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The Relationship Between Anosgnosia For Hemiplegia After Stroke And Fall Events In The Acute Inpatient Stroke Rehabilitation Population

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THE RELATIONSHIP BETWEEN ANOSGNOSIA FOR HEMIPLEGIA AFTER STROKE AND FALL EVENTS IN THE ACUTE INPATIENT STROKE REHABILITATION POPULATION

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ABSTRACT

Background/Significance: Inpatient falls on acute stroke rehabilitation units remains a significant issue that negatively affects healthcare costs and causes physical and psychological injury. Prevelance of falls in the stroke rehabilitation population may be due to the presence of anosognosia for hemiplegia (AHP), which is as an unawareness of physical disability. Though the link between AHP and falls has been suggested in the literature, a formal investigation has not been conducted to address the relationship between the variables.

Purpose: To explore the association between the presence of anosognosia for hemiplegia after stroke and patient fall events while admitted to an acute inpatient rehabilitation program.

Methods: A prospective, correlational research design was utilized. Logistic regression analysis was then performed between a priori variables after the initial data analysis. Demographic data and data related to fall events were collected for each participant. The Visual Analogue Test for assessing Anosognosia for motor impairment (VATA-m) was utilized to assess for AHP.

Findings: There were no statistically significant relationships between the variables presence and severity of AHP and the prevalence and severity of inpatient falls in the sample. Regression analysis also revealed that the presence and severity of AHP was not

responsible for any variation in number of falls or severity of falls in the sample. Clinically significant findings include the presence of AHP in 94% of the sample, and evidence suggesting that clinicians at the bedside were unaware of the extent of the participant's unawareness, which places the participant at a greater risk for fall events.
Discussion: Though there were not statistically significant relationships between the key variables of interest, clinically significant findings are apparent. The prevalence of AHP in this sample was much higher than other literature, indicating that previously published studies may be underreporting AHP prevalence. Clinicians at the bedside also erroneously charted that their patient was aware of his or her physical impairment in 100% of the sample. Future research should focus on further understanding how AHP affects global outcomes for stroke survivors, and how clinicians measure or assess for awareness at the bedside.

Keywords: stroke, anosognosia for hemiplegia, falls

DEDICATION

To my God who holds my future.

To Jordan, who shows me every day what it means for someone to lay down his life for a friend. I love you more than you'll ever know.

To my children, Jonah and Henry Page, who are my heart and my joy.

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CHAPTER 1

INTRODUCTION

The Centers for Disease Control and Prevention estimate that an elderly (i.e., 65 years of age or older) person falls every 17 seconds (Bechdel et al., 2014). That risk increases if one is admitted to an inpatient nursing unit (Ben Natan et al., 2016), where an estimated 10%-50% of patients fall at least once during their inpatient stay (Aberg et al., 2009). Evidence suggests that inpatient nursing units that treat patients with cognitive deficits, such as stroke rehabilitation units, have a higher incidence of patient fall events (Oliver et al., 2010).

A possible explanation for the increased occurrence of falls on stroke rehabilitation units is the presence of anosognosia for hemiplegia (AHP). The contemporary definition of anosognosia for hemiplegia is a lack of awareness of a specific deficit in function due to the presence of a brain lesion (Kortte & Hillis, 2009). Patients with typical manifestations of anosognosia for hemiplegia often have unrealistic expectations of outcomes while in rehabilitation (Orfei et al., 2009) and are more likely to disregard appropriate safety measures, such as ambulating with assistance, which can lead to falls and serious injury (Hartman-Maeir et al., 2001). However, the relationship between falls and AHP is not entirely understood. Understanding AHP after stroke and its relationship to patient safety events in the stroke rehabilitation setting could potentially lead to a more reliable way to predict which stroke patients might have fall events. Furthermore, a more comprehensive understanding of AHP after stroke would inform the development of interventions to reverse the manifestations and consequences of this syndrome. The purpose of this chapter is to introduce: (a) the research problem; (b) background and significance; (c) theoretical framework; (d) specific aims, research questions, and hypotheses; (e) study design and methods; and (f) definitions of terms of the current study.

Problem Statement

Though much work has been done to stratify fall risk in the stroke rehabilitation population and to design interventions to prevent falls, the fall rate remains a high 7 falls per 1,000 patient days (Quigley, 2016). Falls also extend the hospital length of stay by 6 days (Wong et al., 2011) and cost the healthcare system an average of $14,000 per injurious fall (Haines et al., 2013).

Background and Significance

Despite vast improvements in preventative medicine, more than 800,000 individuals suffer strokes annually in the United States (U.S.) (Lloyd, 2011). Unfortunately, stroke remains the single most common disabling neurological condition (Tilson et al., 2012). Though some therapies, such as intravenous thrombolysis, have contributed to survivorship, many stroke survivors are left with devastating disabilities that increase caregiver burden and decrease the patient's overall quality of life. Clients admitted to an inpatient rehabilitation setting with hemiparesis, cognitive impairment, visuospatial hemineglect, and dyspraxia are more likely to experience a fall (Teasell et al., 2002). There is also existing evidence to suggest that stroke survivors who fall are more likely to suffer an injury during the fall and that they are more likely to fall more than once during their tenure in the inpatient rehabilitation setting (Tilson et al., 2012)

Injuries from falls range from 5% (Walsh et al., 2016) to 50% (Maeda et al., 2015). Even if only a small percentage of falls result in actual bodily injury, such as a broken hip or head trauma, the sequelae of such injuries can be catastrophic in this population, extending the length of stay and inhibiting the ability to participate in rehabilitation activities (Oliver et al., 2004). Furthermore, the psychological effect a fall can have on the individual is noteworthy. It is all too common for a patient to experience significant distress and suffering following a fall, which often leads to a fear of falling that can progress to comorbid immobility, negatively affecting one's quality of life and longevity once discharged (Ben Natan et al., 2016).

Falls also negatively impact the costs of patient care. It is estimated that intentional and unintentional falls have an individual and institutional lifetime cost of $18 billion (Guse et al., 2015). In 2005, in an effort to align financial incentives and high-quality care, the Centers for Medicare and Medicaid Services announced provisions that prevent institutions from being reimbursed the cost to care for patients who suffer an injury-inducing fall while hospitalized (Inouye et al., 2009). The Joint Commission published an alert identifying inpatient falls, and related injuries, as sentinel events or unexpected occurrences involving the risk of serious death or injury (Joint Commission, 2015). According to the alert, thousands of patients fall while hospitalized each year, increasing morbidity, mortality, and overall hospital costs (Joint Commission, 2015). Decades of fall prevention research have been conducted, yet there is still no precise, concise, and comprehensive method for reducing falls in the stroke rehabilitation population. Nursing research should focus on an appropriate risk assessment to identify characteristics that place stroke survivors at an increased risk for falls, and stratify fall prevention interventions based on those assessments (Quigley, 2016).

Anosognosia for hemiplegia (AHP) is estimated to occur in 30% (Vuilleumier, 2004) to 77% (Orfei et al., 2007) of individuals following an acute stroke. In the context of stroke, AHP is the inability of an individual to perceive or acknowledge their physical impairment (Besharati et al., 2015), which can have long-term effects on functional outcomes (Gialanella et al., 2005). Thought to be a failure of the sensory-motor feedback loop, AHP causes an individual to receive inaccurate information from the plegic side or limb that an intended movement has been accomplished as planned. This results in insistence and belief that there is no deficit present at all and that the plegic hemibody functions normally (Fotopoulou et al., 2008). In the acute stage of stroke rehabilitation, it is of utmost importance that stroke survivors be actively engaged and participate in the rehabilitation process. Those with AHP have a tendency to obstruct rehabilitative efforts and refuse to participate in treatments that could considerably improve prognosis (Cherney, 2006). Likewise, those with AHP tend to be unrealistic concerning their housing and financial needs at discharge (Orfei et al., 2007), which often leads to a longer hospital stay.

The presence of AHP can also impact the adherence to appropriate safety measures while admitted to an inpatient rehabilitation center (Hartman-Maeir et al., 2001). One who lacks self-awareness of deficits is likely to choose an activity beyond his or her ability and may require more intensive monitoring to prevent falls (Hartman-Maeir et al., 2002). Though AHP is a relatively common occurrence after stroke, self-awareness has consistently been thought to play a major role in falls (Mihaljcic, Haines, Ponsford, & Stolwyk, 2015, 2017). However, AHP is not regularly assessed on admission or during the inpatient rehabilitation stay. In fact, the majority of literature regarding AHP is generated by neuropsychology journal outlets (Byrd et al., 2020), while nursing has remained silent on the issue. Investigating the potential link between AHP and fall events could lead to a more reliable manner by which stroke rehabilitation patients are stratified for risk of falls, and ultimately to the prevention of falls in this population.

Purpose of the Study

The purpose of this study was to explore the association between the presence of anosognosia for hemiplegia after stroke and patient fall events while admitted to an acute inpatient rehabilitation program.

Specific Aims, Research Questions, and Hypotheses

The specific aims, research questions, and hypotheses of this quantitative study were:

SA 1 Describe the prevalence and severity of AHP in the stroke rehabilitation population.

RQ 1.1 What is the prevalence of AHP in the stroke rehabilitation population?

RQ 1.2 What is the severity of AHP in the stroke rehabilitation population?

SA 2 Describe the prevalence and stratification of fall events as defined by the National Database of Nursing Quality Indicators (NDNQI) in the acute stroke rehabilitation population.

RQ 2.1 What is the prevalence of fall events in the stroke rehabilitation population?

RQ 2.2 What is the severity of fall events in the stroke rehabilitation population?

SA 3 Explore the nature of the relationship between the presence and severity of AHP and prevalence and severity of patient fall events in the acute stroke rehabilitation population.

RQ 3.1 What is the nature of the relationship between the presence of AHP and patients who fall in the stroke rehabilitation population?

H 3.1 There is a positive relationship between the presence of AHP after stroke and patients who fall in the acute inpatient stroke rehabilitation population.

RQ 3.2 What is the nature of the relationship between the severity of AHP and the severity of falls in the stroke rehabilitation population?

H 3.2 There is a positive relationship between the severity of AHP after stroke and the severity of patient fall events in the acute inpatient stroke rehabilitation population.

RQ 3.3 Is the presence of AHP predictive for falls in the stroke rehabilitation population?

H 3.3 The presence of AHP is predictive for falls in the stroke rehabilitation population.

Theoretical Framework

The theory of the neurobiology of motor movement awareness was used to guide this study. Anosognosia for hemiplegia is thought to exist due to a malfunction between the motor control system and the sensory feedback loop. Evidence shows that even after a stroke the motor cortex can activate and generate a movement impulse to a plegic limb. Though the limb does not move as directed, incorrect information based on previous muscle movement is transmitted to the cortex. The stroke patient believes that the movement has been completed as directed (Byrd et al., 2020). This leads to a delusional belief that no impairment exists and the affected stroke survivor can perform movements and function normally (Vuilleumier, 2004).

The neurobiology theory of motor movement awareness was nested in the larger Quality Health Outcomes Model. Based on Donabedian's classic triad of structure, process, and outcomes, the model created by Mitchell, Ferketich, and Jennings (1998) recognizes the dynamic relationship that exists between system influences, client characteristics, interventions, and outcomes. The presence of AHP, considered a client characteristic, could potentially influence the ultimate client outcome. However, consideration of the system and interventions that are currently in place must be taken into account. Utilizing this dynamic model will help researchers understand AHP in the context of not only the patient but also the system (Mitchell et al., 1998).

Study Design and Methods

Because the purpose of the current study was to investigate the relationship between two variables of interest, AHP and fall events, the study design used was a prospective correlational design. A correlational research design is a quantitative research method applied when there is some evidence that two or more variables may be related. Because the relationship between AHP and fall events is not entirely clear, a correlational design is advantagous in determining if a relationship between AHP and fall events exists in this population (Sousa et al., 2007). Though causality cannot be established with this design, this study's results can be used to create hypotheses to be tested utilizing experimental research designs for future studies (Polit & Beck, 2017). A prospective approach was essential because AHP is not currently being assessed in the stroke rehabilitation population, so there was not an opportunity to retrospectively examine the relationship between the variables of interest. Logistic regression was then used to determine if AHP or the severity of AHP is predictive of patients who fall and the severity of those falls.

Inclusion criteria included any patient admitted to an acute inpatient stroke rehabilitation unit in the Birmingham area with the primary diagnosis of ischemic stroke. Exclusion criteria included those admitted to the nursing unit with a diagnosis of hemorrhagic stroke, and subarachnoid hemorrhage, as there is little evidence that AHP is a phenomenon of interest in those types of strokes. Further exclusion criteria included those with a history of a previous stroke, movement disorder, dementia, or the presence of extrapyramidal symptoms that predispose one to falls. By utilizing a consecutive sampling method and recruiting all individuals who met the inclusion criteria from an accessible population, the risk of sampling bias was reduced (Polit & Beck, 2017).

Definitions

For the purposes of this research, the following terms are defined:

Anosognosia

Anosognosia is the general lack of awareness of or the underestimation of a deficit (Byrd et al., 2020).

Hemiplegia

Hemiplegia is the complete or incomplete paralysis of limbs affecting one side of the body (Fisher & Curry, 1965).

Anosognosia for Hemiplegia

Anosognosia for hemiplegia is a condition in which an individual exhibits an unawareness and/or denial of hemiplegia (Byrd et al., 2020).

Fall

A fall is an unintentional descent from a sitting, standing, or lying position to a lower plane (Fischer et al., 2005).

Stroke

Stroke is a neurological condition of the central nervous system that is caused by the infarction of brain tissue by a clot of some origin (Sacco et al., 2013).

Summary

Inpatient hospital falls extend hospital stays by 6 days (Wong et al., 2011) and can cost upwards of $14,000 each (Haines et al., 2013). The acute stroke rehabilitation population is especially susceptible to falls (Oliver et al., 2010). Though work has been done to stratify fall risk and implement interventions to prevent falls in this population, the fall risk remains a high 7 falls per 1,000 patient days. One condition that may predispose inpatient stroke rehabilitation patients to falls is the presence of a condition known as anosognosia for hemiplegia (Hartman-Maeir et al., 2001). In this condition, there is a mismatch between the motor output from the motor cortex and sensory information received from a plegic limb (Vuilleumier, 2004). This leads the affected patient to believe that movement has occurred when it has not. This predisposes the individual to make unsafe decisions like attempting to walk unassisted (Hartman-Maeir et al., 2002). However, the relationship between AHP and fall events in the acute stroke rehabilitation population is unclear. In order to advance risk stratification and fall prevention interventions in this population, this study sought to understand the nature of the relationship between AHP and fall events in the acute stroke rehabilitation population.

The specific aims of this study were to (a) Describe the prevalence and severity of AHP in the stroke rehabilitation population, (b) describe the prevalence and stratification of fall events as defined by NDNQI in the acute stroke rehabilitation population, and (c) explore the nature of the relationship between the presence and severity of AHP and patient fall events in the acute stroke rehabilitation population. To address these aims, a prospective correlational study was conducted. The theory of the neurobiology of motor awareness nested within the Quality Health Outcomes Model was used to guide this study.

To date, no known research has been conducted to understand the nature of the relationship between fall events and the presence of AHP in the acute stroke rehabilitation population. This study addressed a gap in knowledge and was necessary to improve risk stratification and fall prevention interventions for the stroke rehabilitation population.

CHAPTER 2

REVIEW OF THE LITERATURE

Despite improvements in preventative and emergency medicine, acute stroke remains the single most common disabling neurological condition in the United States (Tilson et al., 2012). The majority of patients discharged from an acute care clinical setting will be admitted to an acute inpatient rehabilitation center in order to facilitate greater functional independence (Campbell & Matthews, 2010). However, given the lasting sequelae of stroke coupled with the physically demanding nature of physical rehabilitation units, these patients are at an increased risk for falls (Schmid et al., 2010). Falls in this population can result in hip fractures and head trauma (Walsh et al., 2016), extending the patient stay and increasing patient care costs (Guse et al., 2015).

