well-being. For the purposes of this study, positive emotion is defined as the sum of the 4 positive affect items from the CES-D. Positive emotion is broadly defined in Chapter 2.

RESEARCH SIGNIFICANCE

This research has the potential to provide important scientific information about how positive emotion may change over time, and the association between change in positive emotion and recovery of functional status in older, ethnically diverse patients following first time stroke. This line of research is important because knowledge of factors associated with functional recovery is essential in working with persons who have experienced stroke. As life expectancy increases and death rates from stroke decline, an increase in the number of individuals experiencing stroke and requiring rehabilitation is likely to rise in the coming decades. Furthermore, this study may extend previous work indicating that positive emotion can change over time and that positive and negative emotion are distinct and separate processes, lending support to hypotheses regarding the dynamic state of emotions, and the independence of positive and negative emotions. This line of research may also uncover associations between positive emotion and important sociodemographic and clinical variables, helping to

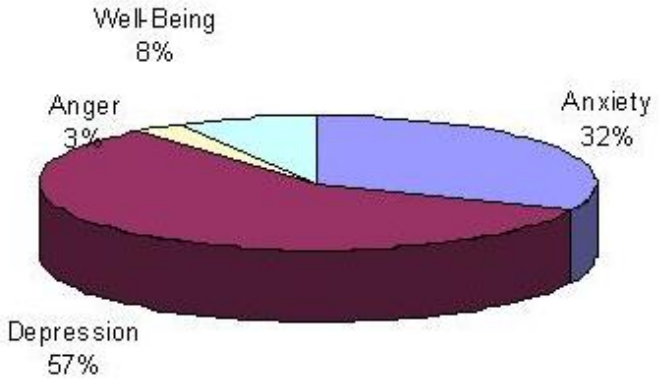
identify those who are resilient and those who are most vulnerable following a stroke, and give rise to interventions that increase positive emotion and support subsequent functional recovery after stroke.

Chapter 2: Review of Literature - Positive Emotion

INTRODUCTION

For the past 50 years, psychology has focused almost exclusively on mental illness and alleviating human suffering from debilitating disorders such as anxiety and depression. Given that approximately 30% of people in the United States suffer from a severe mental illness sometime during their lifetime (Kessler, et al., 1994), the attention given mental disorders has been justified. The scientific rigor applied to the study and treatment of mental disorders in the last half century has resulted in important advancements in classification, diagnosis, and clinical and pharmacological treatment of a variety of disorders, including depression, anxiety, and alcoholism. During the same time period, however, little attention was given to mental health or human thriving. Individuals without serious mental illness, about 70% of the US population, were essentially neglected. The literature of the last few decades is replete with studies addressing mental illness and the negative emotions such as anxiety, anger, fear (i.e., phobias) and depression; however, less than 10% of studies in the last 12 years have examined the positive

Figure 2. Research on Psychological Well-Being



emotions or psychological well-being (source: PubMed). Figure 2 displays results of a key word search for research on psychological well-being compared with research on depression, anxiety and anger from 1996 to 2008. This search revealed only about 8% of the psychological health literature published during this period addressed issues related to psychological well-being. The focus on negative emotion and mental disorders changed in 1998 as Martin Seligman was inducted as president of the American Psychological Association, ushering in the Positive Psychology movement. Positive psychology, as articulated by Seligman (Seligman, et al., 2004), seeks to apply the same scientific rigor used to study mental illness to the study of mental health and well-being. One of the overarching goals of positive psychology is to understand individual characteristics (i.e., genetics, biochemistry, and psychology) that result in human thriving, and to develop interventions to help people become lastingly happier (Seligman, 2003). The positive emotions (optimism, contentment, engagement, purpose, etc.) are at the core of the positive psychology movement, and recent research has demonstrated associations between positive emotion and health, recovery from illness, and survival (Pressman and Cohen, 2005). This chapter

Table 1. Chapter 2. Outline

Introduction

Positive Emotion Defined
- Hedonic vs. Eudaimonic

Cognitive and Behavioral Components of Positive Emotion
- Cognitive vs. Intentional Acts

Independence of Positive and Negative Emotion
- Separate Processes
- Biological Markers
- Neurotransmitter Systems

Positive Emotion and Health
- Disease Prevention
- Recovery from Illness
- Survival

Positive Emotion Pathways
- Biological
- Coping with Stress
- Heath Behaviors

Summary

will introduce the construct of positive emotion and demonstrate how high levels of positive emotion may support recovery of functional status following a significant health event such as a stroke. Refer to Table 1.

POSITIVE EMOTION DEFINED

There is no single, universally accepted definition of positive emotion. Positive emotion is a complex construct that has many synonyms including positive affect, happiness, optimism and subjective well-being. Positive emotion encompasses not only pleasant emotions (i.e., joy, gratitude, interest, and love), but also cognitions (i.e., interpretations of life events or particular circumstances), and specific actions or behaviors (i.e., exercise, attending to beauty, expressing gratitude) that promote health and well-being. Positive emotion reflects an individual's relationship with his or her environment, a way of experiencing and finding meaning in life. Positive emotion is relatively stable over time, but can change in response to immediate circumstances (i.e., a promotion, a divorce, etc.). Also, certain intentional acts, such as identifying the things in life for which one is grateful, have been shown to increase positive emotion. Conversely, focusing on the negative aspects of a particular situation has been shown to decrease positive emotion.

Positive emotion is not simply the absence of negative emotion. Research has demonstrated that positive and negative emotions are independent of each other, are associated with different personality characteristics, differentially affect various biological markers, and are mediated by separate neurotransmitter systems in the brain.

A relatively small but growing body of literature indicates positive emotion is associated with health, disease prevention, survival, and may promote recovery following a significant health event such as a stroke. The mechanisms or pathways linking positive emotion and health include biological (i.e., hormonal, neurochemical, etc.), coping with stress (i.e., resilience), and health behaviors that promote healing, and a sense of well-being.

In the sections that follow, the multidimensional aspects of positive emotion will be explored.

HEDONIC AND EUDAIMONIC COMPONENTS OF POSITIVE EMOTION

Positive emotion is broadly characterized by two overlapping yet distinct viewpoints, the hedonic and eudaimonic. In the section below, each approach to positive emotion is presented.

Hedonic

The hedonic approach focuses on happiness, experiencing and attaining pleasure, and avoiding unpleasant experiences or pain. In the fourth century B.C. the Greek philosopher, Aristippus, posited that experiencing the maximum amount of pleasure was the goal of life. Happiness, according to Aristippus, was the sum total of one's pleasurable moments. Today, most researchers recognize a hedonic component of positive emotion. Seligman and colleagues (2004) acknowledge that positive emotion includes momentary pleasurable subjective states, induced by sensory experiences (i.e., bodily pleasures) or learned behavior associated with positive consequences. Frederickson (1998) views positive emotion as pleasant feelings, including joy, gratitude, serenity, interest,

hope, pride, amusement, inspiration, awe, and love. These positive feeling states are short lived, and subjective. Diener and Lucas (2000) conceptualize positive emotion (or subjective well-being) as a subjective state defined by the individual. Positive emotion includes a wide range of subjective states experienced as positive and pleasant (joy, affection, gratitude, etc.). These mildly pleasant emotions are experienced by most people, most of the time.

Diener and Lucas (1999) also identify subjective well-being as the measure of positive emotion. Positive emotion or subjective well-being includes judgments about the good or bad elements of life and has been operationally defined as life satisfaction, the presence of positive mood and the absence of negative mood. Attaining goals or outcomes that are valued by the individual produces positive mood and satisfaction with life (Diener, et al., 1998). Expecting to attain and eventually attaining a valued goal or outcome can also bring about happiness or positive emotion. (Oishi, et al., 1999).

Eudaimonic

Positive emotion likely involves more than experiencing momentary, pleasurable subjective states, attaining personal desires, or reaching valued goals. Eudaimonic theorists warn that not all goals or outcomes a person might value lead to happiness when achieved. Aristotle was one of the first to oppose happiness as the mere fulfillment of physical desires and argued that true happiness is found in the expression of virtue, that is, in doing what is worth doing. Positive emotion, may also involve other components, such as living a meaningful and engaged life (Seligman, 2002), and experiencing life in a way

that promotes positive attitudes and meaning (Diener and Biswas-Diener, 2008). The eudaimonic approach focuses on meaning, self-actualization, and the realization of one's potential. Waterman (1993) suggested that true happiness occurs when one's life activities are consonant with deeply held values. That is, people are most happy when they live a life that is fully engaged, when activities result in personal growth and development, and when activities of life are challenging and require some effort. Ryff and Singer (1998, 2000) agree that positive emotion or well-being is more than the attainment of pleasurable pursuits. Well-being involves the realization of one's true potential along 6 dimensions: autonomy, personal growth, self-acceptance, life purpose, mastery, and positive relatedness. Ryan and Deci (2000) also advocate self-realization as a component of positive emotion and state that autonomy, competence, and relatedness are basic psychological needs that must be fulfilled for one to experience psychological well-being

In summary, positive emotion is likely multidimensional and includes both hedonic and eudaimonic components (Ryan and Deci, 2001). Recent research has indicated that hedonic and eudaimonic aspects of positive emotion may be distinct, but overlapping (Compton, et al., 1996; King and Napa, 1998). King and Napa (1998) asked adults to rate features that defined the good life. Consistently, respondents indicated that both meaning and happiness determined the good life. Compton and colleagues (1996) found similar results. They examined the factor structure of 18 scales that measured personal growth, subjective well-being, and stress-resistant personality. Their analysis showed that mental health

and optimal functioning was defined by two factors, subjective well-being and personal growth (meaning), with subjective well-being accounting for a larger portion of the variance in their studies.

COGNITIVE AND BEHAVIORAL COMPONENTS OF POSITIVE EMOTION

Positive Emotion and Cognition

Positive emotion also likely contains a cognitive component, a way of viewing and experiencing the world, life events, and circumstances. Judgments as to whether an event or circumstance is good or bad are influenced by positive (or negative) emotion. Frederickson (2009) has indicated positive emotion is tied to personal interpretation (i.e., internal thoughts about a particular situation) rather than immediate external circumstances. Diener and Biswas-Diener (2008) have proposed positive emotion (happiness) to be a broad psychological state that has cognitive components. People who are happy (i.e., those who possess high levels of positive emotion) experience life and view the world in a way that includes positive attitudes, meaning and spirituality. Seligman (1998) has stated how one explains events, either through an optimistic or pessimistic explanatory style, determines how one reacts to victories, small set backs, or monumental defeats. That is, positive or negative emotion determines how a person responds to significant life events or circumstances. Finally, positive emotion has been associated with hopeful thoughts and a future-oriented focus (Dunn, et al., 2009), and remembering good times from the past (Diener and Biswas-Diener, 2008).

Positive Emotion and Intentional Actions

Positive emotion may also be associated with certain intentional actions or behaviors that promote a sense of well-being (Lyubomirsky, et al., 2005). Intentional acts may include behaviors such as treating someone with kindness (Magen and Aharoni, 1991) or exercising (Powell, et al., 2009), and volitional acts such as attending to the beautiful (Diener and Biswas-Diener, 2008) and identifying things in life for which one is grateful (Seligman, et al., 2005). Together, these comprise a "hierarchy of sustainable happiness" (Lyubomirsky, et al., 2005), that increase levels of positive emotion and staves off negative emotions. The directionality of this relationship, whether positive emotion motivates a person to engage in intentional acts, whether intentional acts increase chronic levels of positive emotion, or whether the relationship constitutes a feedback loop has yet to be determined empirically.

Positive emotion includes both cognitive components (i.e. a way of viewing the world that brings meaning and value), and intentional acts that sustain high levels of positive affect while decreasing the presence of negative emotion, thus promoting optimal levels of functioning.

CAN POSITIVE EMOTION CHANGE?

Positive Emotion as a State

While fluctuations in the short-term occur, positive emotion (or happiness) has previously been shown to be relatively stable across time. According to set-point theory, positive emotion (or happiness) has an individual set point and fluctuations above or below this point are temporary. Over time, an individual

adjusts to extreme circumstances or life events, be they good or bad, eventually returning to an original set point. Brickman and colleagues (1978) found that lottery winners, over time, were no more happy than non-winners, and that persons who acquired a spinal cord injury reported being almost as happy as ambulatory, non-disabled peers. Brickman and colleagues (1978) stated that increases in positive emotion (e.g., excitement of a new relationship, thrill of receiving a promotion) are tempered by adaptation, and return to baseline levels within a period of time. They termed this phenomenon, the "hedonic treadmill". Subsequent research showed that well-being is moderately heritable, providing some support for set point theory. Studies of identical twins reared apart were more similar in levels of well-being as compared to non-identical twins who were also reared in separate homes (Tellegen, et al., 1988). Personality factors, which are relatively stable over time, were also shown to be strongly correlated to measures of well-being (Diener and Lucas, 1999).

Positive Emotion as a Trait

Subsequent research, however, challenged set point theory and the hedonic treadmill. Diener and colleagues (2006) determined that set points are not the same for all people, and may not always be emotionally neutral. They also showed that individuals may have multiple set points, as there are different components to subjective well-being, and that set points can change under some conditions (i.e., a divorce, onset of disability, etc.). Diener prefers the term "set ranges" rather than set point. Haidt (2005) proposed a "happiness formula" that included a set point, but also life conditions or circumstances, and intentional,

volitional acts that combine to determine a person's individual level of positive emotion (or subjective well-being). While set points and certain life conditions may be out of an individual's control, intentional or volitional actions are directly in a person's control.

Choosing to engage in certain intentional acts can increase levels of positive emotion. According to Diener (2008), attention, interpretation, and memory are essential to positive emotion. Looking for or attending to positives in situations, thinking of neutral events as positive, finding meaning in adversity, and recalling positive memories are strategies that can maintain or increase positive emotion. Seligman and colleagues (Seligman, et al., 2005) demonstrated that positive emotion can be increased by cultivating pleasure, engagement, and meaning. Individuals who wrote a letter of gratitude and delivered it in person to someone who had been especially kind to them, who wrote about things that went well during the day, or who identified personal strengths of character and then used those strengths in new and different ways experienced increased levels of positive emotion and decreased levels of self-reported depression. The effects of these exercises were maintained for as long as 6 months.

In summary, positive emotion is relatively stable over time, influenced by genetics and personality factors. However, positive emotion can change in response to certain life circumstances and can be influenced (i.e., increased) over relatively long periods of time (i.e., 6 months) by intentional acts.

THE INDEPENDENCE OF POSITIVE AND NEGATIVE EMOTION

Positive and Negative Emotion as Separate Processes

It was once thought that positive and negative emotions were at opposite ends of a single continuum, and that the presence of one emotion was simply the absence of the other. Bradburn (1969) was among the first to demonstrate the independence of positive and negative emotion. Using a scale consisting of five positive affect items and five negative affect items, Bradburn (1969) asked respondents to indicate whether they had experienced positive or negative affect in the past few weeks. His results showed that the correlation was very low between positive and negative affect items, that the correlations between items within positive and negative affect categories was much higher, and that positive and negative affect correlated differently with external variables (i.e., worry and anxiety correlated with negative emotion items, but not with positive emotion items). Diener and Emmons (1984) replicated and extended Bradburn's findings in a series of experiments measuring daily ratings of positive and negative emotion over a long period of time. Their findings showed that while positive and negative affect vary inversely over very short periods of time and are unlikely to be experienced simultaneously at a particular moment, the two types of emotion are relatively independent over longer periods of time. That is, over time, the experience of positive emotion is unrelated to the experience of negative emotion. Their studies also indicated that positive and negative emotion correlated with different personality characteristics. For example, positive emotion, but not negative emotion, correlated with extraversion, while negative emotion, but not positive emotion, correlated with neuroticism and anxiety.

Finally, Diener and Emmons (1984) suggested that experiencing one type of emotion may lead to experiencing other emotions of the same polarity. For example, experiencing joy may also result in the experience of other positive emotions such as happiness and enjoyment. Clark and Watson (1988) also found that positive and negative emotions are different processes and the two types of affect are differentially related to daily (external) events. Since these early studies, the independence of positive and negative emotion has received additional empirical support (Diener and Lucas, 2000; Folkman and Moskowitz, 2000; Huppert and Whittington, 2003).

Biological Markers

In addition to being differentially associated with personality characteristics (extroversion vs. neuroticism and anxiety) and external events (social activities vs. physical problems), positive and negative emotion are differentially associated with certain biological markers. A number of biological markers have been associated with stress and ill-health, such as elevated levels of cortisol, the presence of certain cytokines indicating chronic inflammation (Baum and Posluszny, 1999), and lower levels of HDL ("good") cholesterol (Andersen, et al., 1994). While negative emotion has been associated with high levels of cortisol and inflammatory cytokines (implicated in atherosclerosis and diabetes), and lower levels of HDL cholesterol (implicated in cardiovascular disease), positive emotion has been associated with lower levels of salivary cortisol (Ryff, et al., 2004; Steptoe, et al., 2005), and better inflammatory responses to stress (Ryff, et al., 2004; Steptoe, et al., 2005). Ryff and colleagues (2004) found higher levels

of eudaimonic positive emotion (i.e., self-development, personal growth, and purposeful engagement) were associated with longer sleep duration and longer REM sleep. Positive emotions have also been associated with strong immune response, such as increased T-cells (Segerstrom, et al., 1998) and immunoglobulin A (Barak, 2006).

Neurotransmitter Systems

Positive and negative emotion may be mediated by different neurotransmitter systems in the brain. Serotonin has been associated with negative emotion and depression (Depue, 1995). The administration of medications that increase serotonin levels in the central nervous system (i.e., serotonin specific reuptake inhibitors – SSRI's) have been shown to decrease negative emotion in both depressed patients and non-depressed volunteers (Knutson, et al., 1998). Positive emotion, however, has been shown to be mediated by dopamine in the mesolimbic area of the brain (Matsunaga, et al., 2008). Dopamine has also been shown to be associated with reward systems in the brain (Depue and Collins, 1999).

In summary, positive emotion is not simply the absence of negative emotion. Positive and negative emotions are independent of each other, correlate with different personality characteristics, affect various biological markers in opposing directions, and are mediated by separate neurotransmitter systems in the brain.