While fall risk factors are numerous, and fall risk is considered multifactorial, one reason for falls in this population could be the presence of anosognosia for hemiplegia (AHP), which occurs in up to 77% of individuals following an acute stroke (Orfei et al., 2007). AHP is the inability of an individual to perceive or acknowledge their physical impairment (Besharati et al., 2015). In the context of a stroke, AHP manifests as a delusional insistence and belief that no physical impairment exists at all (Fotopoulou et al., 2008). Because of this, the patient often refuses to participate in rehabilitative services (Cherney, 2006) or adhere to appropriate safety measures while admitted to an inpatient rehabilitation center. Though AHP is a relatively common occurrence after stroke, and self-awareness has consistently been thought to play a major role in falls (Mihaljcic et al., 2017), AHP is not regularly assessed on admission or during the inpatient rehabilitation stay. In fact, the majority of literature regarding AHP is generated by neuropsychology journal outlets (Byrd et al., 2020), while nursing has remained silent on the issue. Investigating the potential link between AHP and fall events could lead to a more reliable manner by which stroke rehabilitation patients are stratified for risk of falls, and ultimately to interventions to prevent falls in this population.

The purpose of this literature review is to gain an understanding of the state of the science concerning falls and anosognosia for hemiplegia after stroke in stroke rehabilitation patients. The purpose of this chapter is to present: (a) epidemiologic basis and concepts of interest, (b) literature search strategy, (c) analysis of the literature relative to concepts, (d) theoretical framework, and (e) study design and methods.

Purpose

The purpose of this study is to explore the nature of the relationship between the presence of anosognosia for hemiplegia after stroke and patient fall events while admitted to an acute inpatient rehabilitation program.

Epidemiologic Basis and Concepts of Interest

Stroke

Stroke is responsible for the death of 140,000 people annually and is the fifth leading cause of death in the United States. Eighty-seven percent of strokes are ischemic in nature, meaning that an artery that supplies the cerebral cortex with oxygen and glucose-rich blood is blocked by a clot or an occluded artery (Kochanek, 2019). Because the brain cannot store oxygen or glucose, every second the artery remains blocked increases the likelihood of permanent disability, receptive and expressive language deficits, and cognitive impairment depending on the area of the brain affected (Benjamin et al., 2018).

Substantial geographic disparities for stroke morbidity and mortality exist, with higher rates in the "stroke belt," which is the southeastern region of the United States (Lanska, 1993). Risk factors for stroke include hypertension (Goff et al., 2014), diabetes mellitus (Khoury et al., 2013), heart rhythm disturbances (Wang et al., 2003; Wolf et al., 1991), smoking (Meschia et al., 2014; Shah & Cole, 2010), physical inactivity (Soares-Miranda et al., 2016), and genetics (Markus & Bevan, 2014). There are also numerous social determinants of health that influence the incidence and severity of stroke. Stroke tends to occur in individuals with less education, lower income, limited access to healthcare, and the absence of healthcare insurance. African American ethnicity is also a nonmodifiable social determinant of health. As social determinants of health increase, the effects multiply, and the likelihood of having a stroke increases dramatically (Reshetnyak, 2020).

Stroke is also a leading cause of disability, with 26% of the stroke population remaining dependent in activities of daily living 6 months following the event (Ma et al., 2014). More than half of those affected report a reduction in the ability to ambulate, while others report symptoms of depression and aphasia that interferes with quality of life (Kelly-Hayes et al., 2003). The economic burden of stroke is high in the United States and is influenced by the initial hospitalization, inpatient rehabilitation services, and outpatient rehabilitation services. In the United States, the cost for inpatient rehabilitation facilities (IRF) averages $9,000 per patient stay per month (Rajsic et al., 2018).

Falls

The classic definition of a fall is an unintentional descent from a sitting, standing, or lying position (Fischer et al., 2005). It is estimated that up to 30% of adults age 65 years and older fall each year. The sequelae include serious or life-threatening injury, immobility, and long-term disability (Florence et al., 2018). Falls are also the leading cause of traumatic brain injury (TBI) and TBI-related deaths in adults aged 65 years and older (Johnston et al., 2018). Additionally, there is extensive evidence that suggests that mere hospitalization increases the chances of a fall (Natan et al., 2014), with inpatient fall rates ranging from 3 to 20 per 1,000 patient days (Cumming et al., 2008). Variation in fall rates among nursing units depends on patient population. Evidence suggests that inpatient nursing units that treat patients with cognitive deficits, such as stroke rehabilitation units, have a higher incidence of patient fall events (Oliver et al., 2010) compared to nursing units that care for cognitively intact patients. Much work has been done in the stroke rehabilitation population concerning risk stratification and the initiation of interventions to prevent fall events. Yet, the fall rate remains a high 7 per 1,000 days (Quigley, 2016), which is more than twice the national average of 2.5 to 3 falls per 1,000 days (Bouldin et al., 2013).

Injury rates related to falls in the stroke rehabilitation population are reported to be anywhere from 5% (Walsh et al., 2016) to 50% (Maeda et al., 2015). Even if only a small percentage of falls result in actual bodily injury such as a broken hip or head injury, the sequelae of such injuries can be catastrophic in this population, extending the length of stay and inhibiting the ability to participate in rehabilitation activities (Oliver et al., 2004). Also noteworthy is the psychological effect a fall can have on the individual patient. It is all too common for a patient to experience significant distress and suffering following a fall, which often leads to a fear of falling and comorbid immobility that negatively affects quality of life and longevity once the patient has been discharged (Natan et al., 2014).

Falls also negatively impact the costs of patient care. Based on healthcare costs from 2015, it is estimated that fatal and non-fatal falls have a total healthcare cost of $49.5 billion (Florence et al., 2018), with a single fall increasing one's hospital costs up to $13,000 per incident (Wong et al., 2011). In 2005, in an effort to align financial incentives and high-quality care, the Centers for Medicare and Medicaid Services announced provisions that prevent institutions from being reimbursed the cost to care for patients who suffer an injury-inducing fall while hospitalized (Inouye et al., 2009). In September of 2015, The Joint Commission published an alert identifying inpatient falls and related injuries as a sentinel event, or an unexpected occurrence involving the risk of serious injury or death (Joint Commission, 2015).

Anosognosia for Hemiplegia (AHP)

Anosognosia is a clinical condition in which a patient is unaware of his or her neurological deficits. This condition has been reported in various mental illnesses, including schizophrenia and bipolar disorder (Miller, 2016), and can exist in the presence of dementia (Turro-Garriga et al., 2016). The most common presentation of anosognosia occurs after a stroke, when an individual fails to recognize that he or she is plegic on one side of the body (Saj et al., 2014). It is estimated that 20%-30% of those who suffer a stroke are affected by AHP in the first days to weeks following the event. Patients may incorrectly verbalize that they are able to perform certain functions, such as combing hair or brushing teeth (Orfei et al., 2009). This has serious implications in the stroke rehabilitation population, as patients with AHP tend to either have unrealistic expectations of therapy, or they may refuse to participate in rehabilitation services altogether (Jenkinson et al., 2011). Patients with AHP, because of the disorder's presence, tend to be overconfident in their functional ability and are more likely to engage in risk-taking behaviors, such as ambulating without assistance, even when instructed to ask for help (Hartman-Maeir et al., 2001). In general, the presence of AHP predisposes the patient to a poorer overall recovery (Vocat et al., 2010).

Summary

The Centers for Disease Control and Prevention estimate that one person falls every 17 seconds (Bechdel et al., 2014). The risk for falling increases if one is admitted to an inpatient nursing unit (Aberg et al., 2009). Evidence also suggests that the presence of a neurological diagnosis, like stroke, increases the risk of falling while receiving inpatient hospital or rehabilitative treatment (Oliver et al., 2010). Thus, much research has been conducted to stratify risk and implement interventions to keep this patient population from experiencing falls, but the fall rate remains high compared with the national average (Quigley, 2016). One possible explanation for this is the presence of

AHP, which is a disorder of awareness. The patient does not realize the extent of his or her disability (Orfei et al., 2009), and may engage in risk-taking behaviors even when advised otherwise.

Analysis of the Literature Relative to Concepts

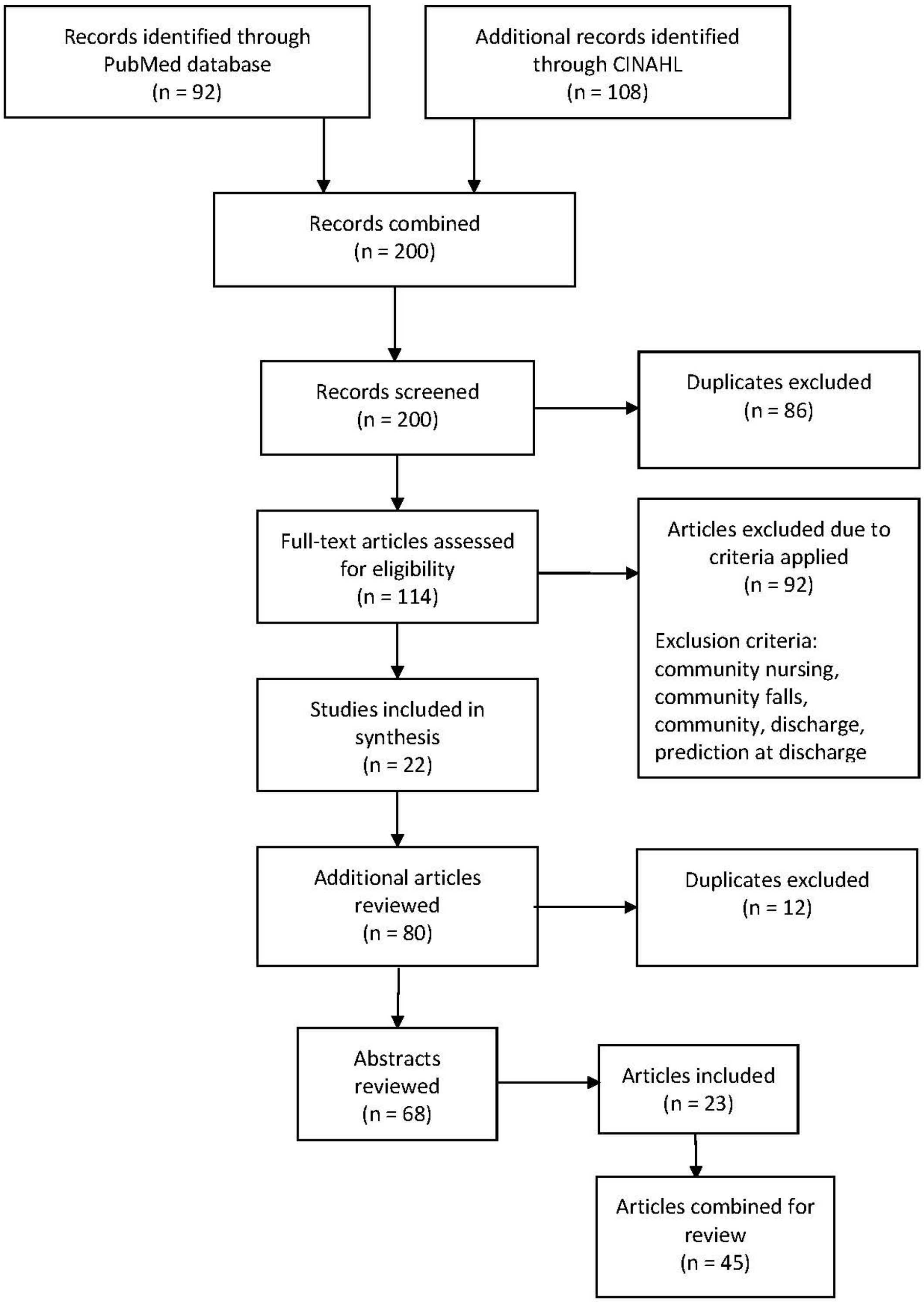
This section presents current risk factors and functional assessment techniques utilized in the stroke rehabilitation population, as well as a review on the concept of anosognosia for hemiplegia. Finally, the current gaps in knowledge will be discussed.

Search Strategy for Fall Risk Assessment and Functional Ability Literature

PubMed and the Cumulative Index to Nursing & Allied Health Literature were searched to identify relevant literature using the terms: *fall risk assessment, stroke,* and *rehabilitation.* The initial search results yielded 200 articles of interest. Article abstracts were reviewed, and publications relevant to community nursing, community falls, discharge, and fall risk at discharge were excluded from the results, leaving 22 articles to include in the synthesis. A review of the articles related to fall risk in the stroke population indicated that further literature review was needed. The keywords *activities of daily living, stroke,* and *fall risk* were entered into the same databases, which yielded 80 results. Removing duplicates, 68 abstracts were considered for inclusion in the review of literature. Twenty-three additional studies were included based on the concepts of interest, for a total of 45 included studies (see Figure 1). Included studies relevant to the current research project all addressed stroke, one's ability to participate in and perform functional activities of daily living, and the use of a specific fall risk instrument in the stroke rehabilitation population.

Figure 1

PRISMA Diagram Depicting Fall Risk Assessment Article Selection



Fall Risk Assessment

Identifying patients at risk for falling while hospitalized is necessary in order to appropriately target prevention measures (Campbell & Matthews, 2010). For decades, a considerable amount of work has been done in an attempt to proactively identify patients at the highest risk of falls. By comparing the characteristics of patients who have experienced a fall while admitted to an inpatient setting with patients who have not experienced a fall, risk assessment instruments have been created (Hendrich et al., 1995; Morse, 1987; Oliver et al., 1997). These classic, retrospective case control studies contributed to the Morse Fall Risk Scale, Hendrich II Fall Risk Scale, and STRATIFY (St. Thomas's Risk Assessment Tool in Falling Elderly Inpatients), which remain the three most widely utilized fall risk assessment instruments (Swartzell et al., 2013). While each of the three instruments has been validated across multiple patient populations (Hendrich, 2007; Morse, 2008; Oliver et al., 2004), not one has been validated for use in stroke rehabilitation. Another limitation of these instruments is that they fail to consider the population-specific needs and deficits present after a stroke (Campbell & Matthews, 2010).

The nursing and rehabilitative medicine community is acutely aware of the specific deficits present after a stroke and has worked to create a stroke-specific risk assessment scale (Baetens et al., 2011; Beghi et al., 2018; Breisinger et al., 2014; Chen et al., 2015; Cox et al., 2015; Goh et al., 2016; Nyström & Hellström, 2013; Patterson et al., 2017; Roos et al., 2016; Schmid et al., 2010; Takatori, Shomoto, et al., 2009; Tilson et al., 2012; Weerdesteyn et al., 2008). Each of these observational studies was conducted in the stroke rehabilitation inpatient population with the primary outcome measure being fall during hospitalization. The purpose of each study was to identify characteristics that are predictive of falls, so large amounts of data were entered into a database, and multiple regression models were created. From there, the significant variables from the regression models were used to promote the creation of multiple new risk assessment profiles by which to stratify fall risk. Due to differences in operational definitions and non-standardized used of variables, the fall risk assessments are all different. Thus, the current literature provides little direction toward a clinically useful set of risk factors relating specifically to fall patients. Likewise, the current studies driving fall risk assessment forward are not based on a priori knowledge, theory, or created conceptual models (Baetens et al., 2011; Beghi et al., 2018; Breisinger et al., 2014; Chen et al., 2015; Cox et al., 2015; Goh et al., 2016; Nyström & Hellström, 2013; Patterson et al., 2017; Roos et al., 2016; Schmid et al., 2010; Takatori, Shomoto, et al., 2009; Tilson et al., 2012; Weerdesteyn et al., 2008). Consequently, there is yet to be an accepted and validated instrument by which to stratify fall risk in the stroke rehabilitation population (Campbell & Matthews, 2010). The latest recommendation from *The International Journal of Stroke* is that all patients should be screened by an experienced clinician on admission and upon change of condition. There are no recommendations for utilizing a specific risk assessment instrument. The variables identified utilizing the search strategy detailed above are described below.