POSITIVE EMOTION AND DISEASE PREVENTION, RECOVERY AND SURVIVAL

A small but growing body of literature suggests that positive emotion may be associated with better health and disease prevention, recovery following onset of illness, and increased survival in some populations.

Disease Prevention

Positive emotion has been associated with less risk for conditions such as hypertension, heart disease, diabetes, and the common cold (Pressman and Cohen, 2005). In a cohort of elderly Mexican Americans not on antihypertensive medication, Ostir and colleagues (2006) found that increased positive emotion was significantly associated with lower continuous systolic and diastolic blood pressure. For those participants on antihypertensives, increased positive emotion was associated with lower continuous diastolic blood pressure. These findings remained after adjusting for sociodemographic characteristics, smoking and alcohol use, weight (BMI), diabetes, and depression. Richman and colleagues (2005) examined the relationship between positive emotion and outcomes for three diseases: hypertension, diabetes, and respiratory tract infections in a large cohort (n = 1041) over a 2 year period. High positive emotion was associated with a decreased likelihood of having or developing disease after controlling for a number of potential confounders, including health behaviors. To examine the relationship between positive emotion and infectious illness in otherwise healthy adults, Cohen and colleagues (2003) assessed levels of positive and negative emotion over a three week period, then exposed

participants to one of two viruses that cause the common cold. Those with high levels of positive emotion were significantly less likely to develop a cold when exposed to the virus. High levels of positive emotion have also been associated with reduced risk for stroke (Ostir, et al., 2001). Taken together, these studies suggest the protective effects of positive emotion with regard to disease onset.

Recovery

Positive emotion has also been associated with recovery and better outcomes following disease onset. For example, in a prospective study over a 15-year period of women with stage I and II breast cancer, Greer and colleagues (1990) showed those with a fighting spirit demonstrated the best outcomes as compared to women who viewed their situation as hopeless. Positive emotion has also been significantly associated with increased odds of recovery following a significant health event such as a heart attack or stroke (Ostir, et al., 2002). Positive emotion appears to promote the recovery process following disease onset.

Survival

Finally, an association between positive emotion and survival has been found in a number of prospective studies (Ostir, et al., 2000; Danner et al., 2001; Giltay, et al., 2006; Xu and Roberts, 2010). Giltay and colleagues (2006) followed a cohort of elderly men ages 64-84 over a 15 year period between 1985 and 2000 to determine whether dispositional optimism was related to lower cardiovascular mortality. All participants were free of pre-existing cardiovascular disease at the beginning of the study. High dispositional optimism was

associated with decreased risk of cardiovascular death. Danner, Snowdon and Friensen (2001) examined hand written autobiographies composed by Catholic nuns at an early age (average age of 22 years). A strong relationship was found between positive content in the autobiographies and survival to older age (age 75-95). Ostir and colleagues (2000) assessed a large population-based sample (n = 2282) of Mexican Americans (age 65-99) living in the southwestern United States and followed them for two years. Those with higher levels of positive emotion at baseline were half as likely to die at follow-up as compared to those with low levels of positive emotion. The relationship between high levels of positive emotion and survival remained after controlling for baseline medical conditions, weight (BMI), smoking and drinking habits, sociodemographic characteristics, and levels of negative emotion. Levy, Slade, Kunkel and Kasl (2002) followed a cohort (n = 660) of adults (mean age = 63) for 23 years to assess survival. Participants with greater positive self-perceptions (as measured by the Attitudes Toward Aging) at baseline lived 7.5 years longer than those with less positive perceptions. This relationship remained after controlling for age, sex, socioeconomic status and baseline functional health.

Based on empirical evidence, positive emotion appears to be protective of disease onset, promotes recovery from illness and disease, and is associated with increased survival.

POSITIVE EMOTION AND BIOLOGICAL, COPING, AND HEALTH BEHAVIOR PATHWAYS

The pathways linking positive emotion and health include biological, adaptive coping, and participation in certain health behaviors.

Biological Pathways

The biological pathways include neuroendocrine (Ryff, et al., 2004; Steptoe, et al., 2005), cardiovascular (Ostir, et al., 2002; Steptoe, et al., 2005), the inflammatory process (Ryff, et al., 2004; Steptoe, et al., 2005), and immune response (Segerstrom et al., 1988; Cohen et al., 2003; Ryff, et al., 2004; Barak, 2006).

Positive emotion has been associated with lower levels of plasma and salivary cortisol (Ryff, et al., 2004; Steptoe et al., 2005; Barak, 2006). Cortisol is a hypothalamic pituitary-adrenal (HPA) hormone that is responsible for regulating metabolic and immune system processes. Cortisol levels fluctuate (i.e., rise and fall) daily in response to challenges, but elevated levels over a long period of time are associated with disease onset. High levels of cortisol have been implicated in autoimmune diseases, infectious diseases, diabetes, poor wound healing, and some cancers (Pressman and Cohen, 2005). By lowering levels of cortisol, positive emotion is thought to promote health and protect against some chronic conditions. In terms of cardiovascular function, positive emotion has also been associated with decreased continuous systolic and diastolic blood pressure (Steptoe, et al., 2005; Ostir, et al., 2006). Blood pressure normally rises and falls in response to bodily demands. Changes (i.e., increases) in blood pressure have also been noted in response to specific emotions, for example anger, fear, etc. While fluctuations in blood pressure are expected, prolonged increases have

been associated with heart disease, kidney dysfunction, and can increase the risk for heart attack or stroke (Acelajado and Oparil, 2009). Positive emotion is thought to reduce the risk for these significant health events by promoting lower (normal) blood pressures. Positive emotion has also been associated with improved immune function (Segerstrom, et al., 1988; Cohen, et al., 2003; Barak, 2006), such as increase in T-cells, "killer" cells, and immunoglobulin A, all associated with a strong immune response. A strong immune system promotes health by mounting bodily defenses against potential threats from the common cold to serious infection.

Coping with Stress Pathway

Another thought is that positive emotion may foster the ability to better cope and adapt to stressful situations (Folkman, 1997; Frederickson, 2001). Folkman (1997) studied men who were providing care to a partner dying with AIDS. She found that descriptions of positive emotion were not only reported, but were common during prolonged periods of high stress (i.e., care giving and bereavement). Care givers used several coping strategies to maintain positive emotion during high stress, including positive reappraisal, goal-directed and problem-focused coping, spiritual beliefs, and infusing ordinary events with positive meaning. Her analysis revealed that care givers may have created positive psychological states in order to gain relief (even temporarily) from distress. Frederickson (2001) has suggested that positive emotions can offset the damaging physiological effects of negative emotion (i.e., fear, anger, etc.) in response to stressful (or threatening) situations. In her "broaden and build"

conceptualization, high positive emotion widens thoughts and actions and facilitates behavioral flexibility. Over time, psychological resources accumulate and help individuals become resilient and healthy.

Health Behaviors Pathway

Finally, positive emotion has been associated with certain health behaviors. People who possess positive emotion are more likely to practice conscientious health habits and use health services more frequently, engage in exercise, and sleep better. Taylor and colleagues (1992) found that men with HIV who were optimistic about their ability to influence the progression of the virus practiced better health habits than did those who were more pessimistic about their disease. Dunn and Brody (2008) have termed the actions one takes to bring about health and optimal functioning, "life regulation qualities". These can include, among other things, engaging in regular physical exercise. Ryff and colleagues (2004) found that positive emotion was associated with better sleep (i.e., longer periods of sleep and longer periods of REM sleep).

SUMMARY

Positive emotion is a complex construct, comprised of both hedonic and eudaimonic components. That is, positive emotion includes pleasant affect (joy, contentment, etc.), as well as viewing and experiencing the world in a way that brings meaning and value. Positive emotion has both cognitive and behavioral components. Hope for the future and remembering good times, as well as engaging in intentional acts, such as kindness to others or exercise, sustain high levels of positive affect while decreasing the presence of negative emotion.

While positive emotion can change in response to immediate circumstances, it is relatively stable over time and can be increased for relatively long periods (i.e., up to 6 months) by engaging in certain thoughts and/or actions. Positive and negative emotions are independent of each other, correlate with different personality characteristics, differentially affect various biological markers, and are mediated by separate neurotransmitter systems. The link between health and positive emotion include adaptive coping, participation in certain health behaviors and biological pathways. Positive emotion appears to be protective of disease onset, is associated with increased survival, and promotes recovery from a serious health event such as a stroke.

Chapter 3: Review of Literature – Stroke

INTRODUCTION

Cerebrovascular accident (also known as stroke) is a serious health problem in the United States and a leading cause of long-term disability. In this chapter, stroke statistics and risk factors for stroke are presented. The impact of increased survival after stroke and aging of the population on stroke incidence and prevalence, as well as future demands for rehabilitation, are discussed. Factors influencing recovery of functional status post stroke, including negative emotion, are examined. Finally, the association between positive emotion and recovery of functional status is presented. The chapter concludes with a rationale for the present study. Refer to Table 2.

Table 2. Chapter 3 Outline

Introduction

Incidence, Prevalence, Risk Factors, Mortality/Morbidity and Cost

Aging of the Population and Survival After Stroke

Recovery of Functional Status
- Age
- Stroke Type and Severity
- Gender
- Race/Ethnicity
- Negative Emotion

Positive Emotion and Recovery of Functional Status Post Stroke

Summary

Rationale for Study

Incidence, Risk Factors, Mortality/Morbidity and Cost

According to figures recently published by the American Heart Association, approximately 780,000 people experience a new or recurrent stroke each year. Approximately 600,000 are first time strokes, and 180,000 are recurrent events (Heart Disease and Stroke Statistics, 2008 Update). Of all strokes, 87% are ischemic in nature; 13% are hemorrhagic.

Risk factors for stroke include cigarette smoking, atrial fibrillation (Wolf et al., 1991), and specific co-morbidities such as diabetes (Kissella, et al., 2005), hypertension, and high cholesterol (Seshadri, et al., 2006). Other factors associated with increased risk for stroke include advanced age (>55), gender, and race/ethnicity. Sadly, many strokes are preventable. Engaging in a healthy lifestyle that includes abstinence from smoking, maintaining an appropriate weight, moderate alcohol consumption, regular exercise, and a healthy diet has been associated with significantly reduced risk of ischemic stroke (Kurth, et al., 2006).

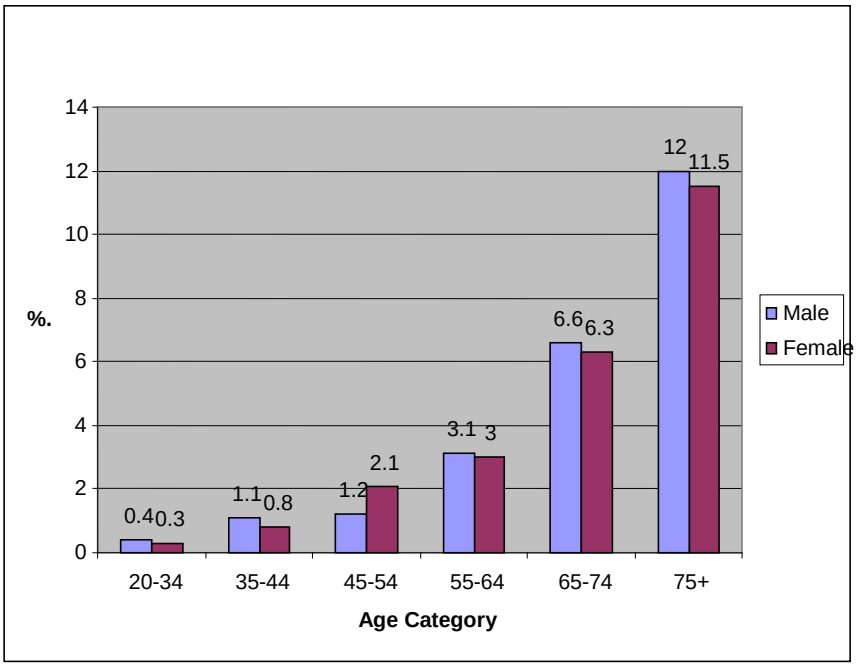
Stroke is the third leading cause of death in the United States after diseases of the heart and cancer. Recent stroke mortality is estimated to be approximately 150,000 lives yearly, and accounts for about one of every 16 deaths in the United States. Approximately 54% of deaths attributable to stroke occur out of hospital (National Center for Health Statistics, 2003). However, recent statistics show age-adjusted deaths due to stroke declined significantly between 1999 and 2005 (Kung, et al., 2005). Advances in stroke management may account, in part, for increased survival.

Stroke is also a leading cause of serious disability. Presently, about 4.7 million Americans with a long-term disability stemming from stroke (Heart Disease and Stroke Statistics, 2008 Update). Stroke accounts for approximately 895,000 hospital discharges each year and is a substantial economic burden in the United States, estimated at $65.5 billion in 2008 for medical, rehabilitation, and other costs related to care.

Aging of the Population and Survival Following Stroke

Since the beginning of the 20th century, life expectancy in the United States has increased from less than 50 years to more than 77 years. From 1960 to 2000, the number of people 65 years of age and older almost doubled. By 2030, this number is projected to double again with about 20% of the population, or approximately 70 million people, at or over the age of 65 (US Census Bureau, 2000). Approximately 4 million Americans (about 1.5% of the population) were age 85 and older in 2000. By the year 2020, this older group is projected to increase to about 7 million. This older group is the fastest growing segment of the elderly population and a major consumer of health care resources. Stroke tends to be a disease of the elderly with the majority of strokes occurring after age 55 (Refer to Figure 3). The risk for stroke doubles every decade thereafter (Kung, et al., 2005).

Figure 3. Stroke Prevalence by Age and Sex: United States, 1999-2002



The number of people surviving stroke and the projected shift in demographics toward older age will likely combine to increase the incidence of

stroke and the number of adults at risk for stroke. Given the cognitive, physical and emotional changes associated with stroke, there will likely be an increase in the need for medical, rehabilitation, and long-term care services.

Recovery of Functional Status Following Stroke

Persons with stroke often experience physical, cognitive, and emotional problems that limit the performance of activities of daily living (ADL's), restrict participation in significant societal roles, and prevent successful re-entry into the community (i.e., community integration). These changes in function following stroke require rehabilitation, and/or continued care (Sacco, et al., 1991; Patel, et al., 2000).

Previous research demonstrates recovery of functional status post stroke is associated with a number of factors, including age (Kugler, et al., 2003), gender (Reeves, et al., 2008), stroke type and severity (Katrak, et al., 2009) race/ethnicity (Bhandari, et al., 2005), social support (Glass, et al., 1993), and education (Hanjo, et al., 2009). Number of co-morbidities (Turhan et al., 2009) and emotional problems, such as depression (Hermann, et al., 1998), are also associated with recovery of functional status following stroke.

Age

Age is an important risk factor for stroke (Williams, et al., 1999), and is associated with recovery of functional status post stroke (Ergeletzis, et al., 2002; Weimer, et al., 2002; Kugler, et al., 2003; Goslin, et al., 2008).

Kugler and colleagues (2003) examined the relationship between age (i.e., <65 years of age vs. >65), mortality, and in-hospital functional recovery following

stroke. In a large sample (N = 3102) of adults age 20 to >85, a measure of functional status (i.e., Barthel Index score) was administered within 24 hours of admission, again one week after admission, and at discharge from acute medical rehabilitation. Age was significantly associated with recovery of functional status. The total sample achieved a mean relative improvement in activities of daily living of 54% over the length of hospital stay, with the greatest amount of functional status change occurring in the first week after admission. There was a weak negative, yet statistically significant relationship between increased age and functional recovery at all time points. Additionally, those over 65 also recovered more slowly than younger patients.

Similar results in early recovery were found by Ergeletzis and colleagues (2002). Functional status following stroke was assessed at admission and discharge from acute medical rehabilitation for patients <80 and ≥80 years of age. Functional status was measured using the FIM Instrument. Admission motor and total FIM ratings were found to be the most significant predictors of functional status at discharge. The older group (i.e., ≥80) made smaller gains in recovery of functional status as compared to the younger (i.e., <80) group. Fewer of those over 80 returned home as compared to the younger group.

A number of studies have examined the relationship between age and recovery of functional status over longer periods of time (i.e., 3 or more months) following discharge from acute medical rehabilitation. Goslin and colleagues (2008) compared immediate and long-term recovery of functional status post stroke between those younger and those older than 65. Assessments of motor

skills, cognition, ADL's and mobility were taken at admission to acute medical rehabilitation, and again at discharge, and at 3-month follow-up. Functional status of all participants improved significantly as a result of rehabilitation. However, the younger group demonstrated greater improvement on measures of mobility, balance, walking, and grip strength. Similar results were found by Wiemar and colleagues (2002) when developing a predictive model of functional independence following stroke. Using a Barthel Index score of >95 as an operational definition of functional independence, age was a significant and independent predictor of both survival and independent function at 100 days following ischemic stroke.

While older age is associated with less recovery of functional status following stroke, studies of both short and long-term recovery of function have demonstrated that older individuals can complete a rehabilitation program, have the potential for functional recovery similar to that of younger individuals, and the majority return home. It has been recommended that the elderly receive the same access to and intensity of rehabilitation services in the early phase after stroke as younger patients.

Stroke Type and Severity

The majority of strokes (87%) are classified as ischemic infarcts (Heart Disease and Stroke Statistics, 2008). While fewer strokes are hemorrhagic in nature, intracerebral hemorrhage (ICH) is associated with more severe neurological impairment, functional disability, and death during acute phases of medical care and rehabilitation (Helweg-Larson, et al., 1984). However, the

relationship between stroke type and severity and long-term recovery of functional status is less clear.

In a prospective study of functional recovery following rehabilitation in patients with intracerebral hemorrhage (ICH) as compared to cerebral infarction (CI), Katrak and colleagues (2009) found that patients with ICH were more severely disabled upon admission to rehabilitation. However, patients with hemorrhagic stroke demonstrated greater functional improvement as measured by the FIM Instrument and Motor Assessment Scale. The majority of patients in both groups were discharged home. Similar results were found in a retrospective study of 1064 cases examining factors that predict recovery of functional status in patients with intracerebral hemorrhage (ICH) as compared to those with cerebral infarction (Kelly, et al., 2003). In that study, Kelly and colleagues (2003) found that patients with ICH had greater functional impairment upon admission to inpatient medical rehabilitation as measured by the FIM Instrument. However, by discharge there was no significant difference in total FIM score between patients with ICH and those with cerebral infarction. Patients with ICH made a significantly greater functional recovery.

Stroke severity has been identified as a significant, independent predictor of functional status recovery (Adams, et al., 1999). Adams and colleagues (1999) found that stroke severity predicted functional outcome as measured by the Barthel Index and Glasgow Outcome Scale at both 7 days and 3 months post stroke. Their findings showed the more severe the stroke, the less favorable the outcome. This relationship remained after adjusting for age, gender,

race/ethnicity, and previous history of stroke. However, the relationship between stroke severity and outcome is not straightforward. Patel and colleagues (2000) followed a cohort of adults for 6 months post stroke to examine the relationship between impairments and functional outcome. After controlling for stroke severity and other covariates, they found the number of functional impairments predicted independence in ambulation and independent performance of 3 or more instrumental activities of daily living (IADL's).

Gender

There is a large body of literature suggesting that stroke differentially effects recovery of functional status in women, resulting in poorer functional outcomes, even though women have the same access to rehabilitation as do men (Reeves, et al., 2008). A number of factors have been proposed to explain why women do not experience the same levels of functional recovery as men. These factors include age, pre-stroke disability, care immediately following stroke, degree of social support, and post-stroke depression.

A number of studies show that women, on average, are about 4 years older than men at the time of first stroke onset (Kapral, et al., 2005; Forster, et al., 2009). This difference in age at stroke onset is explained by longer life expectancies for women.

Women also demonstrate greater levels of pre-stroke disability as compared to men (Petrea, et al., 2009). In a longitudinal study following a large stroke-free cohort to first incident stroke, Petrea and colleagues (2009) reported gender differences in stroke incidence, severity, and disability. They found

women were significantly more disabled before stroke as compared to men in dressing, grooming, and transfer from a bed to a chair. A number of studies have shown that baseline level of function is a strong predictor of recovery of functional status post stroke (Ergeletzis, et al., 2002; Kugler, et al., 2003).

While women have the same access to care following stroke as do men, some studies suggest that women may not receive the same in-hospital diagnostic and treatment procedures. Gargano, Wehner and Reeves (2008) found that women were less likely than men to receive thrombolytic therapy or lipid testing. However, other studies indicate no sex differences in in-hospital stroke care (Karpal, et al., 2005; Forster, et al., 2009).

Some studies have reported that women, particularly older women, are more likely to be single, live alone, and have little social support at the time of first stroke. Social isolation has been shown to be a risk factor for stroke and has been linked to poor recovery of functional status post stroke. Boden-Albala and colleagues (2005) prospectively followed a multiethnic cohort with stroke for 5 years after collecting baseline data on a number of variables, including social isolation. Social isolation was defined as knowing fewer than three people well enough to visit in their homes. Social isolation was associated with an increased risk for recurrent stroke, and was also associated with poorer long-term recovery of function.

Several studies have demonstrated that women report more depressive symptoms and are more likely to be diagnosed with clinical depression after stroke as compared to men (Robinson and Price, 1982; Wade, et al., 1987). Post

stroke depression has been associated with poor recovery of functional status and decreased quality of life (Parikh, et al., 1990). Gargano and colleagues (2007) suggest that loss of role function may explain, in part, gender differences in depressive symptoms following stroke.

Gender differences in outcome following stroke is likely due to a complex interaction of pre-existing health, sociodemographic and psychosocial variables.

Race/Ethnicity

Non-Hispanic blacks and Hispanics are 2 and 1.7 times, respectively, more likely to experience a stroke as compared to whites (Heart Disease and Stroke Statistics, 2007). Blacks may also recover functional status more slowly and not recovery as completely as whites (Bhandari, et al., 2005). Less is known about the functional recovery of Hispanics following stroke. The reason for these disparities in recovery of functional status post stroke include stroke severity (Kuhlemeier and Stein, 1994; Jones, et al., 2000), number of and type of co-morbidities (Stansbury, et al., 2005) delays from stroke onset to the initiation of care (Menon, et al., 1998; Kothari, et al., 1999), variations in acute care (Reed, et al., 2001) and patient choice (Horner, et al., 1995).

In a Maryland study comparing stroke type and functional recovery post stroke for blacks and whites, there was strong evidence of more severe stroke events among blacks (Kuhlemeier and Stein, 1994). In another study involving patients from nine Veterans Administration Hospitals, significant differences were noted between blacks and whites with regard to stroke severity after controlling

for stroke type, atrial fibrillation, prior stroke, and pre-stroke living setting (Jones, et al., 2000).

Differences between blacks, whites and Hispanics have been seen with regard to co-morbidities that are established risk factors for stroke and may complicate recovery of functional status post stroke. While whites tend to be diagnosed more often with diseases of the heart and vascular system (i.e., atrial fibrillation, atherosclerosis), blacks and Hispanics have higher rates of hypertension and diabetes. (Stansbury, et al., 2005).

An important factor in survival and functional recovery following stroke is rapid initiation of care following the stroke event. Initiation of thrombolytic therapy is recommended within three hours of onset of stroke symptoms. Several studies indicate blacks and Hispanics have relatively longer delay time between stroke onset and arrival to an emergency room (Menon, et al., 1998; Kothari, et al., 1999). Additionally, there is evidence that once at the hospital, minorities may not receive the same care as whites. In a review of ethnic disparities in stroke, Stansbury and colleagues (2005) noted that minorities, as compared to whites, may not as often receive therapy with tissue plasminogen activator (tPA), be sent for carotid imaging or receive high-technology, noninvasive procedures, or be under the care of a neurologist.

Finally, patient choice and decision-making may impact recovery of functional status following stroke. Horner and colleagues (1995) noted that minorities, because of a lack of understanding or mistrust of the medical system,

may choose not to seek care and may refuse some treatments which adversely affect functional status recovery.

How persons with stoke from different racial/ethnic groups experience rehabilitation, as well as factors in the post discharge context, requires further exploration. Stansbury and colleagues (2005) also note that race/ethnicity is not a simple demographic variable, but is a complex construct that likely includes elements of culture, socioeconomic status, and biology.

Negative Emotion

Emotional problems, including anxiety and depression, are associated with recovery of functional status post stroke. Post stroke depression is relatively common, affecting 30% to 50% of stroke patients within the first year of event onset (Martin, et al., 2000; Hackett, et al., 2005). Hackett and colleagues (2005) examined 51 observational studies conducted between 1977 and 2002 to determine the prevalence of depression following stroke. There was considerable variation across studies; however, using a random effects statistical approach, a pooled prevalence estimate of 33% was found for studies they examined.

In early recovery from stroke, depression and negative attitudes (such as fatalism, helplessness, and hopelessness) are associated with less functional recovery and reduced long-term survival (Parikh, et al., 1990; Hermann et al., 1998; Lewis, et al., 2001). Lewis and colleagues (2001) adapted the Mental Adjustment to Cancer (MAC) scale to determine whether helplessness/hopelessness and fatalism were associated with reduced risk for

survival after stroke. A fighting spirit was associated with increased survival after stroke, while helplessness/hopelessness and fatalism were associated with decreased survival. After adjusting for demographic and clinical variables such as age, diabetes, ischemic heart disease, pre-stroke dependence, and baseline mobility and living situation, the association remained between helplessness/hopelessness and fatalism, and decreased survival.

Hermann and colleagues (1998) followed a cohort of elderly persons with ischemic stroke for one year. Depressive symptoms and functional status were assessed at three months and again at one year follow-up. Depression was measured using the Montgomery Asberg Depression Rating Scale and Zung Self-Rating Depression scale; functional status and handicap were measured using the FIM Instrument and Oxford Handicap Scale, respectively. Persons with marked depressive symptoms demonstrated less functional recovery and were more handicapped at both three months and one year follow-up.

Positive Emotion and Recovery of Functional Status Following Stroke

While a number of studies have focused on the impact of negative emotion on recovery of function following stroke (Parikh, et al., 1990; Hermann, et al., 1998; Lewis, et al., 2001), the role of positive emotion has yet to be thoroughly explored. The Institute of Medicine (IOM) model of disability includes environment as an important factor in disability. The environment is defined as having both physical and social/psychological components that either facilitate function or worsen the disability. Key constructs in the psychological environment include the person's beliefs, thoughts (cognition) and expectancies.

These can either facilitate a positive reaction and adaptation to disability, or can further limit or restrict the individual. Self-efficacy, sense of personal control, use of adaptive coping strategies, and optimism are psychological factors that have been associated with decreased disability (Brandt and Pope, 1997).

In recent studies, positive emotion has been shown to protect individuals against physical declines in old age, and from stroke onset (Ostir, et al., 2000; Ostir et al., 2001). In a two-year prospective study, Ostir and colleagues (2000) followed a population-based sample of older Mexican Americans (aged 65 to 99) residing in one of 5 states in the southwestern United States. None of the participants reported functional limitations at baseline interview. There was a significant, independent relationship between positive affect at baseline and mobility and functional status two years later. This relationship remained after controlling for functional status, sociodemographic variables, chronic conditions, weight (BMI) smoking and drinking habits, and negative emotion. Additionally, Ostir and colleagues (2001) assessed whether positive or negative affect, or both, predicted risk of stroke in a population based sample of older non-Hispanic whites and non-Hispanic blacks from five counties in North Carolina. Participants had no history of stroke at baseline and were followed for 6 years. Results showed that high positive affect was inversely associated with incidence of stroke.

Positive emotion has also been associated with functional status recovery following stroke. In a cohort of adults 55 years or older who received rehabilitation following stroke, Ostir and colleagues (2008a) found that higher

positive emotion at discharge was associated with increased motor and cognitive status at 3-month follow-up.

Taken together, these studies suggest positive emotion may be both protective of stroke and an important factor in recovery of functional status post stroke.

Summary

Stroke is a serious health problem in the United States and a leading cause of long-term disability. Given the projected shift in demographics toward older age groups and increased survival rates following stroke, it is likely the number of people with functional disabilities post stroke and the demand for health care services (i.e., rehabilitation) will increase in the coming decades. There is ample evidence that recovery of functional status after stroke is influenced by a number of factors, including age, gender, race/ethnicity, and negative emotion (i.e., anxiety, depression). While most of these factors are not modifiable, for example, age, gender, race/ethnicity and genetic predispositions to certain co-morbid conditions, people can make lifestyle choices and engage in healthy behavior to reduce risk for stroke, and possibly improve recovery of functional status post stroke. Positive emotion has recently been shown to be both protective of stroke and may be an important modifiable factor in recovery of functional status post stroke. However, positive emotion and its relationship to recovery of functional status post stroke has not been thoroughly explored. Few studies have examined how positive emotion may change over time and how

change in positive emotion may impact recovery of functional status post stroke (Ostir, et al., 2008b; Seale, et al., 2010).

Rationale for Study

Change in positive emotion and its relationship to recovery of functional status post stroke has not been widely studied. The studies examining the association between positive emotion and recovery of functional status post stroke have assessed positive emotion at only one or two points in time, and have been of relatively short duration (i.e., 3-month follow-up). Not known is how positive emotion may change over longer periods of time (i.e., one year) and whether change in positive emotion can influence recovery of functional status following stroke.

The proposed study examines change in positive emotion in an older, ethnically diverse patient population with a diagnosis of first-time stroke, and evaluates associations between change in positive emotion and recovery functional status over a 12-month follow-up period.

This research has the potential to provide important scientific information about how positive emotion may change over time, and the association between change in positive emotion and recovery of functional status in older, ethnically diverse patients following first time stroke. This line of research may also uncover associations between positive emotion and important sociodemographic and clinical variables, helping to identify those who are resilient and those who are most vulnerable following a stroke, and give rise to interventions that

increase positive emotion and support subsequent functional recovery after stroke.

Identifying personal factors that prevent disease, slow functional decline, improve the ability to live independently, and participate in daily activities and take part in the community are overarching goals of the Healthy People 2020 initiative (Department of Health and Human Services, 2008). A recent publication by the World Health Organization also encourages public policy to focus on achieving greater public mental health (Friei, 2009). Mental health (including the positive emotions) has been shown to influence a wide variety of positive outcomes in both individuals and communities, including better physical health, improved recovery from illness, and fewer limitations in activities of daily living. These preferred health outcomes are not a consequence of the absence of mental illness, but may be due to the presence of positive mental health, or well-being.

Chapter 4: Methods

INTRODUCTION

The purpose of this proposed research project is to examine change in positive emotion and recovery of functional status in an older, ethnically diverse patient population with a diagnosis of first-time stroke, and to evaluate associations between change in positive emotion and recovery functional status over a 12-month follow-up period.

This research has the potential to provide important scientific information about how change in positive emotion may influence recovery of functional status post stroke. This line of research is important because it may also uncover associations between change in positive emotion and important sociodemographic characteristics and clinical measures, helping to identify those who are resilient and those who are most vulnerable following a stroke, and give rise to interventions that increase positive emotion and support subsequent functional recovery post stroke. Knowledge of factors associated with functional recovery is essential in working with persons who have experienced stroke. As life expectancy increases and death rates from stroke decline, an increase in the number of individuals experiencing stroke and requiring rehabilitation is likely to rise in the coming decades.

DESIGN AND SAMPLING

The present study utilized a descriptive, longitudinal design of secondary data collected from a sample of 990 ethnically diverse and cognitively competent adults 55 years of age and older with a diagnosis of first time stroke admitted to

one of 20 inpatient medical rehabilitation facilities in the United States between 2005 and 2006. The 12-month follow-up sample was comprised of 684 participants who had complete information on key variables of interest at discharge from in-patient medical rehabilitation, and at 3 and 12-month follow up.

Setting

Data were collected as part of a prospective cohort study of persons with stroke (ICD-9 codes 436-439) who received acute medical rehabilitation services between 2005 and 2006. A total of 20 facilities were invited to participate in the study and were provided information describing the goals of the study. Of those invited, 16 facilities agreed to participate. Five facilities in the Gulf coast region and affected by hurricanes (2005) were subsequently removed from the study. The 11 remaining facilities were located across diverse regions of the country, including California, Florida, Iowa, Illinois, Kentucky, New Jersey, New York (2), Texas (2), and Washington, DC. Operating bed sizes ranged from 12 to 155 (median bed size = 78); all eleven facilities were accredited by the Joint Commission for Accreditation of Healthcare Organizations (JCAHO); and all but one facility was accredited by the Commission for the Accreditation of Rehabilitation Facilities (CARF).

Recruitment

Clinical nurse researchers conducted a structured in-hospital interview within 24 hours of admission to an acute medical rehabilitation facility. Potential participants were screened for cognitive appropriateness by asking basic

orientation questions about person, place and time. Those who were judged to be competent cognitively were consented in-person at the time of the interview.

Inclusion Criteria

To participate in the study, patients met four inclusion criteria: 1) a diagnosis of a first-time stroke (ICD-9 codes 436-439); 2) age 55 years or older; 3) cognitively competent, and 4) self-identification with one of the three following racial/ethnic groups: non-Hispanic white (white), non-Hispanic black (black), and Hispanic.

Exclusion Criteria

Patients younger than 55 years of age, who were not cognitively competent, who were not white, black, or Hispanic, or who did not provide consent did not participate in this study.

Ethical Considerations

Central (i.e., UTMB) and local (i.e., at each participating facility) ethical committee approval was sought and obtained. Consent was obtained from each patient in-person at the time of initial interview after determining cognitive competence.

Limitations

This secondary analysis is limited to the data as originally collected and coded.

Assumptions

It is assumed these data were collected following standard research guidelines and that the data are accurate.

Description of Data Collection Process (Procedures)

Clinical nurse researchers who underwent intensive training and inter rater reliability assessments, and blinded to the hypotheses of the present study conducted interviews. Patients underwent a structured interview within 24 hours of admission to an acute medical rehabilitation facility, within 72 hours of discharge, and at 3-month and 12-month follow-up. Admission and discharge interviews were conducted in-hospital, and follow-up information was collected via telephone interview. Interviews included sociodemographic, clinical, and emotional items. The inter rater reliability and stability of the follow-up information collected using phone interviews has been established, with ICC values for functional assessments ranging from 0.86 to 0.99 (Heinemann, et al., 1993; Smith, et al., 1996). In-hospital and follow-up interviews were conducted in Spanish or English.

MEASURES

Sociodemographic Characteristics

Previous research has demonstrated recovery of functional status following stroke is associated with a number of factors, including racial/ethnicity (Bhandari, et al., 2005), age (Kugler, et al., 2003), gender (Reeves, et al., 2008), education (Hanjo, et al., 2009), and social support (Glass, et al., 1993). These sociodemographic characteristics known to affect functional status were included as covariates in statistical models described later in this chapter.

Sociodemographic characteristics for the present study included race/ethnicity (white, black, and Hispanic), age (55-97), gender (female vs. male), marital status (married vs. unmarried), and high school education (≥12 years vs. <12).

Clinical Measures

Previous research has identified a number of clinical measures that influence recovery of functional status post stroke. For example, stroke type (Katrak, et al., 2009), number of co-morbidities (Turhan, et al., 2009) and emotional problems, such as depression (Hermann, et al., 1998), have been shown to be associated with functional recovery following stroke.

Clinical measures for the present study included a co-morbidities index (range, 0-5; hypertension, heart attack, diabetes, kidney disease and cancer), length of hospital stay (calculated in days from in-patient admission to discharge), stroke type (ischemic vs. hemorrhagic), therapy after discharge (any therapy vs. none), and depressive symptoms at discharge. Depressive symptoms were measured using the 16 negative affect items from the CES-D (range 0-48).