Measures of Functional Ability

Impaired physical function is a common outcome following an acute stroke. Impaired balance and mobility are two important factors that lead to unsafe ambulation in this population (Roos et al., 2016). The Berg Balance Scale (BBS) was originally created to assess balance and mobility in the geriatric population (Blum & Korner-Bitensky, 2008) but has long been identified as the most commonly utilized scale across the care continuum, including use in the stroke rehabilitation population (Korner-Bitensky et al., 2006). While the majority of studies identify the BBS as predictive fall risk indicator (Cho et al., 2015; Tilson et al., 2012; Weerdesteyn et al., 2008), in some studies, the instrument fails to discriminate between fallers and non-fallers (Baetens et al., 2011; Patterson et al., 2017). Still, another study concludes that balance confidence, and not objective balance, is a positive predictor for inpatient falls (Beghi et al., 2018).

Other measures of activities of daily living (ADL) include measuring mobility via the Modified Motor Assessment Scale (MMAS), the Barthel Index, the Functional Ambulation Category, and abstracting data from the medical chart concerning feeding, toileting, transferring, grooming, and ambulating (Cho et al., 2015; Nystrom & Hellstrom, 2013; Schmid et al., 2010; Takatori, Okada, et al., 2009; Takatori, Shomoto, et al., 2009; Tilson et al., 2012; Vratsistas-Curto et al., 2018). The Motor Assessment Scale (MAS) is an original scale created in 1985 by Carr, Shepherd, Nordholm, and Lynne. This scale uses a task-oriented approach to measure functional recovery following a stroke. A modified version of the scale (MMAS) removed subjective items from the scale to increase the sensitivity and interrater reliability. The modified scale was reviewed for content validity via three physical therapists who treat stroke patients in their practice. The eight items score ADL tasks pertaining to upper extremity motor control, balance, and function (Loewen & Anderson, 1988). Test-retest reliability of the original scale was established ($r = 0.87$ to $r = 1.00$) (Carr et al., 1985), as well as interrater reliability (*r* = 0.29) (Poole & Whitney, 1988). Interrater reliability has also been established for the modified version of the scale, with Spearman rank order coefficients for the total MMAS ranging from 0.83 to 1.00 (Loewen & Anderson, 1988).

The Barthel Index was developed for use in rehabilitation patients who have had a stroke or a history of other neuromuscular disorders. The Barthel Index is a widely used measure of functional disability and will indicate if assistance is needed in completing ADL (Mahoney & Barthel, 1965). The original scale focuses on the following categories: feeding, bathing, grooming, dressing, bowel control, bladder control, toileting, chair transfers, ambulation, and stair climbing. The items are weighted according to the amount of nursing care required to perform the task, scored as 10, 5, or 0, with 0 being a score delineated to total dependence. A modified version of the scale was created in 1988, changing the scale to a 3-point ordinal scale (Collin et al., 1988). Both the Barthel Index and the Modified Barthel Index have established test-retest reliability (Green et al., 2001), interrater reliability (Duffy et al., 2013), and predictive validity (Hsueh et al., 2001) for ADL function 6 months following a stroke.

The Functional Ambulation Category (FAC) is yet another functional assessment that is utilized in rehabilitation patients. Its usefulness is not limited to stroke; however, it is widely utilized in this population due to typical deficits in function experienced following a cerebrovascular accident. This assessment is a functional walking test that evaluates ambulation ability. A 6-point scale is used to quantify how much human support is needed during ambulation regardless of the use of a personal walking assistive device (Holden et al., 1984). Internal consistency and intrarater reliability have not been established for this scale. Interrater reliability was examined by Collen, Wade, and

Bradshaw (1990) and found to be poor (*k* = 0.36). The measure was found to be an accurate predictor of community ambulation at 6 months post stroke (Mehrholz et al., 2007), yet no studies have reported sensitivity or specificity of the measure with stroke patients.

The majority of the literature supports the idea that decreased function, as evidenced by lower scores in the Barthel Index, Modified Motor Assessment Scale, and general functionality, is associated with an increased risk for falls (Cho et al., 2015; Nyström & Hellström, 2013; Tilson et al., 2012; Vratsistas-Curto et al., 2018). Other studies indicate that the Functional Ambulation Category and the Barthel Index are, in fact, not predictive for patient falls (Takatori, Shomoto, et al., 2009).

Another nationally recognized and utilized measure of functional independence is the Functional Independence Measure (FIM). This measure was developed to address the concerns of sensitivity and comprehensiveness that were deemed limitations of the Barthel Index. This measure was also developed to offer a uniform and standard measurement of disability based on the International Classification of Impairment, Disabilities, and Handicaps to be utilized in the United Stated medical system (Keith, 1987; McDowell & Newell, 1996). As with the Barthel Index, the FIM is meant to quantify a patient's disability following a stroke. The disability level indicates the amount of support needed to perform certain ADL. The FIM assesses six areas of function, including self-care, sphincter control, mobility, locomotion, communication, and social cognition. The FIM has demonstrated internal consistency (Dodds et al., 1993; Hsueh et al., 2001), test-retest reliability (Chau et al., 1994), intrarater reliability (Sharrack et al., 1999), and interrater reliability (Chau et al., 1994). Face and content validity of the FIM were determined by utilizing the Delphi method using rehabilitation expert opinion to establish the terms' appropriateness (Granger et al., 1986).

The Uniform Data System (UDS) utilizes the FIM for Medical Rehabilitation (UDSMR). The UDSMR is a not-for-profit organization that is affiliated with the University at Buffalo in the State of New York. Since its inception in the 1980s, the UDS has provided the most comprehensive rehabilitation data to the industry and maintains the world's largest database for medical outcomes in rehabilitation. Facilities worldwide utilize the UDS measurement system to document patient function and improvement during their rehabilitation stay. More specifically, the UDS system provides a comprehensive tool that combines patient assessment and outcome management with reimbursement. Because of this, the UDS database is often used when the rehabilitation industry is looking at trends, setting benchmarks, and engaging the public on policy decisions (Fiedler & Granger, 1996).

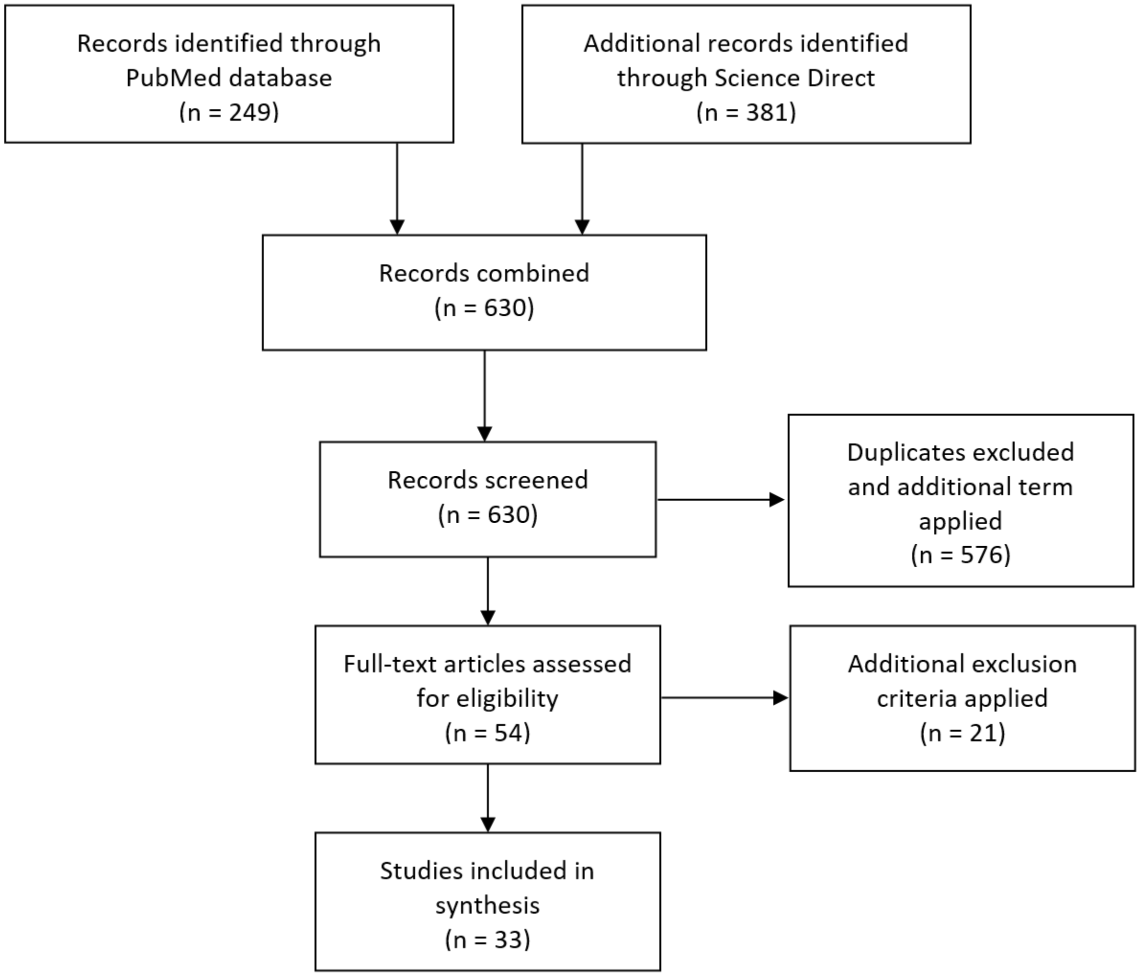
Because the FIM is utilized nationally by the UDS, studies have attempted to use the FIM score to stratify fall risk (Chen et al., 2015; Lee & Stokic, 2008; Goljar et al., 2016). A patient's total FIM score can range from 18 to 126, with the higher score indicating more independence in function. In each of the studies listed above, the FIM score was significantly lower for patients who sustained a fall while hospitalized versus those who did not sustain a fall (Chen et al., 2015; Lee & Stokic, 2008; Goljar et al., 2016), further indicating that general functional ability contributes to fall risk. Likewise, if an individual overestimates their functional ability, the potential for a fall can increase. Due to this connection, anosognosia for hemiplegia or the unawareness of one's functional limitations could be a factor in inpatient falls in the stroke rehabilitation population.

Search Strategy for Anosognosia for Hemiplegia Literature

Two databases were used to locate literature relevant to this review. The term *anosognosia for hemiplegia* was entered into the PubMed and Science Direct databases. A total of 630 articles were identified. After removing duplicates and applying the additional term *stroke,* 54 unique articles were reviewed for inclusion. After abstract review of the articles, additional exclusion criteria were needed. Articles that included research on apraxia, acquired traumatic brain injury as the mechanism of stroke, and hemorrhagic stroke were excluded from the review. A total of 33 articles were included in this review based on the purpose of this review. The content and focus of the articles included history and definition, theoretical evidence for AHP, imaging evidence for AHP, measurement, outcomes, and interventions for AHP (see Figure 2).

Figure 2

PRISMA Diagram Depicting Anosognosia for Hemiplegia Article Selection



Anosognosia for Hemiplegia

History and Definition

Anosognosia for hemiplegia after stroke is a phenomenon that was first described by a French physician in the 20th century. In an article published in 1914, Dr. Joseph Babinski described observations made while he was treating two patients who had survived a stroke. Both of the patients seemed cognitively intact, exhibiting no evidence of confusion or cognitive deficit. Both patients also exhibited a left hemiparesis. Yet, when asked to move the plegic limb, one patient ignored the request. The second patient attributed the inability to move the limb to a previous injury and back pain (Langer, 2009). Dr. Babinski called this unawareness anosognosia, which translated from Greek means "without disease knowledge" (Fotopoulou et al., 2008).

Theoretical Evidence for Anosognosia for Hemiplegia

Denial has been described as a powerful psychological defense mechanism. When one experiences a situation or circumstance that is psychologically painful, there is evidence to suggest that both denial and repression can be used to remove the painful memory from consciousness. With AHP, the painful experience is the knowledge that independent function has been lost, and there is a new functional deficit that is life changing. The psychological hypothesis of repression explains the denial of the hemiplegia (Fotopoulou et al., 2010; Nardone et al., 2008). AHP has also been explained as a consequence of sensory feedback deficits (Levine et al., 1991), or due to spatial neglect or the inability to be fully aware of objects on the body's plegic side (Heilman et al., 2003).

According to Bottini et al. (2009), the psychodynamic theories of AHP have fallen out of favor with the scientific community. They have been replaced by theories based on the neurobiology of motor control. Forward dynamic models of movement are created by the central nervous system to accurately and efficiently complete motor commands. Sensory feedback is sent to the central nervous system so that movements are refined and precise. In healthy individuals, this feedback loop is continuously updating and correcting for motor errors. Contemporary theories for AHP suggest that there is a failure in the feedback mechanism that results in the delusional denial of hemiplegia (Fotopoulou et al., 2010; Jenkinson et al., 2009; Preston & Newport, 2014; Saj et al., 2014; Vocat et al., 2013). According to Fotopoulou et al. (2010), the individual's internal model of movement supersedes any sensory feedback received from the plegic limb. Vocat et al. (2013) termed the inability to process sensory information the "inability of the person to update beliefs" concerning the plegic limb (p. 1771). There is also evidence to suggest that central nervous system controllers meant to detect mismatches between the intended action and the action performed malfunction, producing denial of impairment (Saj et al., 2014). Noisy sensory feedback (Preston & Newport, 2014) and distorted sensory feedback (Jenkinson et al., 2009) have also been implicated in AHP.

Imaging Evidence for Anosognosia for Hemiplegia

In recent lesional mapping studies, AHP has been associated with superficial and deep cortical lesions, mostly confined to the brain's right side (Pia et al., 2004). Anosognosia for hemiplegia has also been associated with subcortical atrophy that primarily involves the frontal white matter and the brain's diencephalic regions (Mattioli et al., 2012; Starkstein et al., 2010). Other radiographic studies indicate a wider network of damage is involved with AHP, including damage to the Rolandic operculum, the insula, and the superior temporal gyri (Moro et al., 2011). Damage to the brain's temporal areas and the basal ganglia have also been implicated in the manifestations of AHP (Mattioli et al., 2012; Moro et al., 2011).

Measuring Anosognosia for Hemiplegia

Anosognosia for hemiplegia is considered a complex and multifaceted phenomenon. Because of this, numerous assessment tools for measuring the presence of AHP have been developed. A recent review of methods for measuring AHP over the last 35 years indicates that numerous assessments for the presence of AHP have been developed (Nurmi Laihosalo & Jehkonen, 2014). Despite the number of AHP assessments available, there are a few instruments that seem to be favored by the scientific community. In the 20th century, the two preferred tools utilized were The Rating Scale, authored by Bisiach et al. in 1986, and The Anosognosia Questionnaire, authored by Starkstein et al., in 1992. The early 21st century showed little change as Bisiach's Rating Scale was still favored among scientists. The second most common scale used is an assessment procedure created by Berti et al. in 1996. The third most utilized instrument is the Visual-Analogue Test for Anosognosia for motor deficits (VATAm), authored by Della Sala et al., which was utilized in this current study (Nurmi Laihosalo & Jehkonen, 2014).