Primary Independent Measure-Positive Emotion

Positive emotion was assessed by 4-items from the Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977). The 4 positive items included “I felt that I was just as good as other people”, “I felt hopeful about the future”, “I was happy”, and “I enjoyed life.” Responses to the positive items were scored on a four-point scale (0 to 3). A score of 0 corresponded to a

response of “rarely or none of the time”, a 1 to “some or a little”, a 2 to “occasionally or a moderate amount of the time”, and 3 to “most or all of the time.” Summed responses from the 4 items created a positive emotion summary score (0-12) with higher scores indicating higher positive emotion. This measure of positive emotion has been used in previous studies with elderly stroke patients (Ostir, et al., 2000; Ostir, et al., 2001; Ostir, et al., 2008a; Ostir, et al., 2008b). This measure has also been used in studies involving elderly patients with coronary artery disease (Brummett, et al., 2009). The factor structure of the CES-D has been examined in older populations (Miller, et al., 1997). A positive emotion change score was calculated as the difference between the positive emotion summary score at 12-month follow-up and at discharge from in-patient medical rehabilitation. This variable was further categorized into three levels: positive change (where increasing change scores indicated higher positive emotion), negative change (where declining change scores indicated lower positive emotion), and no change. The positive emotion change score was used as a dichotomous (<12 vs. 12) and continuous variable.

Outcome Measure-Functional Status (Cognitive and Motor)

Functional status was assessed by the Inpatient Rehabilitation Facilities-Patient Assessment Instrument (IRF-PAI). The IRF-PAI is a 54-item instrument used to assign medical rehabilitation inpatients to a case-mix group. The case-mix group determines prospective reimbursement for medical rehabilitation by the Centers for Medicare and Medicaid Services (Stineman, et al., 1994a; Stineman, et al., 1994b; Carter, et al., 1997). The functional status items in the

IRF-PAI are from the Functional Independence Measure (FIM Instrument), a standardized measure including 18 items covering six domains: self-care, sphincter control, transfers, locomotion, communication, and social cognition. All 18 items are scored into one of seven levels of function, ranging from complete dependence (level 1) to complete independence (level 7). Total FIM ratings have a potential range of 18 to 126, with higher scores indicating greater functional independence. The reliability, validity, and responsiveness of the FIM instrument have been widely investigated (Hamilton, et al., 1994; Ottenbacher, et al., 1996; Stineman, et al., 1996). The reliability (intraclass correlation coefficient) of the Total FIM and of its domains has consistently been found to be >0.85 (Granger, et al., 1993; Hamilton, et al., 1994; Ottenbacher, et al., 1996).

DATA ANALYSIS

The study analyzed data collected on 990 older patients admitted to one of 11 in-patient medical rehabilitation facilities in the United States between 2005 and 2006. Information was collected at 4 time points: within 24 hours of admission and within 72 hours of discharge from an in-patient medical rehabilitation facility, and at 3 and 12 months post discharge. Information on positive emotion was not collected at the admission interview; therefore, this study analyzed data collected at discharge from acute medical rehabilitation, and at 3 and 12-month follow-up. Information collected included sociodemographic characteristics, clinical measures, positive emotion, and functional status (both motor and cognitive). Follow-up data at 12 months was collected on 684 patients who had participated both at discharge from acute medical rehabilitation and 3-

month and 12-month follow-up. All analyses were performed using SPSS software, version 13.0 (SPSS, Inc., Chicago, IL).

The three aims of the study, representative hypotheses, and description of analyses are presented below.

Specific Aim 1

Describe and examine the sociodemographic characteristics, clinical measures, and functional status of older white, black and Hispanic adults with first time stroke at discharge from acute medical rehabilitation. Sociodemographic characteristics include race/ethnicity, age, gender, marital status, and education. Clinical measures include length of stay, stroke type, number of co-morbidities, therapy after discharge, and depressive symptoms. Measures of functional status include cognitive, motor, and total Functional Independence Measure (FIM Instrument) ratings at discharge from acute medical rehabilitation.

Representative Hypotheses

1.a. Blacks and Hispanics will be younger than whites at stroke onset.

1.b. Blacks and Hispanics will experience hemorrhagic strokes (versus ischemic strokes) more often as compared to whites.

1.c. Whites will have fewer medical co-morbidities as compared to blacks and Hispanics.

1.d. Whites will be better educated (i.e., more years of school) as compared to blacks and Hispanics.

1.e. Whites will have higher discharge cognitive, motor, and total FIM ratings as compared to blacks or Hispanics.

Analysis

Descriptive statistics were used to describe the study sample at discharge from acute medical rehabilitation. Continuous measures were described as means and standard deviations. Categorical measures were presented as percentages. Analyses of variance (ANOVA) or t-tests (for continuous variables), and chi-square analyses (for categorical variables) were carried out to test for differences in relevant patient characteristics and clinical measures. All information is presented in tables and charts to allow for visual analysis.

Specific Aim 2

Examine trajectories of change in positive emotion and recovery of functional status for white, black, and Hispanic persons with first time stroke over a 12-month follow-up period after discharge from acute medical rehabilitation.

Representative Hypotheses

2.a. Greater change in positive emotion (i.e., increase or decrease) will occur between discharge and 3-month follow-up and will plateau between 3-month and 12-month follow-up for the 12-month follow-up sample.

2.b. A larger proportion of the 12-month follow-up sample will experience an increase in positive emotion over the follow-up period (verses a decline).

2.c. Older patients (i.e. >75) will report higher levels of positive emotion as compared to younger patients (i.e., <75).

2.d. A greater amount of functional recovery (both cognitive and motor) will occur between discharge and 3-month follow-up, and will plateau between 3-month and 12-month follow-up for the entire sample.

2.e. Younger patients (i.e., <75) will demonstrate better recovery of functional status (both cognitive and motor) as compared to older patients (i.e., >75).

2.f. Whites will demonstrate better recovery of functional status (both cognitive and motor) than blacks and Hispanics at both follow-up time points.

Analysis

Descriptive statistics were used to describe functional status and level of positive emotion at discharge from acute medical rehabilitation. Continuous measures were described as means and standard deviations. Categorical measures were presented as percentages. Analyses of variance (ANOVAs) or t-tests (for continuous variables), and chi-square analyses (for categorical variables) were carried out to test for differences in relevant sociodemographic characteristics and clinical measures. Change in positive emotion was calculated by subtracting discharge positive emotion summary score from positive emotion summary scores at 3 and 12-month follow-up. Change in positive emotion was also reported as percentage of the sample that increased (i.e., positive change)

decreased (i.e., negative change), or remained the same (i.e., no change) over the 12-month follow-up period. Recovery of functional status was determined by examining change in mean cognitive, motor, and total FIM ratings over the 12-month follow-up period. Repeated measures analysis of variance (ANOVA) was used to examine trajectories of change over time for positive emotion and recovery of functional status. All information is presented in tables and charts to allow for visual analysis.

Specific Aim 3

Determine independent and interactive effects of change in positive emotion (positive change, negative change, or no change) sociodemographic characteristics (i.e., race/ethnicity, age, gender, marital status, and education) and clinical measures (i.e., length of stay, stroke type, medical co-morbidities, therapy after discharge, and depressive symptoms) and recovery of functional status over a 12-month follow-up period for whites, blacks, and Hispanics with first time stroke.

Representative Hypotheses

3.a. Race/ethnicity, age, stroke type, number of co-morbidities, and depressive symptoms will be significantly and independently associated with recovery of functional status.

3.b. Change in positive emotion will be associated with recovery of functional status independent of negative emotion (i.e., depressive symptoms).

3.c. Increases in positive emotion between discharge and 12 month follow-up assessment will be significantly associated with better recovery of functional status as compared to no change or a decline in positive emotion.

Analysis

Repeated measures analysis of variance (ANOVA) models were used to compare recovery of functional status by positive emotion change group (i.e., positive, no change, or negative). The first model adjusted for patient sociodemographic characteristics including race/ethnicity, age (continuous), gender (female vs. male), marital status (married vs. unmarried), and years of education (<12 vs. $\geq$ 12). A second model added clinical measures including length of stay, stoke type, co-morbidities index (0-5), and therapy after discharge. A third model added depressive symptoms. Within subjects effects are reported for each model. Model assumptions were tested in two ways. The sphericity test was used to validate repeated measures factor ANOVA. If the sphericity assumption was violated, the Greenhouse-Geisser adjusted p-value was reported. For all models, testing was 2-sided using an alpha of .05. All information is presented in tables and charts to allow for visual analysis.

Chapter 5: Results

INTRODUCTION

Chapter 5 summarizes the results of the data analyses used to address the three specific aims of this research study.

SPECIFIC AIM 1 RESULTS

The goal of Specific Aim 1 was to describe and examine the sociodemographic characteristics, clinical measures, and functional status of older white, black and Hispanic adults with first time stroke at the time of discharge from one of 11 acute medical rehabilitation facilities in the United States between 2005 and 2006. Sociodemographic characteristics included race/ethnicity, age, gender, marital status, and education. Clinical measures included of length of stay, stroke type, number of co-morbidities, therapy after discharge, and depressive symptoms. Functional status included mean cognitive, motor, and total ratings from the Functional Independence Measure (FIM Instrument). Continuous measures were described as means and standard deviations. Categorical measures were presented as percentages. Analyses of variance (ANOVA) or t-tests for continuous variables, and chi-square analyses for categorical variables, were carried out to test for differences in relevant sociodemographic characteristics, clinical measures, and level of functional status at discharge from acute medical rehabilitation. All information is presented in tables and charts to allow for visual analysis.

Descriptive statistics for the Total Sample

The study sample consisted of 990 older adults with first time stroke discharged from one of 11 acute medical rehabilitation facilities in the United States between 2005 and 2006. The study sample was comprised of older adults between the ages of 55 and 97 who were cognitively competent and identified themselves as white, black, or Hispanic. Three hundred six (306) patients were lost during follow-up due to one of the following reasons: declined to participate, unable to be contacted, had missing data on important measures of functional status or emotion, or died. The 12-month follow-up sample was comprised of 684 patients. Refer to Figure 4. Table 3 shows comparisons between those included in the study and those excluded on various sociodemographic characteristics and clinical measures. No significant differences were noted between those included and those excluded.

Figure 4. Flow Diagram for Patient Recruitment and Inclusion

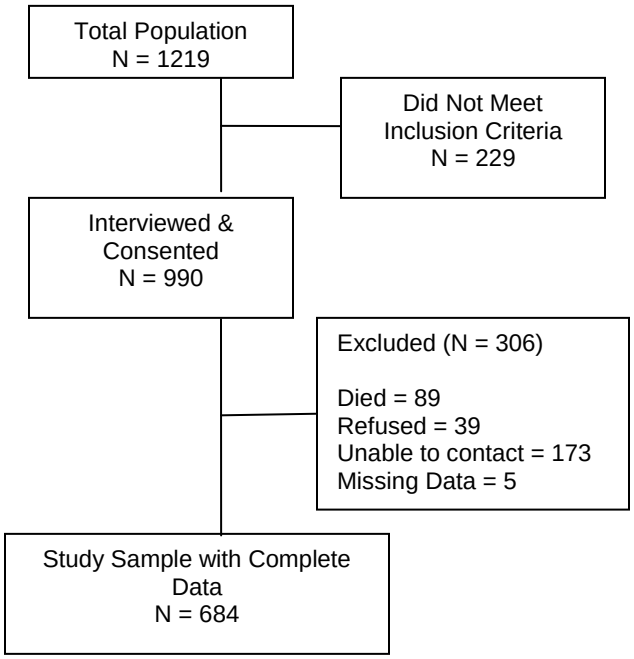


Table 3. Comparisons Between Patients Included and Excluded on Various Sociodemographic Characteristics and Clinical Measures.

	Included (n = 684)	Excluded (n = 306)	
t-tests	Mean (SD)	Mean (SD)	p-value
Age (years)	72.68 (9.26)	73.88 (10.38)	0.071
Length of Stay	20.03 (9.92)	20.44 (10.68)	0.555
Education (years)	12.33 (2.09)	12.07 (2.72)	0.265
Co-morbidities	2.90 (1.24)	2.82 (1.18)	0.328
X^2	Percentage (n)		p-value
Female	52.2 (360)	49.2 (148)	0.407
Married	52.7 (363)	50.8 (153)	0.628
Stroke Type (isch)	75.5 (520)	74.4 (224)	0.547

isch = ischemic

Sociodemographic Characteristics and Clinical Measures for the 12-Month Follow-up Sample

Table 4 shows sociodemographic characteristics and clinical measures for the 12-month follow up sample at discharge from in-patient medical rehabilitation (n = 684). The mean age was 72.9 (SD=9.52) years, 52.3% of the sample was women and 52.8% were married. The majority of the sample was white (79.1%) and had 12 or more years of education (78.3%). The mean length of stay was 20.21 (SD =10.1) days. Most of the sample had two or more medical co-morbidities (88.2%), and the most prevalent type of stroke was ischemic (75.0%).

The majority of the sample (90.0%) received on-going therapy following discharge.

Table 4. Sociodemographic Characteristics and Clinical Measures for the 12-month Follow-up Sample (n=684)

Patient Characteristics	%
Age (years)	
Mean = 72.9 (SD = 9.52)	
55-64	22.1
65-74	31.9
75-84	35.8
85+	10.2
Gender	
Men	47.7
Women	52.3
Ethnicity	
Non-Hispanic white	79.1
Non-Hispanic black	16.4
Hispanic	4.5
Marital Status	
Unmarried	47.2
Married	52.8
Education (years)	
<12	21.7
≥12	78.3
Co-Morbidities	
0	2.4
1	9.4
>2	88.2
Stroke Type (Ischemic)	75.0
Care Post Discharge (any)	90.0
Length of Stay (Mean, SD)	20.21 (10.1)
Depressive Symptoms (Mean, SD)	8.61 (8.61)

Race/Ethnicity

Table 5 shows comparisons between racial/ethnic groups on various sociodemographic characteristics and clinical measures. Whites tended to have longer lengths of stay than blacks or Hispanics (p = .03). Blacks were younger (p = .01), were less often married (p < .001), and were more often discharged home following acute medical rehabilitation (p < .001) as compared to whites or Hispanics. Hispanics had fewer years of education as compared to whites and blacks (p <.001).

Table 5. Comparisons Between Racial/Ethnic Groups on Various Sociodemographic Characteristics and Clinical Measures (n = 684)

ANOVA	White (n=541)	Black (n=112)	Hisp (n=31)	p-value
		Mean (SD)		
Age	73.3 (9.2)	70.5 (9.3)*****	72.7 (9.2)	0.01
Education	12.6 (3.0)	12.1 (2.5)	9.3 (4.0)*****	<0.001
Length of Stay	20.5 (10.4)*****	18.0 (7.7)	18.2 (8.3)	0.03
Co-Morbidities	2.9 (1.2)	3.0 (1.3)	2.6 (1.1)	0.28
Depressive Symp	8.9 (8.6)	7.9 (9.0)	5.9 (7.4)	0.10
X^2				
		Percentage		
Female	50.8	55.3	47.4	0.49
Married	55.9	35.3*	43.9	<0.001
Stroke Type (isch)	74.5	81.3	74.2	0.45
D/C Setting (home)	69.6	84.0*****	71.9	<0.001

isch = ischemic, Symp = symptoms, Hisp = Hispanic

Sub-analysis: Regional Differences

Given the broad geographic representation of acute medical facilities participating in the study, a sub-analysis was carried out to determine if patient characteristics differed by geographic region. Table 6 shows comparisons between participating acute medical rehabilitation facilities by region on various patient sociodemographic characteristics and clinical measures. The 11 participating facilities were divided into 3 regions: Northeast (n = 4), Midwest (n = 3), and South (n = 3). One facility in California was dropped from the analysis as it did not fit into one of the 3 identified geographic regions. This facility contained 6 patients eligible for participation in this study. The exclusion of this facility did not affect statistical analyses. Patients in facilities in the South tended to be older (p = .001) and were more often married (p = .012) as compared to patients in facilities in the Northeast and Midwest. Patients in facilities in the Midwest were predominantly white (p = <.001) and had fewer years of education (p = .002) as compared to patients facilities in the South and Northeast.

Functional Status

The mean cognitive, motor, and total FIM ratings at discharge from acute medical rehabilitation for the 12-month follow-up sample were 25.1 (SD=7.1), 57.7 (SD=17.3), and 82.2 (SD=22.2), respectively. Table 7 shows cognitive, motor, and total FIM ratings for the 12-month follow-up sample by race/ethnicity at discharge from acute medical rehabilitation. At discharge, Hispanics had

Table 6. Comparison Between Patients in Participating Facilities by Region on Various Sociodemographic Characteristics and Clinical Measures

Region (N)	1 (N=4)	2 (N=3)	3(N=3)	
ANOVA	Mean (SD)	Mean (SD)	Mean (SD)	p-value
Age (years)	71.94 (9.27)	72.14 (9.20)	75.59***** (8.92)	0.001
Length of Stay	20.01 (9.19)	20.02 (9.95)	19.82 (11.59)	0.980
Education (years)	12.74 (2.89)	11.90***** (3.18)	12.69 (3.05)	0.002
Co-morbidities	2.83 (1.30)	2.98 (1.22)	2.79 (1.15)	0.216
X^2	Percentage			p-value
Gender (Female)	50.6	53.3	53.5	0.782
Ethnicity (white)	62.1	93.7*****	76.3	<0.001
Married	53.4	46.1	36.8*****	0.012
Stroke type (isch)	77.1	72.9	79.8	0.181

Region 1 = Northeast (New Jersey, New York (2), Washington, DC)
Region 2 = Midwest (Iowa, Illinois, Kentucky)
Region 3 = South (Texas (2), Florida)
isch = ischemic

higher mean motor and total FIM ratings as compared to whites and blacks. Blacks had higher mean cognitive FIM ratings at discharge as compared to whites or Hispanics. An analysis of variance (ANOVA) revealed no statistically significant differences between the racial/ethnic groups at discharge for cognitive ($F(2,681)=2.37$, $p=0.09$), motor ($F(2,681)=.589$, $p=0.56$), and total ($F(2,681)=.985$, $p=0.37$) FIM ratings.