The typical assessment of anosognosia utilized in all of the above-mentioned instruments involves asking patients to reflect upon their condition and provide some type of insight into what they believe their deficit is. Typically, these assessments are performed via structured interviews or self-evaluation questionnaires (Jehkonen et al., 2006; Orfei et al., 2009; Orfei et al., 2007). Structured interviews often begin with the interviewer asking the patient if he or she is aware of a specific deficit. If not, the interviewer will attempt to demonstrate the deficit by asking the patient to move his or her plegic limb. A score is assigned to the patient depending on the level of awareness demonstrated during the interview (Berti et al., 1996; Bisiach et al., 1986). The self-evaluation method of measuring AHP consists of asking patients to rate themselves on their ability to perform various ADL. A caregiver or healthcare provider also completes the questionnaire, and the two are compared. If the patient has overestimated their ability to perform a certain task, as compared to the caregiver or healthcare provider rating, this is interpreted as evidence of anosognosia (Berti et al., 1996; Marcel et al., 2004).

Anosognosia for hemiplegia has traditionally been described as a phenomenon that is restricted to right-sided infarcts. While most imaging evidence supports this assumption (Pia et al., 2004), there is concern that potential patients who have suffered a left-sided infarct are excluded from studies because of their inability to participate in the classical interview and self-evaluation methods of AHP. Left-sided infarcts damage the language center, creating an aphasia that may obscure the presence of anosognosia (Hartman-Maeir et al., 2002). The recently created VATAm allows for a more reliable assessment of anosognosia for hemiplegia. It is useful specifically in individuals with language impairments. Still utilizing self-evaluation and a 4-point analog scale, the VATAm uses questions and pictures to elicit a response from the patient. The patient responses are then compared to the clinician response, and the degree of anosognosia can be determined (Della Sala et al., 2009). Studies utilizing the VATAm allow for the assessment of a larger number of language-impaired patients. This assessment tool has also increased the sensitivity of anosognosia diagnosis in left hemisphere infarct patients (Cocchini et al., 2009; Cocchini et al., 2010; Cocchini et al., 2013; Della Sala et al., 2009).

Outcomes in Anosognosia for Hemiplegia

The presence of anosognosia also influences rehabilitation and recovery after a stroke. Though not recent, a study conducted in 1996 found that patients diagnosed with anosognosia for hemiplegia had a significantly lower Barthel Index at discharge, indicating the need for more assistance in performing ADL. The same study found that the presence of the disorder increased the likelihood of death during hospitalization, and decreased the likelihood of discharge to an independent living situation (Pedersen et al., 1996). Likewise, Gialanella, Monguzzi, Santoro, and Rocchi (2005) compared Functional Independence Scores of patients with anosognosia for hemiplegia with patients who did not have the disorder. Both groups were given standard rehabilitative care. At the time of discharge, patients with AHP had FIM scores, on both the cognitive and motor scale, significantly lower than those of patients without the disorder (Gialanella et al., 2005). While the mechanism remains unclear, the presence of AHP delays discharge, predicts a lower functionality at discharge, and seems to inhibit successful rehabilitation (Appelros et al., 2003; Gialanella et al., 2005; Maeshima et al., 1997; Pedersen et al., 1996). Beyond rehabilitation, the presence of AHP in the acute phase of stroke predicts a poorer functional outcome 1 year after the ischemic event (Prigatano, 2008).

Interventions for Anosognosia for Hemiplegia

There have been three published interventional studies pertaining to AHP (Besharati et al., 2015; Fotopoulou et al., 2009; Moro et al., 2015). In each of the case studies, the patients were first asked if they were able to perform a task with the affected limb. Then, the investigators asked the participants how well they believed they executed the task. Lastly, the investigators showed the participants recorded videos of the task execution. In each instance, after viewing a short video and being visually confronted with evidence that a disability is present, each of the three individuals in the case studies experienced a sudden and dramatic realization of disability. Of note, each participant remained in a state of awareness concerning their disability over time (Besharati et al., 2015a; Fotopoulou et al., 2009; Moro et al., 2015). Because the individuals in these case studies were truly unaware of their motor deficit, becoming acutely aware of their disability was coupled with an emotional response. One participant cried and wondered aloud if she would ever work again (Fotopoulou et al., 2009). Another patient withdrew and would not interact with the investigators for an extended period (Besharati et al., 2015a). The emotional response elicited from the participants raises ethical concerns regarding the development of interventions that confront individuals with AHP. The confrontation method and the ethical considerations of using such a technique are important as more is learned about the presence of AHP in the stroke rehabilitation population, and as interventions are developed for use in this population.

Summary of the Review of Literature Related to Concepts of Interest

Identifying the patients at the highest risk for falls is necessary to appropriately target preventative measures (Campbell & Matthews, 2010). Unfortunately, the scales that are utilized in the stroke rehabilitation population have been validated for use in general surgery, medicine, endocrinology, and long-term rehabilitation populations (Hendrich, 2007; Morse, 2008; Oliver et al., 2004). While these instruments perform well in these specific populations, not one has been validated in the stroke rehabilitation population, nor do they consider the population-specific deficits that are often present after a stroke (Campbell & Matthews, 2010).

This fact is not lost on the stroke rehabilitation community. There have been numerous studies and efforts to create a scale both sensitive and specific to fall risk after a stroke (Baetens et al., 2011; Beghi et al., 2018; Breisinger et al., 2014; Chen et al., 2015; Cox et al., 2015; Goh et al., 2016; Nystrom & Hellstrom, 2013; Roos et al., 2016; Takatori, Shomoto, et al., 2009; Tilson et al., 2012; Weerdesteyn et al., 2008). Each of the studies discussed above collected various data from participants in a stroke rehabilitation program. Each of the data points was entered into a regression. The significant variables were either used or recommended to create a new, more sensitive fall risk assessment. Differences in operational definitions and the use of nonstandardized variables bring into question the generalizability of the study results. Likewise, the studies are not based on any a priori knowledge, theory, or conceptual model, though the patient's functional ability continues to surface as the standard outcome measure following an acute stroke.

Therefore, recent research focuses on different measures of functional ability post-stroke, including impaired balance and mobility (Roos et al., 2016). The most common instrument utilized to measure balance is the Berg Balance Score (Blum & Korner-Bitensky, 2008). Other functional measures include the Motor Assessment Scale (Carr et al., 1985), the Modified Motor Assessment Scale (Loewen & Anderson, 1988), the Barthel Index (Mahoney & Barthel, 1965), and the Functional Ambulation Category (Holden et al., 1984). Though these scales are widely used, and there is sufficient evidence that they are able to predict and measure function, there is conflicting evidence regarding their usefulness in predicting falls (Cho et al., 2015; Nyström & Hellström, 2013; Takatori, Okada, et al., 2009; Takatori, Shomoto, et al., 2009; Vratsistas-Curto et al., 2018). The Functional Independence Measure is a standardized and nationally recognized measure of independence, and studies have suggested that, in general, functional ability contributes to fall risk (Chen et al., 2015; Goljar et al., 2016; Lee & Stokic, 2008).

Closely linked to one's functional ability is the concept of understanding current physical abilities or limitations. Anosognosia for hemiplegia is a phenomenon of unawareness after a stroke that was first described by Dr. Joseph Babinski in the early 20th century (Langer, 2009). Characteristics of the disorder often occur after the acute stage of a stroke. Though plegic on one side, the patient will often insist that he or she can move and perform tasks as before (Fotopoulou et al., 2010). Multiple theories have attempted to explain this disorder's presence, including psychodynamic theories that propose anosognosia is a protective disorder and that the denial and repression of the plegia is instinctive (Nardone et al., 2008). More contemporary theories utilize the classic forward dynamic model to explain how such an order can exist (Bottini et al., 2009).

Forward dynamic models are functional models created by the central nervous system in order to produce smooth, efficient, and coordinated movement (Jordan & Jacobs, 1992). Sensory feedback is sent back to the central nervous system in order to correct for error and refine motor movements in the future. In patients with anosognosia for hemiplegia, there is a deficiency in the feedback mechanism which causes the patients to believe they have moved when they actually have not (Fotopoulou et al., 2010; Jenkinson et al., 2009; Preston & Newport, 2014; Saj et al., 2014; Vocat et al., 2013).

Imaging evidence for anosognosia has suggested that the majority of the time, the disorder is associated with both superficial and deep cortical lesions that are mostly confined to the right side of the brain (Pia et al., 2004). There is also evidence that other important cortical areas, including the brain's temporal area and the basal ganglia, are involved (Mattioli et al., 2012). The idea that AHP is predominantly a disorder that manifests after right-sided infarcts has been the subject of much debate. While imaging evidence supports this notion (Pia et al., 2004), there is concern that assessments used for measuring AHP are not sensitive to individuals who may have AHP and have suffered a left-sided infarct (Hartman-Maeir et al., 2002). Because of this, the Visual-Analogue Test for Anosognosia for motor deficits (VATAm) was created, and has been modified in a way that identifies individuals with AHP after a left-sided infarct (Della Sala et al., 2009).

The presence of anosognosia for hemiplegia influences rehabilitation and recovery after a stroke. Evidence suggests that the presence of the disorder predicts poorer outcomes 12 months post-stroke events (Pedersen et al., 1996). Individuals with AHP often refuse to participate in functional rehabilitation programs (Cherney, 2006) and are less likely to adhere to appropriate safety measures while admitted to a rehabilitation unit. This is problematic as the purpose of rehabilitation is to improve functional ability before discharge, and those with AHP tend to have a longer length of stay, lower functionality at discharge, and are more likely to be discharged to a dependent living situation versus those who do not have the disorder (Gialanella et al., 2005). Three case studies have been conducted in which the anosognosic individual is confronted with video evidence of his or her disability (Besharati et al., 2015a; Fotopoulou et al., 2009; Moro et al., 2015). In each study, the participants experienced a sudden, and dramatic understanding of their deficit, which is promising for future interventions for this population of patients. However, each of the participants had an emotional response to the realization of their disability, which is an essential issue in the protection of human subjects.

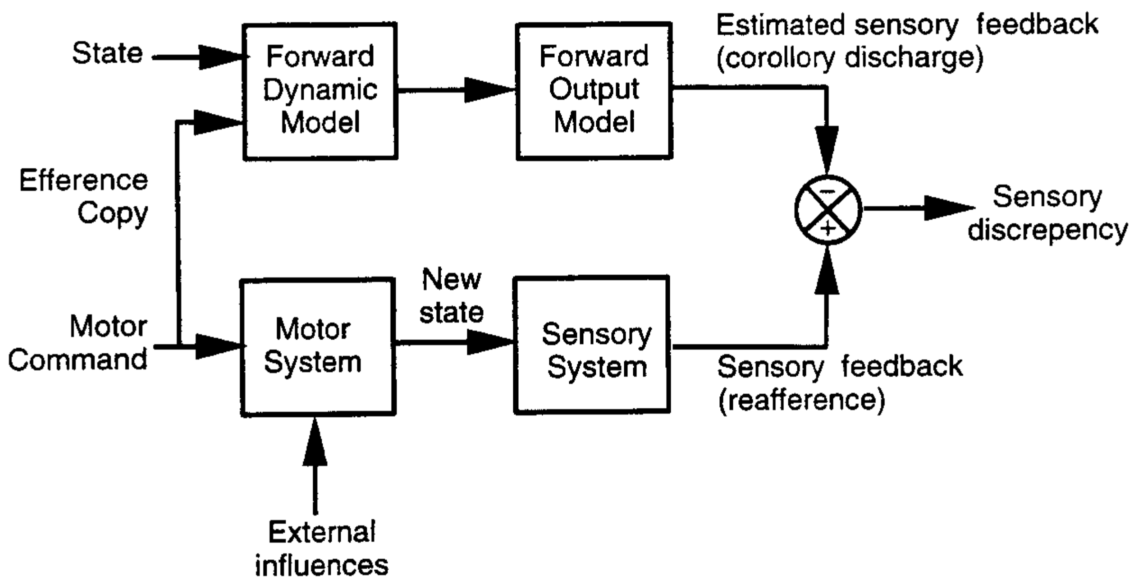
The gaps identified in the literature, specifically relating to fall risk stratification in the stroke rehabilitation population, include the lack of a valid and reliable tool by which to stratify stroke rehabilitation patients and risk for falls. Likewise, the methodology utilized to create population-specific tools is not based on a priori knowledge, conceptual maps, or hypotheses. In addition, anosognosia for hemiplegia, which could be significantly related to falls in the stroke rehabilitation population, remains largely unknown and unassessed by the nursing and healthcare personnel who work closely with this population. This study addressed these gaps by providing a framework for the concepts of interest and identifying the nature of the relationship between falls and anosognosia for hemiplegia in the stroke rehabilitation population.

Theoretical and Conceptual Framework

The theoretical framework used to guide the design of this study was based on the neurobiology of movement (Frith et al., 2000) and the theory of forward dynamic models for physiological motor control (see Figure 3) (Jordan & Jacobs, 1992; Jordan & Wolpert, 1999; Kawato et al., 1987; Wolpert & Miall, 1996). Existing evidence suggests that the central nervous system, in initiating and completing a motor movement, utilizes the concept of an internal model. The model mimics the behavior of a natural process and can predict dimensions of one's own body in relation to the external world (Frith et al., 2000). According to this theory, movement is based on the intention of action and the planning of motor movement. A motor movement's success is attributed to systems within the central nervous system that have been called predictors and controllers. In healthy individuals, due to existing internal models of movement, movement accuracy is "predicted" via the predictor, and the end consequence of the movement is estimated. Another process in the central nervous system, termed the controller, captures the relationship between the desired action and the action that was achieved. This feedback is directed to the sensorimotor cortex and is used to predict more efficient and accurate movements in future motor commands (Frith et al., 2000). Interacting motor and sensory systems not only ensure the successful completion of a planned and executed motor action, but they enable individuals to learn and master more eloquent and coordinated movements as time passes. The sensory feedback loop, seen in Figure 3 as sensory feedback (reafference) and estimated sensory feedback (corollary discharge), is continually updating and detecting discrepancies between the motor action plan and the executed movement. If the movement is not conducted as intended, the comparator notes the sensory discrepancy, and that information is used to inform motor awareness and to compensate for motor errors (Frith et al., 2000; Wolpert & Miall, 1996).

Figure 3

Forward Dynamic Model for Motor Control



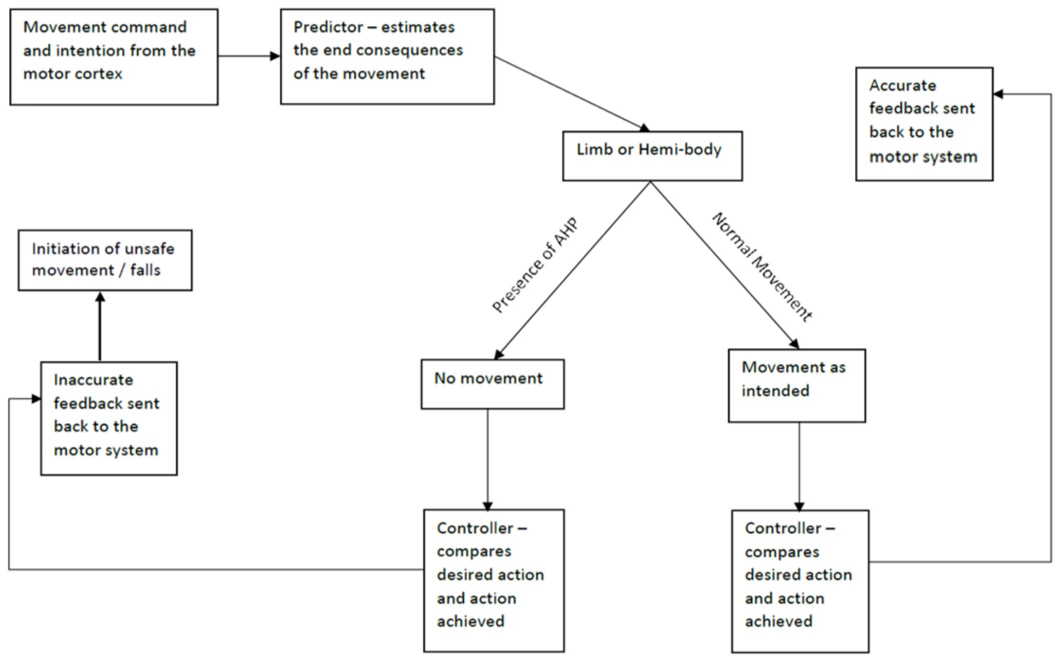
Note. From "Forward Models for Physiological Motor Control," by R. C. Miall and D. M Wolpert, 1996, *Neural Networks, 9*(8), 1265-1279.