Table 7. Comparison of FIM scores by Race/Ethnicity at Discharge from Acute Medical Rehabilitation

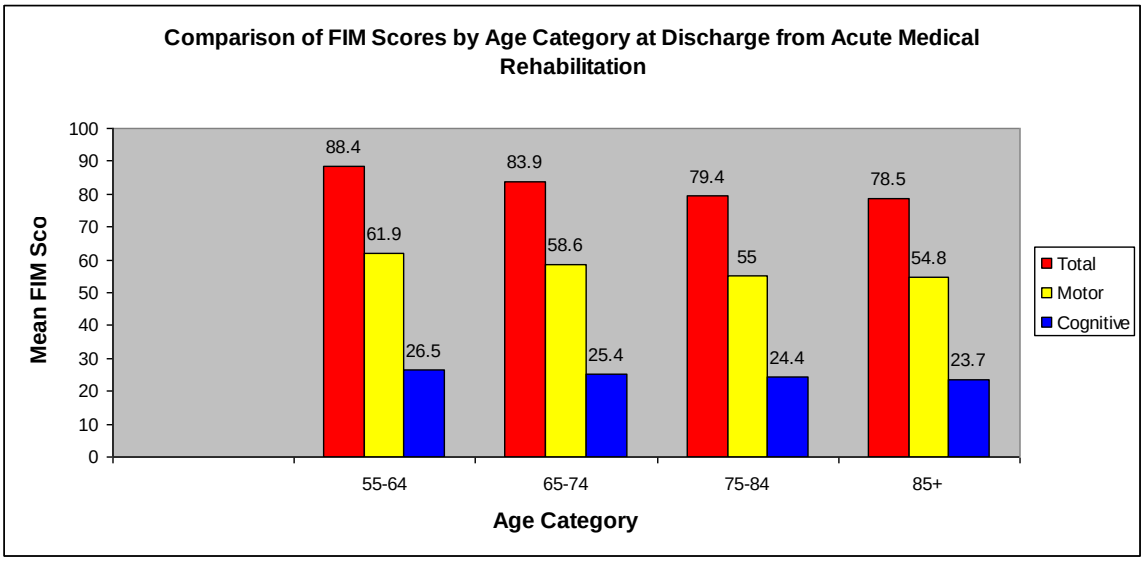
ANOVA				
FIM Score	White (n=541)	Black (n=112)	Hispanic (n=31)	p-value
		Mean (SD)		
Motor	57.4 (17.3)	58.3 (17.9)	60.5 (16.9)	0.56
Cognitive	24.3 (7.0)	26.4 (7.2)	25.6 (8.2)	0.09
Total	82.2 (21.9)	84.74 (21.1)	86.06 (22.8)	0.37

Figure 5 shows mean motor, cognitive and total FIM ratings for the 12-month follow-up sample at discharge from acute medical rehabilitation by age category. At discharge, younger adults (i.e., 55-64) had higher cognitive, motor, and total FIM ratings scores than the older age groups. A negative association was noted between age and FIM ratings at discharge. Those in progressively older age categories had lower cognitive, motor, and total FIM ratings at discharge from acute medical rehabilitation. Analysis of variance (ANOVA) revealed a significant difference between the youngest age group (55-64), and the two oldest age groups (75-84, and 85+) on cognitive ($F(3, 680) = 3.80$, $p=.010$), motor ($F(3,680)=5.91$, $p=.001$) and total FIM ratings ($F(3,680)=6.39$, $p<.001$) at discharge from acute medical rehabilitation.

Summary

Considering evidence in exiting literature, the results presented in this section offer few unexpected findings, giving credibility to the evidence and integrity of the data set. Minorities were younger than whites; however, only

Figure 5. Comparison of FIM Ratings by Age Category at Discharge from Acute Medical Rehabilitation for the 12-Month Follow-up Sample



blacks were significantly younger than the other two racial/ethnic groups. Minorities were also less educated as compared to whites, but only Hispanics were significantly less educated than the other two racial/ethnic groups. Contrary to study hypotheses, there was no difference between racial/ethnic groups with regard to type of stroke and number of medical co-morbidities.

In terms of functional status, it was not surprising to find that younger patients tended to have higher cognitive, motor, and total FIM ratings as compared to older patients. An interesting finding was that whites had lower FIM ratings than minorities at discharge from acute medical rehabilitation.

SPECIFIC AIM 2 RESULTS

The goal of Specific Aim 2 was to examine trajectories of change in positive emotion and recovery of functional status for older whites, blacks, and Hispanic persons with first time stroke over a 12-month follow-up period after

discharge from in-patient medical rehabilitation. Change in positive emotion was calculated by subtracting discharge positive emotion summary score from positive emotion summary scores at 3 and 12-month follow-up. Change in positive emotion was also reported as the percentage of the sample that increased, did not change, or decreased over the 12-month follow-up period. Recovery of functional status was determined by examining change in mean cognitive, motor, and total FIM ratings over the same 12-month follow-up period. One way repeated measures analysis of variance (ANOVA) was used to examine trajectories of change in positive emotion and recovery of functional status over the 12-month follow-up period. To test for time X group interactions, a mixed model repeated measures analysis of variance (ANOVA) was used with racial/ethnic group and age categories as between subjects factors and time as the within subject factor. All information is presented in tables and charts to allow for visual analysis.

Positive Emotion

The mean positive emotion summary score at discharge from acute rehabilitation for the 12-month follow-up sample was 9.41 (SD=2.97). Figure 6 shows mean level of positive emotion for the entire sample at discharge from acute medical rehabilitation by race/ethnicity. Hispanics had the highest mean level of positive emotion (10.2, SD=2.85) while whites had the lowest (9.36, SD=2.9). An analysis of variance (ANOVA) did not reveal any significant differences between racial/ethnic groups on level of positive emotion at discharge from acute medical rehabilitation ($F(2,681)=1.16$, $p=0.32$).

Figure 6. Comparison of Positive Emotion Summary Score by Race/Ethnicity at Discharge from Acute Medical Rehabilitation

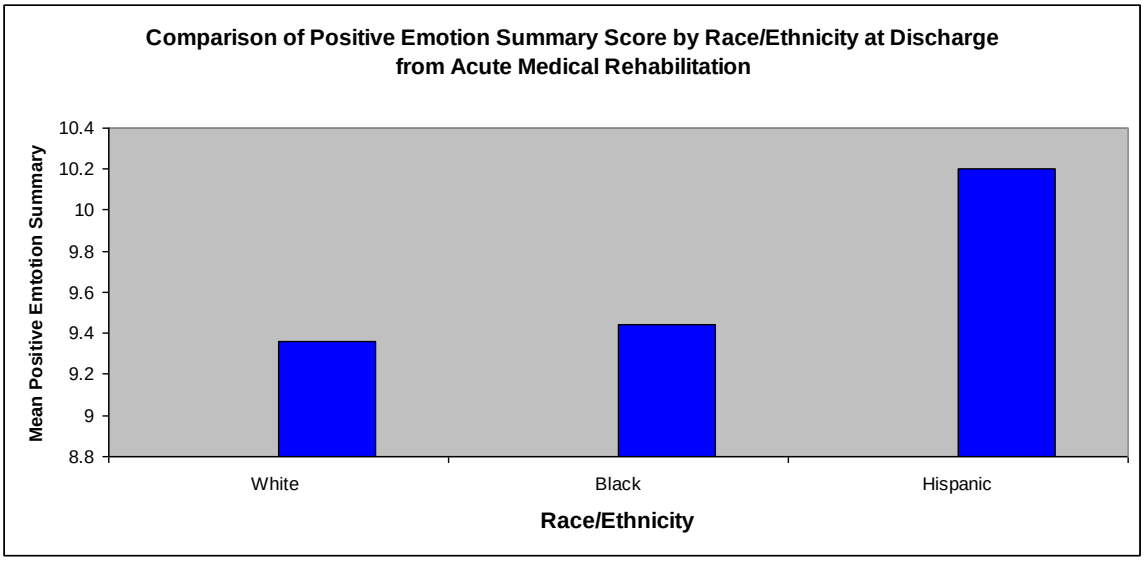
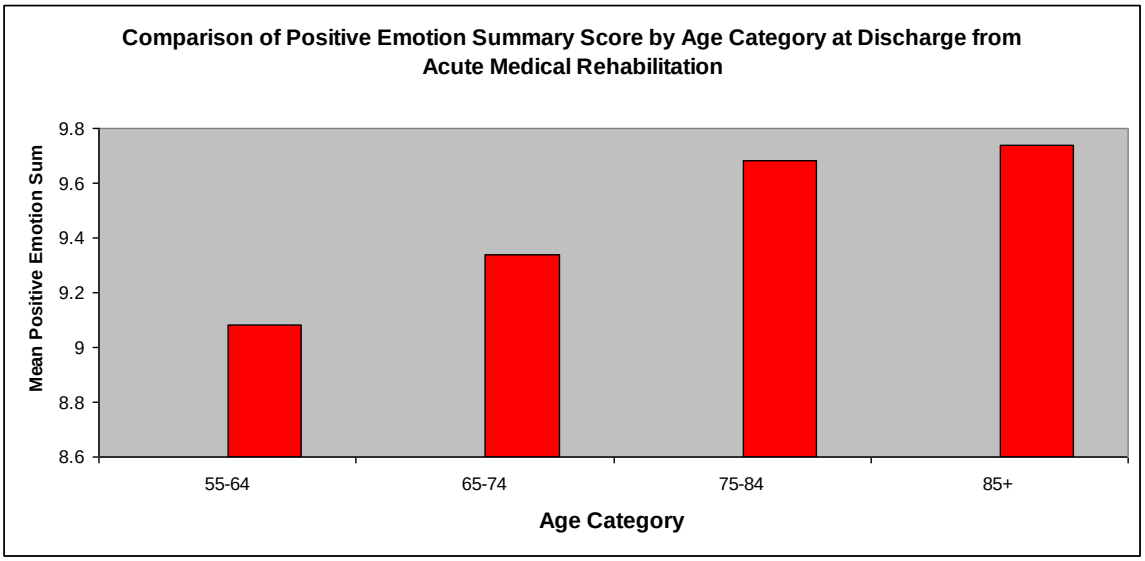


Figure 7 shows mean positive emotion summary score at discharge from acute medical rehabilitation by age category. The oldest age category (85+) had the highest mean level of positive emotion (9.74 SD=2.6) while the youngest age category (55-64) had the lowest mean level of positive emotion (9.08 SD=3.2). A positive association was noted between age and level of positive emotion at discharge from acute medical rehabilitation. As the sample increased in age, so did the level of positive emotion at discharge. An analysis of variance (ANOVA) did not reveal significant differences between age categories and level of positive emotion at discharge ($F(3,680)=1.24$, $p=0.296$).

Figure 7. Comparison of Positive Emotion Summary Score by Age Category at Discharge from Acute Medical Rehabilitation



Change in Positive Emotion for the 12-Month Follow-up Sample

Positive emotion increased for the entire sample over the 12-month follow-up period. At discharge from acute medical rehabilitation, the mean positive emotion summary score was 9.41 (SD = 2.97). At 3-month follow-up, the mean positive emotion summary score increased to 9.76 (SD = 2.92), and at 12-month follow-up, the mean positive emotion summary score was 10.02 (SD = 2.83). A one way repeated measures analysis of variance (ANOVA) revealed a significant effect for time ($F(1.98, 1348.7)=12.72$, $p <0.001$). Pairwise comparisons showed a significant difference between level of positive emotion at discharge from post acute rehabilitation and level of positive emotion at the 3 month ($p = 0.01$) and 12-month follow-up ($p < 0.001$). No significant difference in mean positive emotion summary score was found between the 3 and 12-month follow-ups ($p = 0.08$).

Between discharge and 3-month follow-up, 36.7% of the sample (n=251) reported an increase in positive emotion, 36.3% (n=248) reported no change, and 27% (n=185) reported a decline. Between 3-month follow-up and 12-month follow-up, 33% of the sample (n=226) reported an increase in positive emotion, 44.3% (n=303) reported no change, and 22.7% (n=155) reported a decline. Table 8 shows percent change (i.e., increase, no change or decline) in positive emotion for the 12-month follow-up sample.

Table 8. Percent Change in Positive Emotion Summary Score Over 12-Month Follow-up for the Entire Sample (n=684)

	Increase	No Change	Decrease
		Percentage (n)	
D/C to 3-Month F/U	36.7 (251)	36.3 (248)	27.0 (185)
3- to 12-Month F/U	33.0 (226)	44.3 (303)	22.7 (155)

D/C = discharge
F/U = follow-up

Of those patients who did not change, 23% (n=160) reported the highest positive emotion summary score of 12 at discharge and the two follow-up time points. Group comparisons showed no significant differences between the group that reported the highest level of positive emotion at all time points (n=160) and all others (n=524) on sociodemographic variables (age, gender, marital status, or years of school). No significant differences were noted on clinical measures including stroke type, co-morbidities, or follow-up therapy. Differences were found in length of stay (p=<0.001), FIM total ratings (p=<0.001), and depressive

symptoms (p=<0.001) at discharge from acute medical rehabilitation. Those who scored 12 on the positive emotion measure at discharge and both follow-up time points had shorter lengths of stay, higher FIM total ratings, and reported fewer depressive symptoms. Refer to table 9.

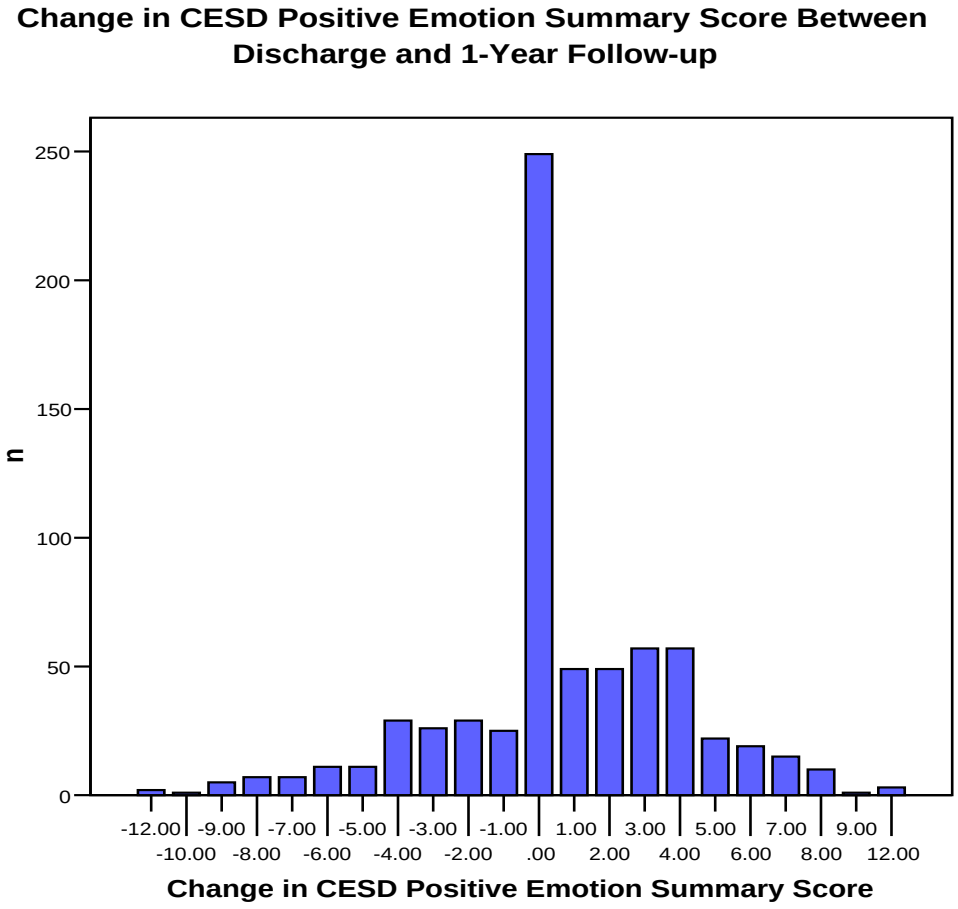
Table 9. Comparison Between Patients with a Positive Emotion Summary Score of 12 vs. <12 on Various Sociodemographic Characteristics and Clinical Measures (N=684)

	PE Summary Score <12 (N=524)	PE Summary Score 12 (N=160)	
t-tests	Mean (SD)	Mean (SD)	p-value
Age (years)	72.88 (9.32)	72.14 (9.04)	0.376
Length of Stay	20.86 (10.21)	17.25 (8.41)*	<0.001
Education (years)	12.34 (3.11)	12.34 (2.98)	0.983
Co-morbidities	2.92 (1.24)	2.82 (1.26)	0.359
Total FIM Score	80.29 (12.61)	90.89 (18.41)*	<0.001
Depressive Symp.	10.61 (8.66)	2.08 (3.92)*	<0.001
X^2	Percentage		p-value
Gender (Female)	52.9	50.6	0.620
Ethnicity (white)	79.6	77.5	0.571
Married	52.9	52.5	0.936
Stroke type (isch)	75.8	75.0	0.339

FIM=Functional Independence Measure (FIM Instrument)
Emot.=Emotion
isch=ischemic
Symp.=Symptoms

Figure 8 shows the distribution of positive emotion summary scores between discharge and 12-month follow-up. During the 12 month follow up period, those who reported an increase in positive emotion gained an average of 3.56 points, while those reporting a decline decreased an average of 3.76 points.