In some individuals with stroke, the predictor and controller roles of the sensorimotor system malfunction because relevant areas of the brain have been damaged via infarction (Frith et al., 2000). Evidence suggests that individuals with a stroke can still activate the motor cortex and initiate a movement command (Langer, 2009). However, due to a malfunction in the predictor, the individual cannot correctly identify the position or movement of the paralyzed limb. Instead, the perception of the paralyzed limb's position and movement is based on previous experience and successful execution of the command, and the individual believes that he or she has completed the movement as intended (see Figure 4). Over time, one's motor system should receive the update that the movement did not occur in the plegic limb. Thus, in the stroke patient, due to the malfunction in the sensorimotor feedback loop, there continues to be a discrepancy between the action intended by the controller and the feedback produced by the predictor. This inability to update via the typical feedback loop manifests itself as a state of unawareness of deficit or disability and delusional denial of deficit (Frith et al., 2000).

Because the individual's awareness is dominated entirely by one's intention to act versus the failure to process sensory information accurately, movement discrepancies are not consciously realized, and the individual will attempt to transfer, move, and ambulate even though warned to ask for help beforehand. Since the patient does not consciously realize that movements are not conducted as planned, traditional fall prevention strategies fail to be effective. The incorrect sensorimotor feedback experienced by the patient will override any extrinsic fall risk intervention implemented by staff. To date, there has not been an experiment that directly studies the relationship between AHP and falls in the stroke rehabilitation population. Most of the literature concerning AHP stems from neuropsychology outlets, while nursing has remained silent on the issue. By understanding the nature of the relationship between AHP and falls in stroke rehabilitation, utilizing the theoretical and conceptual frameworks described here, a more comprehensive understanding of the variables will be achieved. Furthermore, potential interventions and treatments could be implemented to reverse the manifestations and consequences of AHP after stroke in rehabilitation patients.

Figure 4

Conceptual Framework

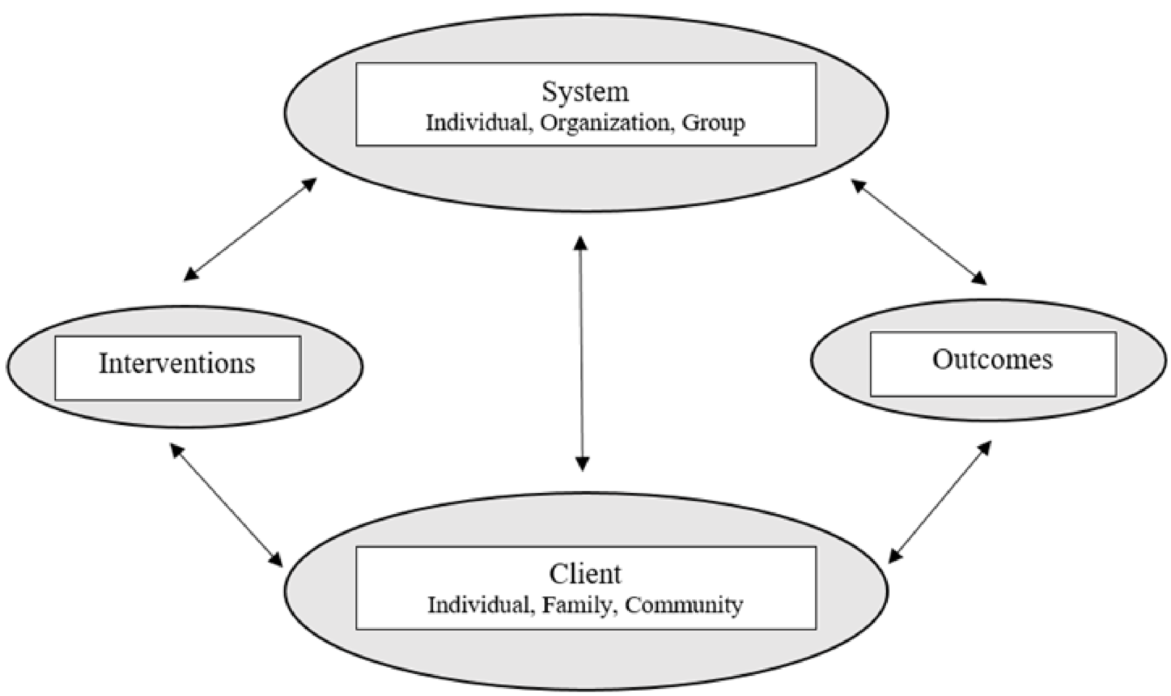


Note. Adapted from original model from "Understanding Anosognosia for Hemiplegia after Stroke," by E. M. Byrd, R. J. Jablonski, and D. E. Vance, 2020, *Rehabilitation Nursing Journal 45*(1), 3-15.

To understand how the neurobiology of AHP fits within the larger context of falls and fall risk in the post-stroke population, the framework above will be nested in the Quality Health Outcomes Model. In 1966, an article written by Avedis Donabedian proposed using a triad of structure, process, and outcomes to evaluate the quality of healthcare (Ayanian & Markel, 2016). Guided by Donabedian's foundational work, Mitchell, Ferketich, Jennings, and Care (1998) introduced the classical framework of structure, process, and outcome as a dynamic model that recognizes the feedback and relationships that occur between variables in the evaluation of health outcomes (Mitchell et al., 1998). In this model, medical interventions affect and are also affected by systems influences and client characteristics in producing health outcomes. Likewise, the bidirectional relationship between the system and the client specifies that single or multiple interventions do not affect the client or the health-related outcome alone. Rather, the effect of an intervention is mediated by both client and systems characteristics, which are variable and different for each individual. The original Quality Health Outcomes Model is depicted below in Figure 5 (Mitchell et al., 1998).

Figure 5

Quality Health Outcomes Model



Note. From "Quality Health Outcomes Model," by P. H. Mitchell, S. Ferketich, B. M. Jennings, and A. A. Care, 1988, *The Journal of Nursing Scholarship, 30*(1), 43-46.

Per the original model, examples of systems characteristics include the hospital or provider network, size of the organization, ownership, and skill mix between registered nurses and nonlicensed personnel. Interventions are defined as any direct or indirect action by personnel in order to impact, change, or improve client outcomes. Outcomes were originally defined in terms of Lohr's (1988) "Five Ds," which included death, disability, dissatisfaction, disease, and discomfort (Lohr, 1988). More contemporary concepts and measures of outcomes include that of health-related quality of life, which incorporates patient perceptions of overall health. Finally, client characteristics include individual client health, demographics, risk for disease, and any other variation or condition that could impact overall outcome (Mitchell et al., 1998).

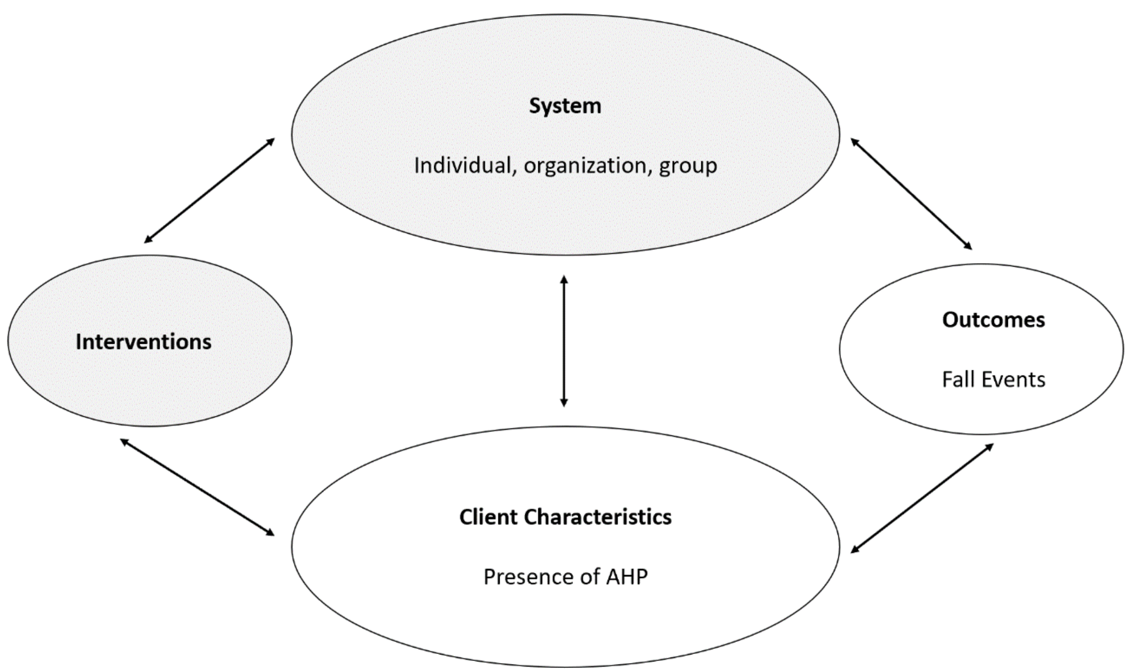
Falls, as an outcome of the proposed project, are a multifactorial problem that can involve a number of systems, interventions, and client factors, depending on the individual situation. The most common systems issues contributing to the outcome of patient falls include inadequate assessment, lack of leadership, failures of communication, deficiencies and safety hazards in the physical environment, and inadequate staffing levels or skill mix. Failures of interventions to prevent falls include the lack of adherence to protocols and safety practices. Client characteristics that have been identified as contributing to a fall event include medical conditions, medications, surgery, procedures, and diagnostic testing that can leave patients in a weakened state or confused (Joint Commission, 2015). Other common client characteristics in the post-stroke population include patient demographics, side of stroke, FIM, and the presence of

AHP (Besharati et al., 2015; Chen et al., 2015; Lee & Stokic, 2008; Goljar et al., 2016; Orfei et al., 2007).

Though numerous systems characteristics, interventions, and client characteristics have been identified as contributing to a fall outcome, the purpose of this study was to investigate the relationship between the presence of AHP and the outcome of falls. Other characteristics, while important when considering the wider ramifications of the results of this study, were not included in this project. A modified version of the Quality Health Outcomes Model (Mitchell et al., 1998) in relation to the current study appears below. The neurobiological framework for AHP was nested in the client characteristics of the Quality Health Outcomes Model (see Figure 6), with the health outcome of fall events being the study's dependent variable.

Figure 6

Quality Health Outcomes Model with Characteristics of AHP Influencing Outcomes



Note. Adapted from "Quality Health Outcomes Model," by P. H. Mitchell, S. Ferketich, B. M. Jennings, and A. A. Care, 1988, *The Journal of Nursing Scholarship, 30*(1), 43-46.

Though not addressed in this study, there are system characteristics and interventions that could potentially influence the outcomes of the study. All patients who were admitted to the University of Alabama at Birmingham Hospital, where this study was implemented, had to be assessed using the Morse Fall Risk Assessment Scale on admission, at the beginning of each shift, after any change in condition, on transfer, and after a fall. Low fall risk is a score of 0 – 24 on the Morse Fall Risk Scale. Moderate risk is a score of 25 – 44, and high risk is a score of 45 or higher. Fall risk levels for moderate and high-risk fall patients were communicated to staff during daily shift huddles, at bedside shift report, and on the communication whiteboard that is utilized in every room. Rounding with purpose was conducted hourly, and standard fall interventions were tailored to meet the patient's clinical needs and reflected in the patient's care plan. Yellow socks, a yellow arm band, and a yellow "High Risk" sign were used to identify patients at a high risk for falls. These are considered standard procedures that are incorporated into every individual's care while admitted as an inpatient. As such, these procedures were not omitted because an individual was participating in the study. Even with traditional risk assessments, this study sought to identify a variable that might enable the clinician to further stratify the stroke rehabilitation population. More specialized stratification dictated the level of staff interventions, ensuring that only those at the highest risk of falling received the highest level of intervention.

Methodology and Design

Methodology

A quantitative research design was utilized to address the research questions in this project. The variables of interest, AHP and falls, were characterized by continuous or categorical variables and were collected via instruments and statistically analyzed. Quantitative methodology was appropriate for analyzing the numerical values used to measure the relationship between AHP and patient falls. The use of qualitative methodology would have been inappropriate and would not facilitate answering the posed research questions.

Design

The specific designs considered for this study included a prospective descriptive correlational design and a logistic regression. Because the current study aimed to investigate the nature of the relationship between two variables, AHP and falls, a prospective correlational design was used. A correlational research design is a quantitative method of research that is used when there is some evidence that two or more variables may be related. Because the relationship between AHP and fall events is not entirely clear, a correlational design would determine if a relationship exists in this population (Sousa et al., 2007). Drawbacks for utilizing a correlation design included the potential interaction of confounding variables on the association and the inability to determine causality regardless of the strength of association (Zou et al., 2003). Though causality cannot be established with this methodology, this study's results can be used to create hypotheses to be tested utilizing experimental research designs in the future (Polit & Beck, 2017). A prospective approach was necessary because assessing for the presence of AHP is not standard of care in the stroke rehabilitation population. Thus, there was not an opportunity to retrospectively examine the relationship between the variables of interest. Unlike a correlational design, logistic regression seeks to evaluate the impact of a predictor variable on a specific outcome. Logistic regression is used to determine the predictive nature of predetermined variables following the preliminary data analysis (Zou et al., 2003).

Summary

In this chapter, support for this study was provided through an integrated review of the literature of the major concepts of interest. In addition, this chapter presented the theoretical model to be utilized, as well as the justification for the research design and methods. Chapter 3 will detail the sampling plan, informed consent, ethical considerations, the data collection process, the data analysis plan, and strategies used for maintaining validity and reliability.

CHAPTER 3

METHODS

As indicated in Chapter 2, the relationship between anosognosia for hemiplegia (AHP) and fall events in the acute stroke rehabilitation population is unknown. While the relationship between the two variables is often implied in the literature, there has not been a study conducted looking directly at the presence of AHP and fall events in stroke rehabilitation. The purpose of this chapter is to discuss in detail the methodological components of the study, including sampling, informed consent, ethical considerations, data collection, reliability and validity, and data analysis. This study addresses the following aims and research questions:

SA 1 Describe the prevalence and severity of AHP in the stroke rehabilitation population.

RQ 1.1 What is the prevalence of AHP in the stroke rehabilitation population?

RQ 1.2 What is the severity of AHP in the stroke rehabilitation population?

SA 2 Describe the prevalence and stratification of fall events as defined by the National Database of Nursing Quality Indicators (NDNQI) in the acute stroke rehabilitation population.

RQ 2.1 What is the prevalence of fall events in the stroke rehabilitation population?

RQ 2.2 What is the severity of fall events in the stroke rehabilitation population?

SA 3 Explore the nature of the relationship between the presence and severity of AHP and prevalence and severity of patient fall events in the acute stroke rehabilitation population.