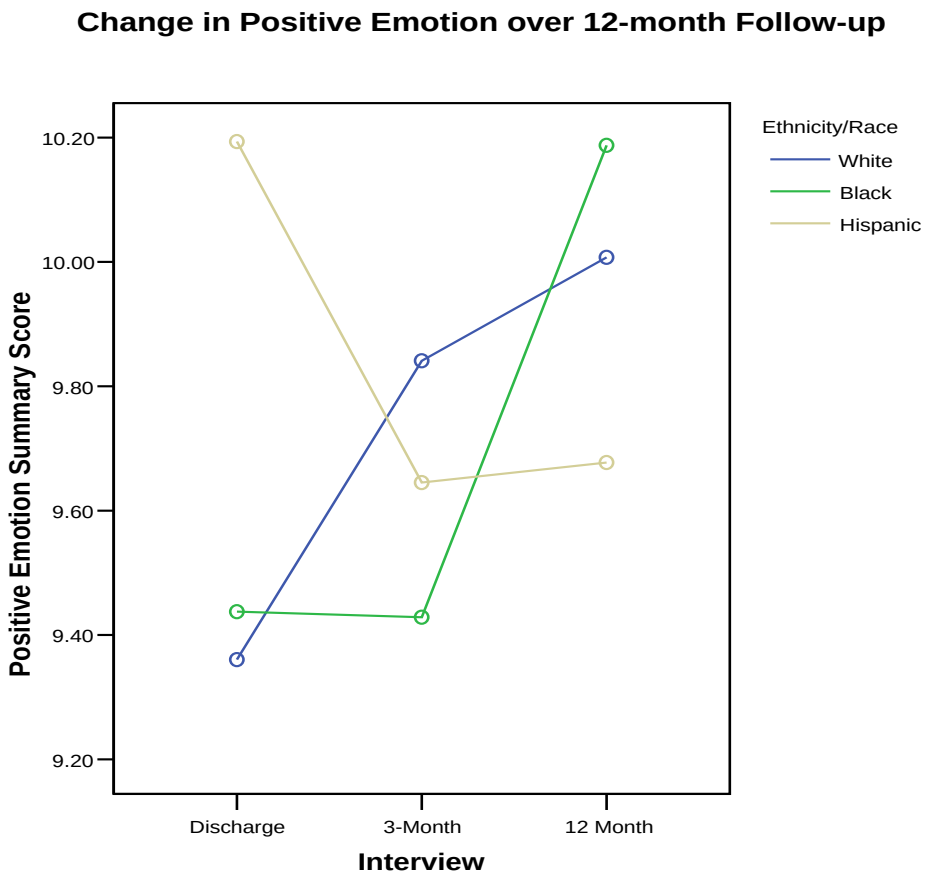
Figure 8. Change in Positive Emotion Summary Score Between Discharge and12-Month Follow-up



Change in Positive Emotion and Race/Ethnicity

Figure 9 shows trajectory of change in mean positive emotion summary score by race/ethnicity over the 12-month follow-up period. Whites reported the lowest level of positive emotion at discharge, but gradually increased between discharge and 3-month follow-up, and between 3-month follow-up and 12-month follow-up.

Figure 9. Change in Mean Positive Emotion Summary Score over 12-Month Follow-up by Race/Ethnicity

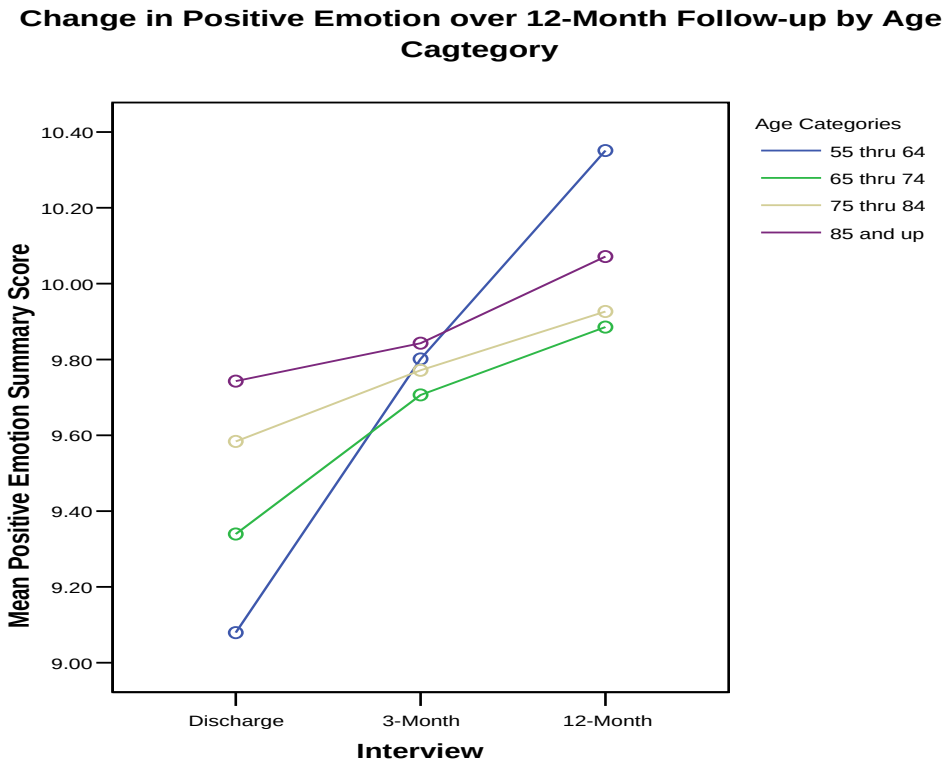


Blacks were essentially unchanged in level of positive emotion between discharge and 3-month follow-up, then increased between the 3-month follow-up and 12-month follow-up. Hispanics reported the highest levels of positive emotion at discharge from acute medical rehabilitation, then declined between discharge and 3-month follow-up. Positive emotion was essentially unchanged between 3-month follow-up and 12-month follow-up for Hispanics. A mixed model repeated measures ANOVA with race/ethnicity as the between subjects factor and time as the within subjects factor did not reveal a significant race X time interaction. ($F(3.94, 1344.7)=2.07$, $p=0.08$).

Change in Positive Emotion and Age

The trajectory of change in positive emotion over the 12-month follow-up period was similar for all age groups. Positive emotion gradually increased for all age groups from discharge to 3-month follow-up, and between 3-month and 12-month follow-up. The youngest age group (55-64) reported the lowest levels of positive emotion at discharge from acute medical rehabilitation, but by 12-month follow-up, this group reported the highest level of positive emotion. The oldest age group (85+) reported the highest level of positive emotion at discharge and gradually increased over time. A mixed model repeated measures ANOVA with age category as the between subjects factor and time as the within subjects factor did not reveal a significant age X time interaction ($F(5.93, 1344.4)=1.53$, $p=0.17$). Refer to Figure 10.

Figure 10. Change in Positive Emotion by Age Category over 12-month Follow-up



Recovery of Functional Status for the 12-Month Follow-up Sample

Functional status improved over time for the 12-month follow-up sample. A one way repeated measures ANOVA revealed a significant change in mean cognitive ($F(1.38, 944.8)=722.53$, $p<0.001$), motor ($F(1.71, 1165.98=619.35$, $p<0.001$) and total ($F(1.6,1095)=890.4$, $p<0.001$) FIM ratings over the 12-month follow-up period. A significant increase in cognitive ($p=<0.001$), motor ($p=<0.001$), and total ($p=<0.001$) FIM ratings was noted between discharge from acute medical rehabilitation and 3-month follow-up. No significant change

was noted for cognitive (p=1.0), motor (p=0.7), and total (p=0.6) FIM ratings between 3-month and 12-month follow-up. Refer to Table 10.

Table 10. Mean FIM Ratings for the 12-Month Follow-up Sample at Discharge, 3-Month, and 12-Month Follow-up

FIM Score	Discharge	3-Months	12-Months
		Mean (SD)	
Cognitive	25.1 (7.1)	32.2 (4.5)	32.4 (4.8)
Motor	57.7 (17.4)	72.8 (17.7)	73.3 (18.4)
Total	82.8 (22.2)	105.1 (20.5)	105.7 (21.6)

Figure 11 presents mean total FIM ratings for the 12-month follow-up sample at discharge from acute medical rehabilitation and at 3 and 12-month follow-up.

Recovery of Functional Status and Race/Ethnicity

A similar trajectory of recovery of functional status was noted for the three racial/ethnic groups over the 12-month follow-up period with significant increases in cognitive, motor, and total FIM ratings occurring between discharge and 3-month follow-up, then plateauing between 3-month and 12-month follow-up. A mixed model repeated measures ANOVA with race/ethnicity as the between subjects factor and time as the within subjects factor showed a significant main effect for time for cognitive ($F(1.39, 940.34=162.6$, $p=<0.001$), motor ($F(1.70, 1160.3=122.89$, $p=<0.001$), and total ($F(1.6,1092.7=184.75$, $p=<0.001$) FIM ratings. Pairwise comparisons showed significant recovery of functional status

from discharge to 3 month follow-up for cognitive (p<0.001), motor (p=<0.001), and total (p=<0.001) ratings. No significant recovery was noted from 3-month to 12-month follow up for cognitive (p=1.0), motor (p=0.44), and total (p=0.55) FIM ratings.

Figure 11. Mean FIM Ratings for the 12-Month Follow-up Sample at Discharge, 3-Month, and 12-Month Follow-up

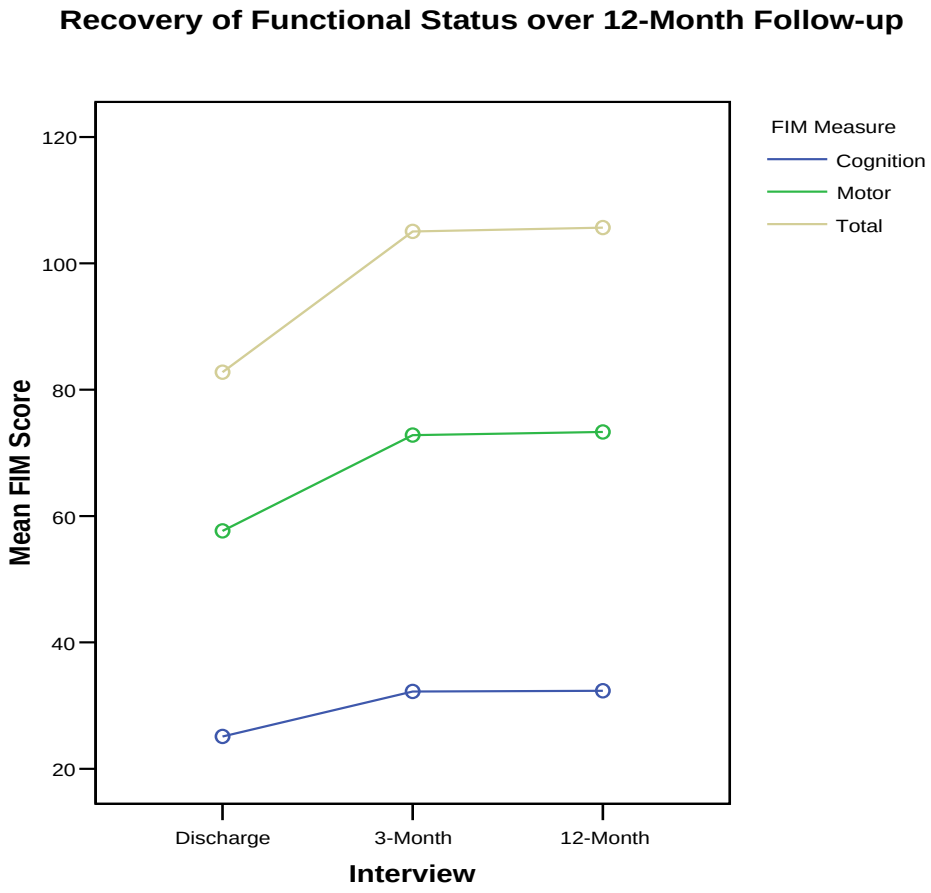


Table 11. Cognitive, Motor, and Total FIM Ratings by Race/Ethnicity over 12-Month Follow-up

	White (n=541)	Black (n=112)	Hispanic (n=31)
	Mean (SD)		
FIM Measure			
Cognitive			
Discharge	24.8 (7.0)	26.4 (7.2)	25.5 (8.2)
3-Month	35.4 (4.3)	32.1 (5.1)	30.6 (5.3)
12-Month	35.5 (4.5)	32.1 (4.9)	32.3 (4.8)
Motor			
Discharge	57.4 (17.3)	58.3 (17.8)	60.5 (16.9)
3-Month	73.6 (16.9)	70.3 (19.3)	67.4 (22.1)
12-Month	73.7 (18.0)	72.9 (18.7)	68.1 (23.6)
Total			
Discharge	82.2 (21.9)	84.7 (23.1)	82.8 (22.2)
3-Month	105.9 (19.5)	102.5 (22.7)	98.0 (26.1)
12-Month	106.2 (20.9)	105.0 (22.1)	98.7 (29.6)

However, the amount of functional recovery over time was different for the three racial/ethnic groups. At discharge, whites had the lowest cognitive, motor, and total FIM ratings as compared to minorities. However, at 3-month and 12-month follow-up, cognitive, motor and total FIM ratings were higher for whites as compared to minorities. At 3-month and 12-month follow-up, Hispanics had significantly lower motor and total FIM ratings as compared to whites and blacks. Refer to Table 11. A mixed model repeated measures ANOVA revealed a significant time X race ethnicity interaction for cognitive ($F(2.78, 946.33=5.11$, $p=0.002$), motor ($F(3.4, 1160.3=6.73$, $p=<0.001$), and total ($F(3.21,1092.7=7.92$, $p=<0.001$) FIM ratings.

Recovery of Functional Status and Age Category

The trajectory of recovery of functional status was similar for each of the four age categories with cognitive, motor, and total FIM ratings increasing from discharge to 3-month follow-up and plateauing between 3-month and 12-month follow-up. Cognitive, motor, and total FIM ratings were highest for the youngest age group (55-64) and lowest for the oldest age group (85+) at discharge and at 3 and 12-month follow-up. Cognitive, motor, and total FIM ratings increased from discharge to 3-month follow-up, and again between 3 and 12-month follow-up for the three younger age groups (55-64, 65-74, 75-84). However, for the oldest age group (85+), cognitive, motor, and total FIM ratings declined between the 3-month and 12-month follow-ups. Refer to Table 12.

Table 12. Motor, Cognitive, and Total FIM Ratings by Age Category over 12-Month Follow-up

	55-64 (n=151)	65-74 (n=218)	75-84 (n=245)	85+ (n=70)
		Mean (SD)		
FIM Measure				
Cognitive				
Discharge	26.5 (6.6)	25.4 (7.2)	24.4 (7.2)	23.7 (7.3)
3-Month	33.0 (3.6)	32.2 (4.4)	31.8 (5.1)	32.1 (4.2)
12-Month	33.3 (2.8)	32.4 (499)	31.9 (5.6)	31.7 (5.6)
Motor				
Discharge	61.9 (16.0)	58.6 (17.2)	54.8 (16.2)	57.7 (17.4)
3-Month	77.9 (15.4)	72.8 (16.8)	69.9 (19.2)	72.2 (16.9)
12-Month	78.3 (15.7)	74.5 (17.1)	69.9 (20.5)	70.3 (17.5)
Total				
Discharge	88.4 (20.3)	83.9 (21.8)	79.4 (23.1)	78.5 (21.3)
3-Month	110.9 (17.3)	104.9 (19.3)	101.7 (22.6)	104.2 (19.8)
12-Month	111.6 (17.3)	106.9 (19.9)	101.9 (24.5)	101.9 (21.5)

A mixed model repeated measures ANOVA with age category as the between subjects factor and time as the within subjects factor revealed a significant main effect for time for cognitive (F(138,940.62=590.96, p=<0.001), motor (F(1.7,1157.04=505.6, p=<0.001), and total (F(1.6, 1085.2=726.98, p=<0.001) FIM ratings. Pairwise comparisons showed significant change between discharge and 3-month follow-up for cognitive (p=<0.001), motor (p=<0.001), and total (p=<0.001) FIM ratings. However, no significant recovery was noted between 3-month and 12-month follow-up for cognitive (p=1.0), motor (p=1.0), and total (p=1.0) FIM ratings. No significant time X age interaction was found for cognitive (F(4.15, 940.62=1.42, p=0.34), motor (F(511,1157.04=1.04, p=0.4), and total (F(4.79,1085=.97, p=0.43) FIM ratings.

Summary

An interesting finding was that whites had the lowest levels of positive emotion at discharge from acute medical rehabilitation as compared to minorities. Another interesting finding, although not unexpected, was a positive association between increasing age and positive emotion at discharge from acute medical rehabilitation.

As predicted, change in positive emotion for the entire 12-month follow-up sample increased between discharge and 3-month follow-up, then plateaued between 3-month and 12-month follow-ups. Also predicted was the direction of change. A larger percentage of the sample showed gains in positive emotion verses a decline. A surprisingly large percentage of the sample (23%) reported

the highest level of positive emotion at discharge and at 3 and 12-month follow-up (i.e., a positive emotion summary score of 12).

Unexpected was the different trajectories of change in positive emotion for the 3 racial/ethnic groups. Whites gradually increased in level of positive emotion from discharge to 3-month follow-up and from 3-month to 12-month follow-up. Blacks, plateaued early between discharge and 3-month follow-up, then increased in level of positive emotion from 3-month to 12-month follow-up. Hispanics decreased in level of positive emotion between discharge and 3-month follow-up, then plateaued between 3-month and 12-month follow-up.

Analyses also confirmed hypotheses regarding recovery of functional status. For the 12-month follow-up sample, functional status improved over time. Significantly greater recovery of functional status occurred between discharge and 3-month follow-up, then recovery plateaued between 3-month and 12-month follow-ups. This trajectory of recovery was seen with cognitive, motor and total FIM ratings for the 12-month follow-up sample. As predicted, the youngest age group (55-64) demonstrated better functional recovery than older age groups (75-84, and 85+). Finally, while the trajectory of recovery of functional status was similar for the three racial/ethnic groups, whites demonstrated better functional recovery than minorities, with blacks or Hispanics showing lower cognitive, motor and total FIM ratings at 3 and 12-month follow-up as compared to whites. Hispanics had significantly lower motor and total FIM ratings at 3 and 12-month follow-up as compared to whites and blacks.

SPECIFIC AIM 3 RESULTS

The goal of Specific Aim 3 was to determine independent and interactive effects of change in positive emotion (positive change, negative change, or no change) sociodemographic characteristics (i.e., race/ethnicity, age, gender, marital status, and education) and clinical measures (i.e., length of stay, stroke type, medical co-morbidities, therapy after discharge, and depressive symptoms) and recovery of functional status over a 12-month follow-up period for older whites, blacks and Hispanics with first time stroke. Change in positive emotion was calculated as the difference between level of positive emotion at 12-month follow-up and discharge from acute medical rehabilitation. Change in positive emotion was categorized as positive (i.e., gain in positive emotion), no change, or negative (i.e., decline in positive emotion).