RQ 3.1 What is the nature of the relationship between the presence of AHP and patients who fall in the stroke rehabilitation population?

H 3.1 There is a positive relationship between the presence of AHP after stroke and patients who fall in the acute inpatient stroke rehabilitation population.

RQ 3.2 What is the nature of the relationship between the severity of AHP and the severity of falls in the stroke rehabilitation population?

H 3.2 There is a positive relationship between the severity of AHP after stroke and the severity of patient fall events in the acute inpatient stroke rehabilitation population

RQ 3.3 Is the presence of AHP predictive for falls in the stroke rehabilitation population?

H 3.3 The presence of AHP is predictive for falls in the stroke rehabilitation population.

Research Design and Methods

Study Design

Because the purpose of this study was to investigate the relationship between two variables, AHP and fall events, a prospective correlational design was used. A correlational research design is a quantitative method of research utilized when there is some existing evidence that two or more variables may be related. Because the relationship between AHP and fall events is not entirely clear, the correlational design would determine if a relationship between AHP and fall events exists in the stroke rehabilitation population (Sousa et al., 2007). Though causality cannot be established with this design, the results of this study will be used to create hypotheses to be tested utilizing experimental research designs in the future (Polit & Beck, 2017). A prospective approach was utilized because AHP is not currently being assessed in the stroke rehabilitation population, so there was not an opportunity to retrospectively examine the relationship between the variables of interest. Logistic regression was used to determine the predictive nature of AHP and falls in the stroke rehabilitation population.

Setting

The setting for this study was the fourth floor Stroke and General Rehabilitation Unit, where stroke patients treated at the University of Alabama at Birmingham Hospital receive inpatient rehabilitation. A meeting with stakeholders, including the nurse manager and medical director, occurred to assure buy-in and future access to organizational risk management material pending IRB approval. (See Appendix A for IRB approval.) The request for access to the risk management portal was made in the initial meeting with the managerial staff and then escalated to other individuals in the organization once IRB approval was obtained. A second meeting was held with the nursing and support staff on the unit after receiving IRB approval in order to establish uniform awareness of the project and the principal investigator's data collection activities. Additionally, the nursing staff were instructed on inclusion criteria for the study so that they could help identify potential participants for recruitment.

This unit receives most of its patients from the University of Alabama at Birmingham Hospital, which is certified as a Certified Stroke Center by the American Heart Association, American Stroke Association, and the Joint Commission. Admission to the inpatient rehabilitation center is determined by a physician and admissions team. In order to be admitted, the patient has to have a diagnosis of stroke, and he or she must be able to tolerate 3 hours of physical therapy per day. Patients who are not able to tolerate this level of activity, or are unable to follow commands from a therapist, are not admitted. Because of the scientific potential of the study, access to the population of interest was granted.

The usual length of stay for stroke rehabilitation patients at is 7-10 days. The primary investigator made three site visits a week to recruit newly admitted stroke rehabilitation patients for inclusion into the study. Once consent was obtained, an assessment for the presence of AHP was conducted by the investigator. Fall incident reports were collected on a weekly basis for 11 weeks, ending on March 20, 2020.

Sample

Inclusion criteria included any patient admitted to the Stroke Rehabilitation Unit with the primary diagnosis of ischemic stroke. Exclusion criteria included those admitted to the nursing unit with a diagnosis of hemorrhagic stroke or subarachnoid hemorrhage, as there is little evidence that AHP is a phenomenon of interest in those types of strokes. Further exclusion criteria included individuals who had a preexisting diagnosis of a movement disorder, including Parkinson's Disease, dystonia, or Huntington's Chorea, dementia, and previous stroke as these disorders predispose one to falls independent of the presence of AHP or stroke. By utilizing a consecutive sampling method and recruiting all individuals who met the inclusion criteria from an accessible population, the risk of sampling bias was greatly reduced (Polit & Beck, 2017).

Recruitment Strategies

With the IRB application, the principal investigator requested a partial waiver of authorization for recruitment so that medical records could be reviewed and subject appropriateness established before the patient was approached and the consent process proceeded. The current fall risk assessment that is utilized by the University of Alabama at Birmingham Hospital is the Morse Fall Risk Scale (Morse, 2008). This assessment is completed each shift by a clinician caring for the patient according to hospital policy and procedure. One question included in the Morse Fall Risk Scale addresses the patient's mental status. The clinician is asked to address if the patient is oriented to his or her own ability, or if the patient overestimates and forgets his or her limitations. This question, though it cannot distinguish between AHP and a cognitive impairment of a different origin, was intended to be used by the principal investigator as a pre-consent screening tool to identify which patients to approach for inclusion in the study. So, if a clinician noted on the Morse Fall Risk Scale that an admitted patient was not aware of his or her deficits, then that could be an indication that AHP was present. However, during tri-weekly chart reviews, it was noted that every stroke patient who was eligible for participation was deemed by the clinician to be aware of his or her own deficits, meaning that this question answered by the clinician could not reliably separate those with awareness from those with unawareness. Therefore, every patient, regardless of the Morse Fall Risk Scale Completion, was approached for consent.

Recruitment activities targeted three barriers identified in the literature that limit patient participation: institutional constraints, poor communication, and difficulties unique to stroke survivors (Boden-Albala et al., 2015). To address these barriers, the principal investigator worked actively to update and engage the clinicians on the Stroke Rehabilitation Unit as much as possible. Regular engagement of the nursing staff along with biweekly updates on the progress of the study was provided by the principal investigator. Also, easy to understand words and phrases were used in place of more scientific terms, like AHP, so as to establish clear understanding and a trusting relationship with the patient. Special considerations that apply to the stroke patient include both fatigue and lack of energy after rehabilitation. Therefore, timing the approach to maintain patient autonomy during the consent process required careful evaluation and strategies that included asking the nurse or the patient caregiver if it was a good time to talk. If the nurse, patient, or caregiver indicated that the time was not appropriate, that request was respected and an appointment for an additional encounter was established.

Informed Consent

The cognitive changes and deficits that can occur after a stroke present many potential ethical issues for those interested in post-stroke research (Cherney, 2006). All patients admitted to the Stroke Rehabilitation Unit at the University of Alabama at

Birmingham Spain Rehabilitation undergo a cognitive assessment conducted by a neuropsychologist. The result of the cognitive assessment is documented in the patient's electronical medical record. Prior to the informed consent process, the patient's medical record was examined and if there was a noted cognitive deficit present per the neuropsychology assessment, then consent per legally authorized representative was initiated. Patients admitted to the Stroke Rehabilitation Unit had family contacts and phone numbers listed in the electronic medical record. By utilizing these records, and consulting with the patient's social worker, the patient's legally authorized representative was determined. In the presence of a documented cognitive impairment, this individual was contacted, and a meeting was arranged. During the meeting, the principal investigator explained the study, its purpose, and obtained consent from the legally authorized representative.

All participants and legally authorized representatives were informed of the purpose of the study, and the principal investigator ensured that all who participated understood that inclusion in this research study would not provide any additional therapy or likelihood of recovery of function. Participants were also informed that they had complete freedom to decide whether to participate, and that they could withdraw consent at any time. Maintaining confidentiality and protecting patient identity occurred via de-identified patient information along with the assignment of a unique identifier to each participant. All data were kept in a password-protected, encrypted database behind a locked office door with the only digital participant key kept in a separate locked location. The digital key linking the patient data to the de-identified results was destroyed as soon as data collection was complete. No backup files of patient data or data collection material remain.

Ethical Issues

Perhaps one of the most dramatic and immediate effects that a stroke can have on patients is in their ability to understand spoken word or express their thoughts in an understandable manner. In the acute phase of stroke, the patient may experience global aphasia, in which they are unable to understand or express language at all (Slyter, 1998). This presents an obvious issue concerning one's ability to give informed consent regarding any treatment, emergent or research related, in the acute stroke period. Shamoo and Resnick (2015) characterize informed consent as a widely recognized and fundamental principle of research since the adoption of the Nuremburg Code. Part of the process is for the healthcare professional to detail the patient's diagnosis, the purpose of the procedure or research, the risks and benefits of the procedure, and any alternatives that are available. Then, and only then, can the patient make a decision on how to proceed (Shamoo & Resnik, 2015).

In the instance of stroke, the expressive and receptive language deficit can present immediately and continue for an extended and unknown period of time. Data suggest that those with either type of aphasia, expressive or receptive, are more likely to be excluded from science-progressing research altogether due to the researcher's inability to adequately obtain informed consent from either the individual or a healthcare proxy (Jayes & Palmer, 2014). In one study conducted to understand patient and family comprehension of aspects of research related to informed consent in a stroke-related trial, none of the participants were able to articulate the purpose of the study, the rationale behind the intervention, or that participation was voluntary (Mangset et al., 2008). The results of a study conducted by Penn et al. (2009) suggest that in the circumstance of aphasia, the attainment of truly informed consent is complex, difficult to obtain, and often neglected in this population. The patient's understanding may be compromised, as well as his or her ability to express desires to a healthcare provider, rendering the individual vulnerable and susceptible to participating in research in which he or she does not wish to participate (Penn et al., 2009).

Another dramatic consequence of stroke is a new cognitive impairment, which is present in up to 39% of stroke patients (Meyer et al., 2010). There is also evidence to suggest that stroke has more of an impact on attention and executive function when compared to memory (Cumming et al., 2013). If the patient has a new inability to care for him- or herself, then his or her decision-making capacity should be questioned. This presents a major ethical dilemma for researchers interested in this population, because it can be argued that those with diminished executive function and decision-making capacity are mentally disabled and are therefore unable to give informed consent for the enrollment in research. The Common Rule and Federal Drug Administration legislation requires additional protections for those who have diminished capacity to ensure they are not exploited (Shamoo & Resnik, 2015). It is important, however, to strive for a balance between the protection of human research participants and respect for their autonomy. Assuming incapacity because the individual has had a stroke, or is slurring words, undermines the patient's dignity and threatens autonomy (Pope, 2012), which is one's ability to self-govern and choose free from undue influence (Department of Health, 2014).

In order to facilitate research in a population that may have expressive or receptive aphasia or a new cognitive impairment involves issuing a standardized mental assessment to each patient who is invited to participate (Pope, 2012). This way, all patients are treated equally, and the use of a standardized research protocol will reduce bias in subject selection. Standardizing the mental assessment also gives the individual the opportunity to demonstrate their ability or inability to understand, rationalize, and make decisions. Using a standardized assessment, incapacity will be demonstrated, and never assumed based on diagnosis or researcher bias (Pope, 2012). While there is not a standard core assessment instrument that is recommended for use in stroke patients (Moye et al., 2013), there are numerous tools that are reliable and easy to administer. The tool utilized in this study is the Aid to Capacity Evaluation, which is recommended by the American Psychological Association and the American Bar Association (Moye et al., 2013). This tool is easily administered at the bedside in under 10 minutes, has been validated by previous studies, and has exhibited sufficient inter-rater reliability (Dunn et al., 2006; Etchells et al., 1999; Sessums et al., 2011). Individuals who demonstrated diminished capacity did not consent to participation in the study; rather, the primary investigator worked to identify a legally authorized representative who could act as surrogate decision maker.

All states have legislation that allows for some form of surrogate decision-making (Pope, 2012). Surrogate decision-making, however, is not without controversy. The concept of substituted judgment is the standard that the surrogate decision maker is asked to uphold, so that the decision made is the decision that the patient would make if they were able (Johansson & Broström, 2011). Johansson and Brostom (2011) cite the major ethical issue with surrogate decision-making as how one can be certain they are acting in a manner consistent with what the patient would do given the same circumstances. Another issue with surrogate decision-making as it relates to stroke research is that the surrogate often perceives the duty of decision-making as a source of stress, and is less likely to enroll the patient in research (McCormack & Reay, 2013). In order to mitigate the risks of surrogate decision-making for participation in this study, education regarding the role of the surrogate was introduced prior to the consent process. By briefly reviewing the ethical goals of the role and having a conversation regarding the patient's prior articulation of healthcare preferences, clarity and support were offered to the surrogate decision maker.

Informed consent, whether by the stroke patient or the legally authorized representative, was obtained from each subject who participated. Components necessary for informed consent include but are not limited to the general rationale for the study, the nature of the study, the objectives and methodology to be used, the role of the investigator, and the participant risks, benefits, and absolute voluntary nature of the enrollment (Penn et al., 2009). Each of these components was addressed during the informed consent process. All participants were also given copies of the informed consent materials and ample time to have questions or concerns addressed (Labuzetta et al., 2011).

Another ethical issue involving the enrollment of human participants concerns a concept known as therapeutic misconception (Savage, 2006). This occurs when the patient or the surrogate decision maker does not understand the difference between treatment and research. Some stroke research aims to reduce disability and preserve function of stroke patients, while other studies, such as this one, seek to understand the relationship between variables. But the participant often overestimates the likelihood of direct benefit from the treatment. Appelbaum, Lidz, and Grisso (2004) found that the more debilitated the patient, the more desperate for a cure, thus the patient was more likely to overestimate the benefit gained from the research. Other studies indicate that those who participate in research often assume the researcher's goodwill toward them (de Melo-Martín & Ho, 2008) and trust the researcher without question. An individual suffering from the effects of a stroke, facing a new life of disability, and desperate for a cure is perhaps one of the most vulnerable to therapeutic misconception. To minimize the risk of therapeutic misconception, the principal investigator emphasized and reiterated the purpose of the study, which was to investigate the relationship between the presence of anosognosia for hemiplegia and fall events in the acute inpatient rehabilitation setting. No additional interventions, beyond the usual standard of care, were initiated to prevent patient falls.

In conclusion, all patients were treated equally and with respect. There was no discrimination based upon socioeconomic status, religion, race, or sexual orientation. Maintaining confidentiality and protecting patient identity occurred via de-identified patient information along with the assignment of a unique identifier for each participant. All data were kept in a locked, encrypted database behind a locked office door with the only participant key stored in a separate, locked location. The participant key was destroyed as soon as data collection was complete.

Data Collection

Data collection began January 1, 2020. The original goal of this project was to have a total of 34 stroke patients participate in the study. According to a power analysis conducted utilizing G*Power 3.1.9.7, with an alpha of 0.05, power of 0.95, and estimated large effect size, a sample size of 34 participants was needed. The power analysis was conducted before data collection began, and the results demonstrated feasibility of the study. In mid-March 2020, COVID-19 became a national concern, and data collection was stopped in an effort to mitigate the spread of disease. At the time, data from 16 stroke patient and clinician dyads had been collected. Preliminary data analysis revealed that 15 of the 16 stroke participants had a positive VATAm score, indicating the presence of anosognosia for hemiplegia. Based on these results, the dissertation committee was consulted, and the decision was made to move forward with completion of the study, noting that the sample size would be a significant limitation in the application and interpretation of statistical tests. An additional power analysis was conducted based on the small sample size, and a power of 0.72 was needed in order to achieve statistical significance. Data analysis was completed by October 2020.

Each participant was given a unique identifier that was used to link the information from the fall events database to the participant data collected by the principal investigator. All identified significant demographic information, and information pertaining to the history of the recent stroke, was entered into a locked, encrypted database maintained primarily by the principal investigator, Elizabeth Byrd.

Variables of Interest

Key variables of interest of this study included age, gender, ethnicity, side of stroke, presence of anosognosia for hemiplegia, and number of falls while admitted to the Stroke Rehabilitation Unit. The variables collected, conceptual and operational definitions, levels of measurement, and associated measurement are in Table 1. (See Appendix B for NDNQI fall injury definitions, Appendix C for VATA-m instrumentation, and Appendix D for VATA-m permission from the original authors.)