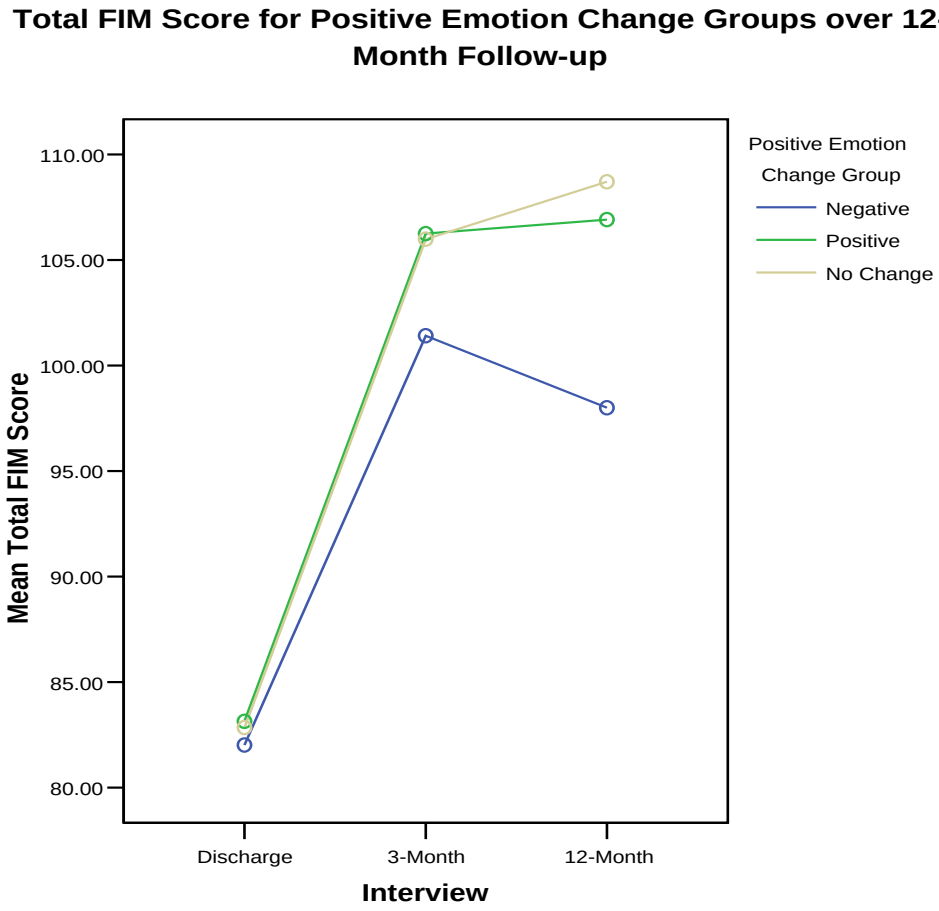
Table 13 displays mean cognitive, motor, and total FIM ratings by positive emotion change group at discharge from acute medical rehabilitation, and at 3 and 12-month follow-up. Cognitive, motor and total FIM ratings increased for each of the three change groups between discharge from acute medical rehabilitation and 3-month follow-up. The no change group demonstrated the highest scores, followed by the positive change group. The negative change group had the lowest FIM ratings. Examining mean total FIM ratings, the no change group increased 24.0 points between discharge and 3-month follow-up, while the positive change and negative change groups increased 22.6 and 19.4 points, respectively. However, the trajectory of recovery changed between 3-month and 12-month follow up. While the no change group and positive change group continued to demonstrate modest increases in cognitive, motor and total

FIM ratings, the negative change group actually showed a decline in FIM ratings. Examining total FIM ratings, the no change and positive change groups increased another 0.6 and 2.8 points, respectively, between 3 and 12-month follow-up, while the negative change group declined 3.5 points. By 12-month follow-up, the no change and positive change groups had total FIM ratings 13.7 and 10.1 points higher, respectively, as compared to the negative change group. Figure 12 presents total FIM ratings at discharge, 3 month and 12 month follow-up for the three positive emotion change groups.

Table 13. Cognitive, Motor, and Total FIM Ratings by Positive Emotion Change Group over 12-Month Follow-up

Positive Emotion Change Group:			
	Positive (n=282)	No Change (n=249)	Negative (n=153)
	Mean (SD)		
FIM Measure			
Cognition			
Discharge	27.7 (7.0)	25.5 (7.3)	25.1 (7.5)
3-Month	31.8 (4.9)	33.3 (2.9)	31.2 (5.5)
12-Month	32.5 (4.3)	33.4 (3.2)	30.4 (6.7)
Motor			
Discharge	56.5 (17.4)	60.4 (17.1)	55.4 (17.4)
3-Month	72.0 (18.5)	76.2 (15.5)	68.9 (18.5)
12-Month	74.2 (17.9)	76.7 (16.1)	66.1 (21.0)
Total			
Discharge	81.2 (21.8)	85.9 (22.1)	80.6 (22.4)
3-Month	103.8 (21.4)	109.6 (17.2)	100.0 (22.1)
12-Month	106.6 (20.5)	110.2 (18.2)	96.5 (25.7)

Figure 12. Total FIM Ratings for Positive Emotion Change Groups over 12-Month Follow-up



Multivariate Repeated Measures ANOVA Models

Repeated measures analysis of variance (ANOVA) models were used to examine recovery of functional status by positive emotion change group (i.e., positive, no change, or negative). The first model adjusted for patient sociodemographic characteristics including race/ethnicity, age (continuous), gender (female vs. male), marital status (married vs. unmarried), and years of education (<12 vs. ≥ 12). A second model added clinical measures including length of stay, stoke type, co-morbidities index (0-5), and therapy after discharge.

A third model added depressive symptoms. Within subjects effects are reported for each model. Model assumptions were tested in two ways. The sphericity test was used to validate repeated measures factor ANOVA. If the sphericity assumption was violated, the Greenhouse-Geisser adjusted p-value was reported. For all models, testing was 2-sided using an alpha of .05.

Table 14 shows repeated measures ANOVA models predicting recovery of functional status (FIM ratings) from change in positive emotion. There was a significant gain in cognitive, motor, and total FIM ratings between discharge and 12-month follow-up. In addition to change in positive emotion, Model 1 shows age, gender, and marital status were significant predictors of recovery of functional status. On the other hand, ethnicity and education were not significantly associated with functional status recovery. In model 2, clinical measures including length of stay, stroke type (ischemic vs. other), co-morbidities index (0-5), and therapy after discharge (any vs. none) were added. Length of stay, number of co-morbidities, and therapy after discharge were significantly associated with recovery of functional status. Stroke type was not predictive of recovery of functional status. With the addition of these variables, ethnicity was a significant predictor of functional status recovery. Education remained non-significant. Model 3 added depressive symptoms. Depressive symptoms were a significant predictor of functional status recovery, as were the other variables identified in the previous model. Education and stroke type remained non-significant predictors of functional status recovery.

Table 14. Repeated Measures ANOVA Models Predicting Recovery of Functional Status over 12-Month Follow-up (n=684).

	Model 1		Model 2		Model 3	
Measure	F value	p-value	F value	p-value	F value	p-value
Time	226.3	<.001	344.3	<.001	373.9	<.001
Time X						
PE Change Group	9.76	<.001	6.22	<.001	4.41	.010
Race/ethnicity	2.64	.10	7.89	.004	9.79	.001
Age (continuous)	15.1	<.001	21.67	<.001	22.68	<.001
Women (vs. men)	8.46	.003	10.89	.001	10.19	<.001
Married (vs. unmarried)	5.68	.015	5.22	.019	4.76	.025
Education (≥12 vs. <12)	1.86	.161	1.10	.302	1.36	.248
Length of Stay (days)			88.22	<.001	87.75	<.001
Stroke Type (isch vs. other)			1.27	.265	1.84	.174
Comorbidities (0-5)			11.05	.001	9.43	.001
Therapy after D/C (any vs. none)			10.42	.001	8.59	.002
Depressive Symptoms					24.84	<.001

PE=positive emotion
isch=ischemic
D/C=discharge

Summary

Analyses confirmed hypotheses for Aim 3 of the study. As predicted, recovery of functional status (i.e., increase in cognitive, motor and total FIM ratings) was predicted by race/ethnicity, age, number of co-morbidities, and

depressive symptoms. Gender, length of stay, and therapy after discharge from acute medical rehabilitation also predicted recovery of functional status. Contrary to study hypotheses, education and stroke type did not predict recovery of functional status.

Change in positive emotion (i.e., positive change, no change, negative change) was significantly associated with recovery of functional status, even after the addition of depressive symptoms to the repeated measures ANOVA model, lending further support to the independence of positive and negative emotion.

An unexpected finding was the amount of recovery of functional status relative to the direction of change in positive emotion. It was predicted that gains in positive emotion would be associated with better recovery of functional status. However, analyses revealed that the no change group had the greatest degree of recovery as indicated by the highest cognitive, motor, and total FIM scores, followed by the positive change group. This finding may have been due to the surprisingly large percentage (i.e., 23%) of patients in this group with the highest level of positive emotion (i.e., a positive emotion summary score of 12) at discharge, and at 3 and 12-month follow-up. As predicted, the negative change group demonstrated less functional recovery as compared to the no change and positive change groups. In fact, the negative change group actually demonstrated a decline in function between 3-month and 12-month follow up.

Chapter 6: Discussion

INTRODUCTION

Cerebrovascular accident (also known as stroke) is a serious health problem in the United States, and a leading cause of disability. (Rosamond, et al., 2008). Given that stroke is a disease of the elderly, the projected shift in demographics toward older age will likely increase the incidence of stroke and the need for medical, rehabilitation, and long-term care services (US Census Bureau, 2000).

Those who survive stroke often experience physical, cognitive, and emotional problems that limit the performance of activities of daily living (ADL's), restrict participation in significant societal roles, and prevent successful re-entry into the community (Sacco, et al., 1991; Patel, et al., 2000). Recovery of functional status following stroke is associated with a number of factors, including emotion. While numerous studies have focused on the impact of negative emotion on recovery of functional status following stroke (Hermann, et al., 1998; Hackett, et al., 2005), the role of positive emotion has yet to be thoroughly explored. Positive emotion (such as happiness, optimism, and hopefulness) is associated with decreased disability, better health, and increased survival (Pressman and Cohen, 2005; Xu and Roberts, 2010). In the elderly, positive emotion has been shown to be protective of stroke (Ostir, et al., 2001) and has been associated with recovery of functional status post stroke (Ostir, et al., 2008). How positive emotion may change over time and how change in positive emotion may impact functional recovery over a relatively long period of time (i.e.,

one year) after a stroke has not been widely studied and represents a gap in the current literature.

In this chapter, the purpose, specific aims, data analysis and findings of this study are reviewed. Conclusions, implications, and directions for future research are presented.

Purpose

The purpose of this research project was two fold. First, to examine change in positive emotion and recovery of functional status in an older, ethnically diverse patient population with a diagnosis of first-time stroke, and secondly, to evaluate associations between change in positive emotion and recovery functional status over a 12-month follow-up period.

AIM 1: DESCRIBE AND EXAMINE THE SOCIODEMOGRAPHIC CHARACTERISTICS, CLINICAL MEASURES, AND FUNCTIONAL STATUS

Findings

Descriptive statistics were used to examine the sociodemographic characteristics, clinical measures, and functional status for 684 older white, black and Hispanic adults with first time stroke at discharge from acute medical rehabilitation. Continuous measures were described as means and standard deviations. Categorical measures were presented as percentages. Analyses of variance (ANOVA) or t-tests (for continuous variables), and chi-square analyses (for categorical variables) were carried out to test for differences in relevant patient characteristics or clinical measures.

The majority of the 12-month follow-up sample was white (79.1%), female (52.3%), and married (52.8%). The mean age was 72.9 (SD=9.52) with the largest percentage of the sample in the 75-84 age category (35.8%). The majority of the sample (78.3%) had 12 or more years of education and the mean length of stay in acute medical rehabilitation was 20.21 days (SD=10.1). The most prevalent type of stroke was ischemic (75.0%) and most of the sample had two or more medical co-morbidities (88.2%). The majority of the 12-month follow-up sample received on-going therapy following discharge from acute medical rehabilitation (90.0%).

Significant differences were noted between racial/ethnic groups on certain sociodemographic characteristics and clinical measures. Whites tended to have longer lengths of stay than blacks or Hispanics. Blacks were younger, less often married, and more often discharged home following acute medical rehabilitation as compared to whites or Hispanics. Hispanics had fewer years of education as compared to whites and blacks. Based on prior research, these differences were expected and supported the hypotheses of this study.

In terms of functional status at discharge from acute medical rehabilitation, the mean cognitive, motor, and total FIM ratings for the 12-month follow-up sample were 25.1 (SD=7.1), 57.7 (SD=17.3), and 82.2 (SD=22.2), respectively.

Racial/ethnic and age differences were found in functional status at discharge from acute medical rehabilitation. Hispanics had higher mean motor and total FIM ratings as compared to whites and blacks, while blacks had higher mean cognitive FIM ratings at discharge as compared to whites or Hispanics.

These differences were not statistically significant. However, the fact that minorities had higher FIM ratings as compared to whites was an unexpected finding. Ottenbacher and colleagues (2008) in a large tri-ethnic study of older adults who received in-patient medical rehabilitation after first stroke found that blacks and Hispanics had lower discharge FIM ratings as compared to whites. The current finding in this study supports recent research indicating some disparities, in terms of access and quality of care, may be narrowing for some minorities (Agency for Healthcare Research and Quality, 2006).

Differences in FIM ratings for the four age categories were also found. The youngest age group (55-64) had the highest cognitive, motor, and total FIM ratings at discharge as compared to the two older age groups (75-84 and 85+). This difference was statistically significant, and supported study hypotheses. A number of pervious studies have demonstrated that following stroke, those younger at stroke onset show greater functional recovery at discharge from acute medical rehabilitation as compared to those in older age groups. (Ergeletzis, et al., 2002; Weimer, et al., 2002; Kugler, et al., 2003; Goslin, et al., 2008).

AIM 2: EXAMINE TRAJECTORIES OF CHANGE IN POSITIVE EMOTION AND RECOVERY OF FUNCTIONAL STATUS OVER A 12-MONTH FOLLOW-UP PERIOD

Findings

Positive Emotion

The mean level of positive emotion for the entire 12-month follow-up sample at discharge from acute medical rehabilitation was 9.41 (SD=2.97).

Given that the maximum possible positive emotion summary score is 12, this average represents a relatively high level of positive emotion. Previous research has demonstrated that older adults can experience high levels of positive emotion, even after a significant medical event such as a stroke (Ostir, et al., 2008b).

An interesting finding was that the level of positive emotion at discharge from acute medical rehabilitation differed by racial/ethnic group, and by age category. Hispanics had the highest mean level of positive emotion at discharge from acute medical rehabilitation, while whites had the lowest. Differences in mean level of positive emotion at discharge from acute medical rehabilitation for racial/ethnic groups were not statistically significant. Patients in the oldest age category (85+) had the highest mean level of positive emotion at discharge from acute medical rehabilitation while the youngest age category (55-64) had the lowest. This difference was not statistically significant. However, it was not surprising to find that older adults had higher levels of positive emotion as compared to younger adults. Several studies have shown that positive emotion may increase as people age (Deiner, et al., 1991; Carstensen and Turk-Charles, 1994; Mroczek & Kolarz, 1998), and that older people, in general, tend to be happier. Studies demonstrate that as people age, changes in emotional regulation and cognition may result in increased positive emotion. In the elderly, there is a tendency toward maximizing positive experiences while minimizing experiences of negative emotion. The elderly also use positive reappraisal of life

events as a coping strategy more often than those who are younger (Windsor, 2009).

Change in Positive Emotion

A significant change in positive emotion was observed over the 12-month follow-up period for the entire study sample. Consistent with study hypotheses, most change occurred between discharge and 3-month follow-up, then plateaued between the 3-month and 12-month follow-ups. In terms of the direction of change, a larger percentage of patients reported an increase in positive emotion (36.7%) between discharge from acute medical rehabilitation and 3-month follow-up as compared to no change (36.3%) or a decline (27%). Between 3-month and 12-month follow-up interviews, more of the sample reported no change (44%) as compared to an increase or decrease in positive emotion. Of those that reported a change in positive emotion between 3 and 12-month follow-ups, a larger percentage reported an increase (33%) as opposed to a decline (22.7%). This finding supports and extends previous work examining positive emotion after stroke. Prior research has demonstrated that in the first three months following stroke, positive emotion can change (Ostir, et al., 2008; Seale, et al., 2010). The current study shows that positive emotion can continue to change over relatively longer periods of time, up to at least one year following a stroke. Also, as hypothesized, of the patients demonstrating change in positive emotion, a greater percentage showed an increase as opposed to a decline.

A surprising finding was the large number of patients (i.e., 23%) in the sample reporting the highest level of positive emotion at discharge, and at 3 and

12-month follow-up. Previous research has demonstrated that adults can experience high levels of positive emotion even after a significant medical event such as a stroke (Ostir, et al., 2008b). However, the group of patients reporting the highest level of positive emotion at all time points was significantly different from others in the sample with regard to certain clinical measures. Those reporting the highest level of positive emotion at all interview time points had shorter lengths of stay, demonstrated higher total FIM ratings, and reported fewer depressive symptoms at discharge from acute medial rehabilitation. This group may represent a resilient subgroup of patients, able to maintain a stable equilibrium of emotional functioning following stroke. Bonanno (2004) has hypothesized a difference between resilience and recovery. Following loss or trauma, emotional functioning may temporarily change (i.e., decline) for some people, then gradually recover over time. This negative change in emotional functioning may cross a clinical threshold and result in a diagnosis, such as depression. Resilience, on the other hand, is the ability to maintain stable and relatively high levels of psychological health in the face of a potentially disruptive event, such as a stroke.

Change in Positive Emotion and Race/Ethnicity

The three racial/ethnic groups showed very different trajectories of change in positive emotion over the 12-month follow-up period. Whites had the lowest mean level of positive emotion at discharge from acute rehabilitation, then gradually increased between discharge and 3-month follow-up. Gains in positive emotion were also noted for whites between 3-month and 12-month follow-up

interviews. Hispanics had the highest mean level of positive emotion at discharge from acute medical rehabilitation, then demonstrated a decline in positive emotion between discharge and 3-month follow-up. Change in positive emotion plateaued for Hispanics between 3-month and 12-month follow-ups. Blacks demonstrated little change in positive emotion between discharge from acute medical rehabilitation and 3-month follow-up, then reported an increase in positive emotion between 3-month and 12-month follow-up interviews. By the 12-month follow-up, blacks reported higher levels of positive emotion than whites or Hispanics. Trajectories of change in positive emotion over a 12-month follow-up period have not been previously studied, and the reasons for racial/ethnic differences in change in positive emotion are not clear. One possible explanation is that stroke is experienced differently by the various racial/ethnic groups. Whites and blacks may have experienced an initial negative reaction to stroke resulting in lower positive emotion summary scores at discharge from rehabilitation, while Hispanics may have experienced a more positive initial reaction. As time progressed between discharge and the two follow-up interviews, coping strategies and circumstances in the discharge environment may have influenced the trajectory of change in positive emotion. For example, whites and blacks may have employed more positive coping strategies than Hispanics (i.e., positive reappraisal, finding meaning, being grateful for surviving the stroke, etc.), accounting for increases in positive emotion. Another possible explanation may involve racial/ethnic differences with regard to demands, role expectations, and support in the discharge environment. For example, those

who felt unable to meet role demands (i.e., bread winner, head of household, home maker, etc.), or felt they had become a burden on the spouse or other family members following stroke may have experienced declines in positive emotion. Conversely, situations where role demands were softened or absent, or where ample support was available, might have resulted in no change or an increase in positive emotion. Finally, a feedback loop between emotion and function may account for changes in positive emotion. That is, those who recover functional abilities may experience a boost in positive emotion which motivates actions that fuel further recovery. The opposite may also be true, where poor recovery leads to decreases in positive emotion and a loss of motivation to engage in behavior that supports continued functional recovery. This topic will be explored later in this chapter when the interaction between change in positive emotion and recovery of functional status is addressed.

Change in Positive Emotion and Age

The trajectory of change in positive emotion was relatively consistent across all age groups with an increase reported between discharge and 3-month follow-up and again between 3-month and 12-month follow-ups. The youngest age group reported the lowest level of positive emotion at discharge from acute medical rehabilitation while the oldest age group (85+) reported the highest level of positive emotion. By 12-month follow-up, however, the younger age group had surpassed all other age groups in reported level of positive emotion. Evidence suggests that older people report higher levels of positive emotion as compared to younger age groups which may account for the initial difference in

levels of positive emotion between young and older age groups at discharge from acute medical rehabilitation (Windsor, 2009). The dramatic increase in positive emotion over time by the youngest age group may have to do with the hypothesized positive feedback loop previously mentioned. That is, as the younger age group experienced gains in functional status they were motivated to continue to engage in behavior that supported further recovery.

Recovery of Functional Status

As predicted, functional status improved over time for the 12-month follow-up sample, with the majority of recovery taking place between discharge from acute medical rehabilitation and the 3-month follow-up interview. Modest gains in functional status (i.e., cognitive, motor, and total FIM ratings) continued for the entire follow-up sample between the 3-month and 12-month follow-up interviews, but this change was not statistically significant. This trajectory of change (i.e., significant change early after discharge, then plateauing between 3 and 12-month follow-up) in functional status is supported by the literature (Patel et al., 2000).

Recovery of Functional Status and Race/Ethnicity

A similar trajectory of recovery of functional status was noted for the three racial/ethnic groups over the 12-month follow-up period. Cognitive, motor, and total FIM ratings increased significantly between discharge and 3-month follow-up. Recovery continued between 3 and 12-month follow up; however, these gains were not statistically significant. At 3-month follow-up, whites had the highest cognitive, motor and total FIM ratings, while Hispanics had the lowest. At

12-month follow-up, whites had the highest cognitive, motor and total FIM ratings, as compared to minorities. The motor and total FIM ratings at 12-month follow-up were more similar for whites and blacks as compared to Hispanics. Analyses demonstrated the amount of functional recovery was significantly different for the 3 racial/ethnic groups. Prior research has demonstrated that minorities recover functional status post stroke at a slower rate and not as completely as whites (Bhandari, et al., 2005; Stansbury, et al., 2005). However, more recent evidence suggests that some disparities (i.e., access to health care and quality of care) are improving for some racial minorities (Agency for Healthcare Research and Quality, 2006). The evidence also suggests that disparities remain prevalent for Hispanics and the very poor. Ongoing disparities in healthcare may account, in part, for the differences in functional recovery between Hispanics and the other two racial groups. Factors in the discharge environment post hospitalization that impact recovery of functional status (i.e., social support, availability of and access to community-based resources) may also account for the differences noted in functional recovery between the three racial/ethnic groups.

Recovery of Functional Status and Age

Cognitive, motor, and total FIM ratings increased from discharge to 3-month follow-up and from 3-month to 12-month follow-up for each of the four age categories over the 12-month follow-up period. Again, the amount of recovery of functional status was significant between discharge from acute medical rehabilitation and 3-month follow-up, then plateaued between 3 and 12-month

follow-up interviews. As predicted by study hypotheses, significant differences in FIM ratings at discharge from medical rehabilitation were noted between the youngest age group (55-64) and the two older age groups (75-84 and 85+). While the youngest age group (55-64) demonstrated better functional recovery than other age groups, particularly the two older age groups (75-84 and 85+) over 12-month follow up on cognitive, motor, or total FIM ratings, the differences were not statistically significant. It has been consistently demonstrated in the literature that age is associated with recovery of functional status post stroke (Ergeletzis, et al., 2002; Weimer, et al., 2002; Kugler, et al., 2003; Goslin, et al., 2008).

AIM 3: DETERMINE INDEPENDENT AND INTERACTIVE EFFECTS OF CHANGE IN POSITIVE EMOTION, SOCIODEMOGRAPHIC CHARACTERISTICS, CLINICAL MEASURES, AND RECOVERY OF FUNCTIONAL STATUS

Findings

As predicted, certain sociodemographic characteristics (i.e., age and race/ethnicity) and clinical measures (i.e., stroke type, number of co-morbidities, and depressive symptoms) were significantly and independently associated with recovery of functional status post stroke. This finding is supported by the literature (Chae, et al., 1996; Hermann, et al., 1998; Adams, et al., 1999; Kugler, et al., 2003; Kissella, et al., 2005; Stansbury, et al., 2005; Seshadri, et al., 2006).

Also, as predicted by study hypotheses, change in positive emotion was associated with recovery of functional status independent of depressive

symptoms, lending further support to the evidence that positive and negative emotion are independent (Bradburn, 1969; Diener and Emmons, 1984; Diener and Lucas, 2000; Folkman and Moskowitz, 2000; Huppert and Whittington, 2003).

Change in positive emotion was associated with recovery of functional status over the 12-month follow-up. Recovery of functional status was noted for the three positive emotion change groups (i.e., positive change, no change, and negative change) as demonstrated by gains in cognitive, motor and total FIM ratings between discharge from acute medical rehabilitation and 3-month follow-up. However, functional recovery relative to the direction of change in positive emotion did not support study hypotheses. The no change group demonstrated the highest FIM scores, followed by the positive change group and negative change group, respectively. The fact that the no change group showed greater functional status recovery as compared to the two other positive emotion change groups is likely due to the number of patients in that change group reporting the highest level of positive emotion. Within the no change group, 23% of patients (n = 160) reported the highest level of positive emotion (i.e., positive emotion summary score of 12) at discharge, and at 3 and 12-month follow-up. Between 3 and 12-month follow-up, the no change and positive change groups continued to demonstrate modest gains in functional status as evidenced by small increases in cognitive, motor and total FIM ratings. However, the negative change group showed a decline in functional status during this same time period. The relationship between change in positive emotion and recovery of functional status

may represent a feedback loop whereby increases in positive emotion provide motivation to the person with stroke to engage in activities that result in improved functional status. Conversely, declines in positive emotion may result in a loss of motivation to engage in behavior that support continued functional recovery. For example, following discharge from rehabilitation, a person with high positive emotion may continue to engage in exercises to improve function, employ compensatory strategies, and seek assistance from a support network. All of which would likely result in improvements in functional status. The noted improvements in functional status might, in turn, result in further increases in positive emotion. The opposite might be true for someone who experiences a decline in positive emotion, resulting in decreased motivation to participate in a home exercise program, employ compensatory strategies or use adaptive equipment, and withdraw from support. Lyubominsky and colleagues (2005) hypothesize a "hierarchy of sustainable happiness" whereby those who possess high levels of positive emotion make conscious choices to engage in thoughts and behaviors that bring about functional change. Dunn and Brody (2008) have termed the actions one takes to bring about functional change, "life regulation qualities". These can include developing and striving to attain personal goals, engaging in regular physical exercise, and participating in meaningful relationships (i.e., giving to others, mentoring another). If properly structured, community life following rehabilitation can provide opportunities for such activities. Increases in positive emotion might also impact the cognitive appraisal of the person's current situation and outlook on the future. Zinn and colleagues

(2004) have demonstrated that cognitive status can impact functional recovery. A person with positive emotion might view the onset of stroke as a challenge to be overcome verses a catastrophic and limiting event. Riener (2007) and Stefanucci and colleagues (2008) demonstrated that persons with high positive emotion view difficult situations less challenging as compared to those who are anxious or in a depressed mood. A person with a positive outlook might be able to recognize small gains in function as evidence of improvement, producing hope for continued functional change and providing motivation to continue with a challenging home exercise program. Dunn, Uswatte and Elliott (2009) report that hope and a future-oriented focus may increase positive emotion and motivate a person to act in ways that enhance the chances of a favorable outcome after onset of disability. Recognizing and continuing to gauge progress, particularly after discharge from rehabilitation, may enhance positive emotion and undo the effects of stress and negative emotion that frequently occur following initial onset of stroke (Frederickson, et al., 2000).

Interpretation of findings

The current study examined change in positive emotion over a 12-month follow-up period and tested whether change in positive emotion (i.e., an increase, no change, or a decline) was associated with recovery of functional status. Over the 12-month follow-up period, 41.2% of participants reported an increase in positive emotion, 22.4% declined, and 36.4% showed no change, adding support to the notion that positive emotion is a dynamic process that can change with time (Ostir, et al., 2008b; Seale, et al., 2010). Given that a large percentage of

the study sample experienced gains in positive emotion over the 12-month follow-up, previous research indicating that older adults can experience high levels of positive emotion, even after a significant health event such as a stroke, is supported. Additionally, change in positive emotion over the 12-month follow-up period was associated with recovery of functional status. No change in positive emotion score, as well as increases in positive emotion scores over the follow-up period, were significantly associated with higher cognitive, motor and total FIM ratings as compared to a decline in positive emotion. This association remained after adjusting for sociodemographic characteristics and clinical measures known to affect recovery of functional status post stroke. It is important to note that the association between change in positive emotion and recovery of functional status was maintained after adjusting for depressive symptoms. Previous studies have demonstrated the independence of positive emotion and depression (Deiner and Lucas, 2000; Folkman and Moskowitz, 2000). Results of this research lend further support to the hypothesis that positive and negative emotions are independent, and that the presence of one is not simply the absence of the other. An interesting finding was the differences in change in positive emotion between racial/ethnic groups. The different trajectories of change in positive emotion and their association with recovery of functional status may account, in part, for racial/ethnic differences in functional status recovery post stroke. As no previous research has examined change in positive emotion over a 12-month follow-up period and examined the relationship

of change in positive emotion and recovery of functional status, this finding is original.

Strengths

This study has a number of strengths including broad geographic representation, use of ICD-9 codes, and reliable measurement instruments. Data were collected on three racial/ethnic groups over a relatively long (i.e., 12-month) follow-up period. The 12-month follow-up sample (n = 684) represented approximately 70% of the initial, eligible patient sample.

Limitations

Although data were collected across diverse geographic regions in the United States, study participants were not randomly selected and may not be representative of all persons with stroke. As is the case with all longitudinal studies, biases may have been introduced by missing data or unbalanced representation of the population.

Change in positive emotion and recovery of functional status was examined using three reference points. A weakness of longitudinal studies is that multiple assessment points may affect the stability and reliability of measures.

Also, to test hypotheses concerning the association between change in positive emotion and recovery of functional status while controlling for variables known to impact recovery following stroke, repeated measures techniques were employed. While this statistical procedure is appropriate for theory-testing, other designs and analyses are available (e.g., latent growth models, multi-level

modeling, etc.) and may have provided additional information about the relative importance of positive emotion in the prediction of functional outcome following stroke in the context of important clinical variables.

Although the measure of positive emotion employed in this study has been used previously with elderly stroke and cardiac patients, it has potential limitations as well. The measure is comprised of only four items and has a limited range of 0-12. Ceiling effects may have been present.

Finally, because inter-hospital variability exists with regard to the type and quality of care delivered by acute medical rehabilitation facilities, hospitals participating in this study may not adequately reflect the rehabilitation experience at other facilities. However, it should be noted that facilities included in the study were Joint Commission for Accreditation of Healthcare Organizations (JCAHO) and Commission for the Accreditation of Rehabilitation Facilities (CARF) accredited. Both agencies set guidelines and standards for care in medical rehabilitation facilities.

Implications

This study supports previous research indicating certain sociodemographic characteristics (i.e., race/ethnicity and age) and clinical measures (i.e., number of co-morbidities, and depressive symptoms) are predictive of functional status post stroke. Most of these factors are non-modifiable. However, positive emotion represents a modifiable factor that may support recovery of functional status post stroke. Functional status is clearly an important health outcome linked to independence, life satisfaction and quality of

life. Ahlsio, et al., (1984) and Indredavik and colleagues (1998) found that following a stroke, those who were independent in performing activities of daily living (ADL) reported significantly higher levels of quality of life as compared to those who were restricted or dependent. Beckley (2006) demonstrated that for people who had sustained a stroke, community participation was related to the person's ability to perform ADL tasks without support. Identifying determinants of health, including personal factors that prevent disease, slow functional declines, improve the ability to live independently, and participate in daily activities and take part in the community is an important national health priority (Department of Health and Human Services, 2008).

Summary

In summary, this study extends previous work indicating that positive emotion can change over time, and lends support to hypotheses regarding the dynamic state of emotions and the independence of positive and negative emotions. Because knowledge of factors associated with functional recovery is essential in working with persons who have experienced stroke, this line of research remains important. Given that positive emotion has been shown to be both protective of stroke (Pennix, et al., 2000; Ostir et al., 2001) and supportive of functional recovery after stroke (Ostir, et al., 2008a), further exploration into the role of positive emotion and its association with recovery of functional status after stroke is warranted. This line of research may give rise to interventions that increase positive emotion and support subsequent functional recovery after stroke onset. Continued exploration of associations between positive emotion

and important sociodemographic characteristics and clinical measures may identify those who are resilient and those who are most vulnerable following a stroke.

Recommendations for future research

As no previous research has examined change in positive emotion over a 12-month follow-up period and studied the relationship of change in positive emotion and recovery of functional status, future research is needed to replicate these findings. Future studies should explore use of additional measures of positive emotion, perhaps multiple measures of this construct in a single study. Given that the number of minorities, particularly Hispanics, was relatively small in the present study (i.e., n=31), over-sampling of blacks and Hispanics should be a consideration for future studies examining the association between positive emotion and recovery of functional status post stroke. Associations between positive emotion and other important rehabilitation outcomes should be explored, for example, community participation and life satisfaction. Finally, as positive emotion appears to be a modifiable factor important in recovery of functional status post stroke, interventions should be employed to increase positive emotion during rehabilitation. Long-term follow-up contacts (i.e., one year or beyond) could be conducted to determine if these interventions influenced change in positive emotion and recovery of functional status, extending the durability of rehabilitation outcomes.

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Vita

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Gary Steven Seale was born in Birmingham, Alabama on December 19, 1957, the oldest child of Gary R. Seale and Barbara Heron. He completed a Bachelor of Science with a double major in Biology and Psychology from Jacksonville State University, Jacksonville, Alabama in 1980. He completed a Master of Science in General Psychology from Jacksonville State University, Jacksonville, Alabama in 1982. After obtaining his Master's degree, he held a number of clinical positions, working in community-based settings with adults with mental illness and dual diagnosis. He has held clinical positions at the Helen Keller School in Talladega, Alabama, the Georgia Mental Health Institute in Atlanta, Georgia, the West Alabama Mental Health Center in Demopolis, Alabama, and the Texas Department of Mental Health and Mental Retardation. He is licensed in Texas as a Psychological Associate and Chemical Dependency Counselor. In 1990, he joined the Transitional Learning Center (TLC) at Galveston, Texas. Since that time he has worked exclusively with adults with acquired brain injury in a comprehensive, post-acute community re-entry program. His peer-reviewed publications include *Development of Critical Paths for Post Acute TBI Rehabilitation* (1996), *Levels of Self-Awareness After TBI: Comparing Patients' and Rehabilitation Specialists' Perceptions* (2001), *Comparisons of the Community Integration Questionnaire, Craig Handicap Assessment and Recording Technique, and Disability Rating Scale in TBI Rehabilitation* (2002), and *Use of the Community Integration Questionnaire to Characterize Change in Function for Individuals with TBI who Participated in a Post Acute Rehabilitation Programme* (2002). He entered the Doctoral Program at UTMB in 2006 and developed an interest in the association between positive emotion and health outcomes. Recently, he co-authored a book chapter entitled, *Emotional Regulation, Processing, and Recovery after Acquired Brain Injury* (2009). He has a peer-reviewed publication, C*hange in Positive Emotion and Recovery of Functional Status Following Stroke* (2010), which was written in conjunction with this current research project. He is presently the Director of Clinical Programs at the Transitional Learning Center in Galveston, Texas.

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