Table 1

Variables, Levels of Measurement, and Definitions

Conceptual Definition	**Level of Measurement**	**Operational Definition**	**Psychometric Performance**
Age	Ratio	Age in years at the time of the stroke	*NA*
Gender	Nominal	Male, Female, Transgender	*NA*
Ethnicity	Nominal	Caucasian, African American, American Indian or Alaska Native, Asian, Native Hawaiian, or Other	*NA*
Side of stroke	Nominal	Side of stroke; Right, Left, or Both	*NA*
Anosognosia for hemiplegia	Nominal	VATA-M score of participants minus the VATA-M score of the caregiver/nurse (difference of 6 to 12 indicates mild anosognosia; difference of 12 to 24 indicates moderate anosognosia; difference of 24 to 36 indicates severe anosognosia)	Internal consistency (α = 0.93), Test retest (r = 0.95) (Della Sala, Cocchini, Beschin, & Cameron, 2009)

Anosognosia for hemiplegia	Continuous	VATA-M score of participants minus the VATA-M score of the caregiver/nurse (difference of 6 to 12 indicates mild anosognosia; difference of 12 to 24 indicates moderate anosognosia; difference of 24 to 36 indicates severe anosognosia)	Same as above
Falls	Nominal	Yes, or No	*NA*
Number of falls	Ratio	Number of falls experienced by an individual patient	*NA*
Fall injury	Nominal	None, Minor, Moderate, Major, Death	*NA*
Fall injury	Categorical	1 – 5 (None to Death)	*NA*
Length of stay	Ratio	Number of days admitted to the stroke rehabilitation unit	*NA*

Instrumentation – VATA-m

The Visual-Analogue Test assessing Anosognosia for Motor Impairment (VATA-m) was used to assess for the presence and severity of AHP after stroke. This assessment tool was born out of a consensus that the diagnostic properties of AHP were complicated by discrepancies (Orfei et al., 2007). In some assessments, participants were asked to rate their ability or disability concerning a specific task of the upper or lower limb (Berti et al., 1996). Though such methods provide qualitative insight to the patient's awareness, there are conflicting thoughts as to what qualifies as evidence of unawareness (Karnath et al., 2005). Quantitative results in which patients rate their ability to perform a task, though they allow clinicians to understand changes in awareness across time, without normative data, can only imply the presence of AHP. Likewise, the quantitative exams rely heavily on the patient's verbal competence, which may be skewed in the presence of aphasia, leading to the exclusion of patients with aphasia following a stroke (Stone et al., 1993). The purpose of the VATA-m is to diagnose the presence of AHP and allow for the comparison of the patient's score with a caregiver score. This instrument is also suitable for patients with language deficits (Della Sala et al., 2009), and was created specifically for use in the post-stroke population.

In order to validate the images chosen for the original visual analogue scale, a series of 17 pictures was shown to a group of five healthy individuals. The volunteers were asked to describe the motor task that was depicted in the picture. If the picture was not accurately identified by four out of the five healthy individuals, then the picture of the motor task was amended based on the feedback of the participants. Once agreement on the pictures was achieved, the new edited versions of the pictures were presented to a group of healthy volunteers along with three aphasic patients. The aphasic patients were instructed to identify their difficulties performing the pictured tasks utilizing a 4-point visual analogue scale. A score of "0" indicated that there was no difficulty in performing the task. A score of "3" indicated there was significant difficulty in performing the task. The participants were able to respond verbally, by rating their ability a 0–3, or nonverbally, by pointing to a visual analogue scale. All the participants in the pilot study correctly identified all the motor tasks. The tasks that were correctly identified were carried over into the trial version of the instrument (Della Sala et al., 2009).

The final version of the VATA-m consists of 12 experimental questions and four questions which are termed "check questions." Check questions are questions that, according to the researchers, should yield obvious results. For example, one check question is "I have difficulty juggling five balls in the air." If this question, or any of the three additional check questions are answered incorrectly by the participant or the caregiver, then there is just cause to believe that either the caregiver or the participant is not able to comprehend the instrument, and the data should not be used. Since the check questions serve to determine the comprehension of the instrument, the scores obtained on these four items are not carried over into the total (Della Sala et al., 2009).

To administer the instrument, two paper copies of the VATA-m were needed. The 12 experimental questions each have a picture of a motor task, a description of the motor task, and a visual analogue scale that ranges from 0–3, where 0 indicates there is no difficulty in completing the task, and a 3 indicates major difficulties in completing the task. The participant was shown the picture, and the principal investigator read the description of the motor task. The patient was then asked to verbally indicate on the scale from 0–3 his or her ability to complete the task. If aphasic, the patient was instructed to point to a number on the visual analogue scale that corresponded with his or her ability to perform the task. In order to obtain comparative data, the patient's clinician (nurse or patient care technician) was also asked to complete the VATA-m, including the "check questions." Each instrument was scored independently with a maximum score of 36 and a minimum score of 0. From here, the patient's self-evaluation score was subtracted from that of the caregiver, and the discrepancy in the scores was used to determine the presence and degree of AHP (Della Sala et al., 2009).

In the initial trial of the VATA-m, a total of 68 stroke patients were admitted to the study. Thirty-three had evidence of left-brain damage, and 35 had evidence of right-brain damage. All participants were asked to rate their VATA-m scores. A group of 100 care partners (of the stroke patients) were also asked to rate the participants' motor difficulty based on the VATA-m pictures and descriptions. Due to incorrect answers on "check questions," five participants and one care partner's data were excluded from the analysis. In total, 63 patients and 99 caregivers were included in the study. For 36 patients, there were two caregivers who completed the VATA-m instrument. Motor skills of a subgroup of 54 patients were also examined and rated by a physiotherapist utilizing the Motricity Index (Wade, 1992). In this subgroup of patients, the physiotherapist's results were compared to caregiver results on the VATA-m utilizing Pearson correlation. Results indicate that the caregiver ratings were a reliable assessment of the patient's motor function ($r = -0.47$; $p < 0.01$, two-tailed). In order to determine the cut points of mild, moderate, and severe anosognosia, the researchers statistically determined a discrepancy threshold for the 36 pairs of caregivers who evaluated the same patient. To do this, both caregiver scores were compared, which elicited a discrepancy score (from 0 indicating perfect agreement, and 36 indicating disagreement). This difference was calculated to give a group mean discrepancy of 1.9 ($SD = 2.2$). A value of two standard deviations above the group mean was set as a cut off score (+6.3). Assuming normal distribution, the two standard deviations encompass 95% of the data points. Therefore, mild anosognosia is defined as a total score (caregiver-reported score minus patient self-report score) of 6.3 – 12. Moderate anosognosia is defined as 12.1 to 24, and severe anosognosia is defined as a score of 24.1 – 36 (Della Sala et al., 2009).

Test-retest reliability was established utilizing 112 participants. A total of 63 caregivers and 49 participants were retested utilizing the tool. Spearman-Brown correlation analysis was performed on each group. Both groups resulted with high correlation coefficients ($r = .95$, $p < .01$) for caregivers and ($r = .83$, $p < .01$) for patients. Internal consistency was analyzed for the upper and lower extremity questions separately. Discrepancy values were calculated for each question and patient utilizing Cronbach's alpha, with results indicating high internal consistency for both upper (Cronbach's alpha = 0.929) and lower extremity questions (Cronbach's alpha = 0.840) (Della Sala et al., 2009). Internal consistency for the current sample was calculated as well and reported with the study results.

Because of the pictures of motor tasks used in the VATA-m, expressive verbal skills are not required and there is an increased likelihood that aphasic patients could be successfully assessed for AHP. Though not evident in the literature, recent research suggests that AHP after stroke is common across both right- and left-sided infarcts (Nurmi Laihosalo & Jehkonen, 2014). Utilizing the VATA-m allowed for greater access to a wider range of patients.

In order to utilize the instrument discussed, written correspondence with the original authors, Drs. Sergio Della Sala and Gianna Cocchini, was initiated, and permission to utilize the VATA-m was granted. Since the instrument was created in 2009, some upgrades and enhancements were made to modernize the instrument. In particular, the graphics for the motor skills were all refined and updated. Likewise, there is a "check question" that asks if the patient has difficulty jumping over a lorry. This description was changed to describe jumping over a "truck," as that is the term that is used in the United States (Della Sala et al., 2009). While minor changes to the aesthetics of the instrument were needed, care was taken to maintain the integrity of the instrument.

There are some limitations to the use of the VATA-m instrument. First, this instrument relies somewhat on an individual's receptive verbal competence, and ability to understand written words and phrases. While the check questions are meant to screen for understanding, some have argued that a separate instrument assessing cognition should be used in conjunction with the instrument. One also must consider that not every patient has had the same degree of experience with each situation. For example, an individual with a dishwashing machine may not have the direct experience necessary to rate his or her ability to wash dishes. Some authors have also suggested that gender bias in response to the VATA-m questions should be considered. Lastly, the ability of the caregiver to accurately rate the patient's ability should always be considered. Some studies have shown that caregiver ratings tend to be more subjective, depending on personal and medical factors, rather than a real-time objective assessment (Marcel et al., 2004). While keeping these limitations in mind, the VATA-m has been used successfully to test for the presence of AHP in the post-stroke population (Cocchini et al., 2009; Cocchini et al., 2010; Cocchini et al., 2013; Della Sala et al., 2009; Garbarini et al., 2012).

Instrumentation – Falls

On a weekly basis, the principal investigator accessed the system used by the organization to determine if a research study participant experienced a fall. It is the policy of the institution that all safety events, including falls, are to be entered into a database known as Trend Tracker. This database is maintained under the Office of Risk

Management and Insurance. The nurse at the bedside, who witnesses or discovers the patient who fell, is to enter the appropriate information into the database. This information includes the patient name and medical record number, additional demographic information, sustained injuries during the fall, and a narrative report concerning the circumstances surrounding the fall. According to hospital policy and procedure, the nurse must also complete a Post Fall Huddle form. This form includes information concerning what the individual was doing prior to the fall, the current risk assessment documented in the electronic medical record, descriptions of the events that occurred prior to and during the fall, and the location and environmental conditions where the fall occurred. These forms are kept on file in the nurse manager's office and in the Center for Nursing Excellence at the University of Alabama at Birmingham Hospital. The data from Trend Tracker, and the Post Fall Huddle form were compared to maintain reliability. There were no discrepancies found between the data entered on the Trend Tracker, Post Fall Huddle Form, or the physician clinical note in reference to a patient fall.

Rigor and Validity

In order to maintain methodological rigor, multiple strategies were utilized. To decrease the likelihood of self-selection bias during sampling and obtaining informed consent, 100% of the admissions to the Stroke Rehabilitation Unit were screened for inclusion into the study. Likewise, 100% of the patients who meet inclusion criteria on the electronic medical record pre-screen were invited to participate in the study. To prevent misclassification of data, information was screened, recorded, and obtained from the patient in the same manner each time. During the data collection process, intrarater reliability was assessed by weekly audits performed by the principal investigator, to ensure the accuracy of the data recorded. Confounding bias was reduced by screening and inviting all patients who met the inclusion criteria to participate in the study (Yang et al., 2012).

Validity is the extent to which a study provides an approximate truth of an inference (Polit & Beck, 2017). Because this is a correlational study, no intervention was performed. Due to the study design, it was impossible to determine causation regarding the relationship between AHP and falls in the stroke rehabilitation population. Internal validity of correlational studies tends to be low, but external validity more likely reflects relationships that exist in the real world.

Data Analysis

Data analysis was performed utilizing IBM SPSS Statistics Version 26 software. Analysis of the variables began by examining descriptive statistics, missingness, and assessing for outliers. Relationships between the independent variable (AHP) and the dependent variable (falls) were explored utilizing univariate correlations.

Descriptive Statistics

Descriptive statistics were used to describe the basic features of the data that were collected and is the first step in any quantitative data analysis. Mean, median, mode, range, and standard deviation were calculated for age, AHP (continuous), and number of falls experienced by an individual patient. Frequency and proportions were calculated for gender, ethnicity, side of stroke, AHP (nominal), falls, and fall injury.

Assessment of Normality

Before any additional statistical analyses were performed on continuous data, the data were assessed for normality and homogeneity of variance. The Shapiro-Wilks test was used to verify the assumption of normality. Levene's test was used to assess for homogeneity of variance. Because the sample size was so small, measures of skewness and kurtosis were calculated. Due to the small sample size, and the results of the statistical tests above, nonparametric statistical testing techniques were utilized.

Specific Aim 1

The first aim of this study was to describe the prevalence and severity of AHP in the stroke rehabilitation population. The related research questions that accompanied this specific aim were to determine the prevalence of AHP in the stroke rehabilitation population and determine the severity of AHP in the stroke rehabilitation population. The prevalence was computed by determining what percentage of the patients screened for AHP showed manifestations of the disorder as evidence by a positive VATA-m. In order to determine the severity of AHP in the stroke rehabilitation population, frequency distribution and proportions were calculated for the categories of VATA-m (mild, moderate, or severe anosognosia). These calculations produced the prevalence and severity of anosognosia present in the population sampled.

Specific Aim 2

The second aim of this study was to describe the prevalence and stratification of fall events as defined by NDNQI in the acute stroke rehabilitation population. The research questions that accompany this aim were to determine the prevalence of fall events in the stroke rehabilitation population and determine the severity of fall events in the stroke rehabilitation population. The prevalence was computed by determining what percentage of patients with AHP experienced a fall while admitted to the stroke rehabilitation unit. To determine the severity of fall events, frequency distribution and proportions of fall injury were calculated for the categories of fall injury as defined by NDNQI (none, minor, moderate, major, and death). These calculations provided the prevalence and the severity of fall events in the population sampled.

Specific Aim 3

The final aim of this project was to explore the nature of the relationship between the presence and severity of AHP and prevalence and severity of patient fall events in the acute stroke rehabilitation population. Three research questions related to this specific aim. The first research question was: What is the nature of the relationship between the presence of AHP and patients who fall in the stroke rehabilitation population? To determine the nature of the relationship between the presence of AHP and the number of falls in the stroke rehabilitation population, Fisher's Exact Test was used. This test is used when there is a small sample size and the assumptions of the Pearson Chi-square test are not met. The categorical measurements for AHP and the dichotomous outcome of falls were analyzed utilizing the Fisher's Exact Test. A significant Fisher Exact Test indicates that the observed outcome is not due to chance alone. Since the Fisher Exact Test was not significant for this sample, no further statistical analysis, such as correlation, was performed.

The second research question was: What is the nature of the relationship between severity of AHP and the severity of falls in the stroke rehabilitation population? To determine the nature of the relationship between the severity of AHP and the severity of falls in the stroke rehabilitation population, Fisher's Exact Test was used. The categorical measurements for severity of anosognosia and the categorical outcome of fall injury were analyzed utilizing the test above. A significant Fisher Exact Test indicates that the observed outcome is not due to chance alone. Because the Fisher Exact Test was not significant with this sample, no other statistical analysis was performed.

The third research question was: Is the presence of AHP predictive for falls in the stroke rehabilitation population? To determine if AHP is predictive of fall events, logistic regression was computed, and the output indicated what percentage of variance in patient falls (outcome variable) was explained by AHP (predictor variable) in this population. Normality and homogeneity of variance is not required when conducting a logistic regression, so the outcomes of those statistical analyses did not impact the regression equation. The continuous data collected for the presence of AHP and patients who fall were utilized in the logistic regression.

Summary

The purpose of this chapter was to discuss the methodological components of the study, including the sampling plan, plan for obtaining informed consent, ethical considerations, instrumentation, data collection procedures, methods for maintaining rigor and validity, and the data analysis plan as it pertained to each specific aim. The next chapter will present the findings from this data analysis.

CHAPTER 4

RESULTS

The purpose of this study was to explore the relationship between anosognosia for hemiplegia (AHP) and fall events in the acute inpatient stroke rehabilitation population. The results of this study are reported in this chapter. This study utilized primary data collected on-site at the University of Alabama at Birmingham Hospital Spain Rehabilitation Center and investigated the following aims and research questions:

SA 1 Describe the prevalence and severity of AHP in the stroke rehabilitation population.

RQ 1.1 What is the prevalence of AHP in the stroke rehabilitation population?

RQ 1.2 What is the severity of AHP in the stroke rehabilitation population?

SA 2 Describe the prevalence and stratification of fall events as defined by NDNQI in the acute stroke rehabilitation population.

RQ 2.1 What is the prevalence of fall events in the stroke rehabilitation population?

RQ 2.2 What is the severity of fall events in the stroke rehabilitation population?

SA 3 Explore the nature of the relationship between the presence and severity of AHP and prevalence and severity of patient fall events in the acute stroke rehabilitation population.

RQ 3.1 What is the nature of the relationship between the presence of AHP and patients who fall in the stroke rehabilitation population?

H 3.1 There is a positive relationship between the presence of AHP after stroke and patients who fall in the acute inpatient stroke rehabilitation population.

RQ 3.2 What is the nature of the relationship between the severity of AHP and the severity of falls in the stroke rehabilitation population?

H 3.2 There is a positive relationship between the severity of AHP after stroke and the severity of patient fall events in the acute inpatient stroke rehabilitation population.

RQ 3.3 Is the presence of AHP predictive for falls in the stroke rehabilitation population?

H 3.3 The presence of AHP is predictive for falls in the stroke rehabilitation population.

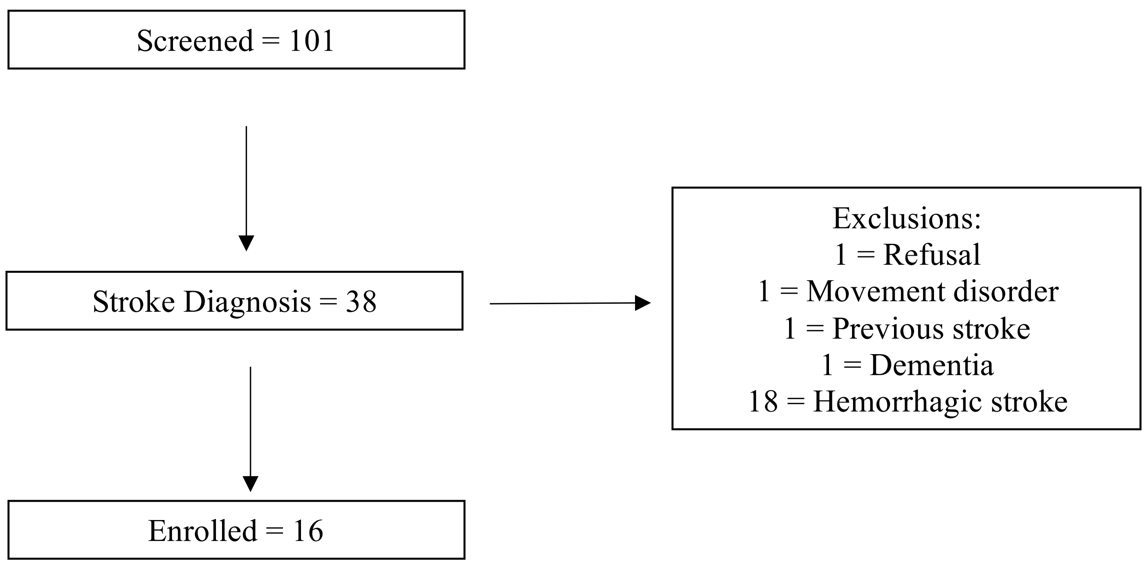
Sample

Data collection began January 1, 2020, and was halted on March 20, 2020, due to the ongoing COVID-19 pandemic. All patients admitted to the Stroke and General Rehabilitation Unit were screened for inclusion. A total of 101 patients were screened for eligibility. Thirty-eight patients (38%) of those screened had a diagnosis of stroke, which prompted a more detailed medical record review. Of the 38 patients with a stroke diagnosis, 18 (47%) had experienced hemorrhagic strokes and were excluded from participation. Other exclusions included one patient (3%) who refused, one (3%) with a preexisting movement disorder, one (3%) with a previous stroke, and one patient (3%)

with preexisting dementia. This left a total of 16 (42%) patient and clinician dyads who were enrolled and participated in the data collection process (see Figure 7).

Figure 7

Sample Selection



Stroke Participant Description

The average age of the participants enrolled in the study was 57 years (SD = 15.1), with 10 (62.5%) identifying as male and 6 (37.5%) identifying as female (see Table 1). More than half of the sample (9 participants or 56%) were Caucasian, five (31%) were African American, one (6%) was Hispanic, and the remaining one (6%) participant declined to answer (see Table 3).

Table 2

Gender Identification of Participants

Gender Identification	*n*	Percentage
Male	10	62.5%
Female	6	37.5%

Table 3

Ethnicity of Participants

Ethnicity	*n*	Percentage
Caucasian	9	56.25%
African American	5	31.25%
Hispanic	1	6.25%
Declined to answer	1	6.25%

The majority of the participants (n = 13, 81%) experienced a right-sided stroke, with the remaining three (19%) patients diagnosed with a left-sided stroke (see Table 4). Anatomical location of the ischemic event varied across six locations in the cortex. The middle cerebral artery (MCA) was the most common location of the ischemic event, with eight participants (50%) diagnosed with a stoke to this area. Three participants (19%) experienced an ischemic event to the corona radiata, two participants (13%) an event in the basal ganglia, and the remaining three (6.3% per anatomical location) participants an event in the medulla, posterior inferior cerebellar artery (PICA), and the thalamus (see Table 5).

Table 4

Side of Stroke

Side of Stroke	*n*	Percentage
Right	13	81%
Left	3	19%

Table 5

Anatomical Location of Stroke

Anatomical Location of Stroke	*n*	Percentage
Middle cerebral artery	8	50%
Corona radiata	3	18.75%
Basal ganglia	2	12.5%
Medulla	1	6.25%
Posterior inferior cerebellar artery	1	6.25%
Thalamus	1	6.25%

Clinician Participant Description

Of the clinicians who work on the Stroke and General Rehabilitation Unit, six individuals were consistently present and available during the data collection period. Three of the clinicians (50%) were registered nurses, and the remaining three (50%) were patient care technicians. Clinician age ranged from 27 years to 49 years (*M* = 36.3, *SD* = 8.8). Four of the six (67%) were African American, one (17%) was Caucasian, and one (17%) participant declined to answer the question about race. The participating clinicians have worked on a rehabilitation unit for a range of 2–22 years (*M* = 7.6, *SD* = 7). Two of the clinicians (33%) identified as male, and the other four (67%) identified as female.

For this group, the highest degree earned by the registered nurses was an undergraduate degree, and the highest degree earned by the patient care technicians was a high school diploma.

Results

Aim 1: Description of AHP in a Stroke Rehabilitation Sample

Prevalence of AHP in a Stroke Rehabilitation Sample

Of the 16 stroke rehabilitation patients enrolled in this study, 15 (94%) showed evidence of AHP, meaning that the discrepancy score between the patient and the clinician on the VATA-m was greater than 6.27. The prevalence of AHP in this population is considerably higher than what is noted in the literature, where it is estimated that between 30% (Vuilleumier, 2004) and 77% (Orfei et al., 2007) show evidence of AHP.

Severity of AHP in a Stroke Rehabilitation Sample

The severity of AHP ranged from none to severe. One participant's score was not high enough to be classified as AHP, but there was a difference (5 points) in VATA-m scores between the participant and the clinician. Seven participants (44%) had discrepancy scores between 6.27–12 and were classified as exhibiting mild AHP. Another 7 participants (44%) had discrepancy scores between 12.1–24 and were classified as having moderate AHP. The final participant (6.3%) had a discrepancy score greater than 24.1 and was classified as having severe anosognosia for hemiplegia.

Aim 2: Description of Fall Events in a Stroke Rehabilitation Sample

Prevalence of Fall Events in a Stroke Rehabilitation Sample

Of the 16 patients enrolled in the study, four (25%) sustained falls during the data collection period. One fall (25%) involved a participant with severe anosognosia. The other three falls (75%) occurred with individuals categorized as having mild AHP. All falls occurred in the private patient rooms, with three of the four falls unwitnessed by family members or rehabilitation staff. One patient slipped and fell while in the shower alone and pulled the emergency cord to notify the unit staff that help was needed in the bathroom. The other two individuals who experienced a fall were found by unit staff, one a nutrition employee delivering a meal, and the other a registered nurse completing hourly rounds. Neither of these individuals was able to recall the circumstances of the fall. The one witnessed fall involved a patient and a family member. The family member was attempting to help the patient transfer from the wheelchair to the bed when the fall occurred.

Severity of Falls in a Stroke Rehabilitation Sample

The severity of patient falls was based on preexisting categories of injury as defined by the National Database of Nursing Quality Indicators (NDNQI). This national database is the largest repository of nursing quality metrics in the United States. According to NDNQI, there are five categories of fall injury. The category “None” indicates no injuries, signs, or symptoms related to the fall. A “Minor” fall means that there is injury requiring the application of a dressing, ice, cleaning of a wound, or the presence of an abrasion. The additional categories speak to more serious injuries including suturing, surgery, or patient death in relation to injuries sustained from the fall. Three of the falls that occurred on the inpatient stroke unit during the data collection period were classified as "None" (75% of the falls) where there was no evidence of injury after assessment or imaging. The one additional fall (25%) resulted in a minor injury, a bruise above the patient's eye, but no injury that needed medical intervention.

Aim 3: The Relationship Between AHP and Fall Events in a Stroke Rehabilitation Sample

Relationship Between AHP and Fall Events in a Stroke Rehabilitation Sample

In order to understand the relationship between the presence of AHP and falls, Fisher's Exact Test was used. This statistical technique was more desirable than Pearson Chi-Square due to the small sample size. Pearson Chi-Square was also not utilized since the assumptions for normality and homogeneity of variance were not met, again due to sample size. Primary outcome results indicated a nonsignificant relationship between the categorical variable of presence of AHP and patients who fell during the data collection period (p = 0.99, two tailed Fisher's Exact Test). The same statistical technique was used to understand the relationship between the severity of AHP and the severity of falls in the stroke rehabilitation population. The outcome indicated a nonsignificant relationship between the severity of AHP and the severity of falls in this sample (p = 0.138, two-tailed Fisher's Exact Test).

Presence of AHP Predictive for Falls or Severity of Falls in a Stroke Rehabilitation Sample

To determine if either the presence or the severity of AHP was predictive for falls in this sample, logistic regression was utilized. In the first model, the predictor was the presence of AHP and the dependent variable was the incidence of fall during admission. According to the model, the predictor (presence of AHP) was not predictive of patient fall events (F (1, 14) = .318, p = .582), with an R^2 of .022. A simple logistic regression was also calculated to predict the effect of severity of AHP on the incidence of falls. The model was not predictive of patient fall events (F (1, 14) = 0, p = 1), with an R^2 of -.071. In this sample, neither presence nor severity of AHP was predictive for fall events.

Difference in VATA-m Means

To determine whether a statistically significant difference existed between clinician VATA-m scores and patient VATA-m scores, the means of the two groups were compared utilizing the Mann-Whitney U test. The group with the highest mean rank was the clinician group with a mean rank of 23.06. Comparatively, the patient group mean rank was 9.94 (see Table 6). Based on the statistical test, the clinician ranked the patient's motor ability as significantly worse than the patient did (U = 23, p = 0) (see Table 7). This is a clinically significant finding because the clinician staff reported 100% of the time that the patient was aware of their own disability according to the Morse Fall Risk Scale.

Table 6

Total VATA-m Scores for Comparing Means

Patient or Caregiver	*n*	Mean Rank	Sum of Ranks
Yes (patient)	16	9.94	159
No (clinician)	16	23.06	369

Table 7

Test Statistics for Comparing VATA-m Means

Mann-Whitney U	23
Z	159
Asymp. Sig. (2-tailed)	0.00

Conclusion

The purpose of this chapter was to present the statistical findings of the dissertation study. The next chapter will include a detailed discussion concerning each specific aim and research question, limitations, implications for future research, implications for practice, action, and policy, and the importance of clinical research.

CHAPTER 5

DISCUSSION

Introduction

The purpose of this study was to address a gap in knowledge related to the presence of anosognosia for hemiplegia (AHP) after stroke and inpatient falls in the stroke rehabilitation population. A correlational, descriptive research design was utilized to explore the relationship between the variables and to discern if the presence of AHP is predictive for fall events in individuals admitted to a stroke rehabilitation unit. This chapter presents a detailed discussion on the findings, limitations, and implications for nursing practice based on the results. The direction of future research and conclusions of this study are addressed as well.

Discussion

The purpose of Aim 1 was to characterize the prevalence and severity of AHP in the stroke rehabilitation sample. The results in this population indicated that 15 of the 16 (93.8%) stroke patients enrolled had a discrepancy score suggestive of AHP.

The results from this study are considerably different from the results of other studies. Estimates in prevalence of AHP in the stroke rehabilitation population range from 10% (Baier & Karnath, 2005) to 58% (Cutting, 1978). The variability across studies can be attributed to multiple factors, including the lack of a standardized instrument by which to assess the presence of AHP. The VATA-m, which was utilized in this study, has the unique feature of including a visual scale that allows individuals with expressive aphasia to participate. Three left-sided stroke patients with diagnosed aphasia were able to communication and participate in the assessment. Other instruments utilized in assessing AHP did not have this feature and required the individual to verbally participate in the assessment. This means that earlier published studies that excluded patients because of an inability to speak potentially underreported the phenomenon, minimizing its significant impact on the stroke rehabilitation population.

The VATA-m was also an easy and efficient instrument that was administered at each patient's bedside. The instrument took no longer than 10 minutes per patient to administer, and none of the 16 participants had any negative feedback concerning the amount of time taken to answer the questions on the instrument. The feedback that was received pertained to a few individual questions. For example, some participants had family members or partners who "always" washed the dishes or had a dishwasher in the home. Other participants had partners who "always" drove when they were traveling. The participants were very candid and asked for clarification on how to answer these questions. To elicit an answer for these questions, the questions were rephrased from "Can you do this?" to "Can you do this if you had to?" Simply rephrasing how the questions were asked allowed participants to give a thoughtful answer. Even with this potential limitation, because of the ease of use, and because the VATA-m is inclusive to a subpopulation of aphasic stroke patients, the recommendation is that this instrument be incorporated into the daily charting activities of rehabilitation clinicians so that the presence of AHP for each patient is understood.

The VATA-m instrument was designed to additionally determine the severity of unawareness experienced by the stroke survivor (Della Sala et al., 2009). Across the current sample, the severity of AHP was evenly distributed, with one patient in the none and severe category, and seven patients each in the mild and moderate categories. This is an important finding, even in a small sample, and further supports the need to incorporate the VATA-m into daily patient documentation and care.

Current literature exploring the severity of AHP related the more severe forms of the phenomenon with losses in proprioception, spatial neglect, and disorientation (Vocat et al., 2010). Additional studies examined relationships between unawareness severity and lesion size and location (Levine et al., 1991), dysarthria, ptosis, and headache (Baier & Karnath, 2005). What remains unclear and uninvestigated is the clinical importance of the severity of AHP. The results of the current study support the assumption that AHP exists, and that it exists across a spectrum of severity, but the effects of the severity of AHP have yet to be discerned. For example, does the inpatient rehabilitation stay increase with the severity of AHP? Or, does the severity of AHP predict the disposition of the patient at discharge? Questions such as these should be incorporated into future research into the phenomenon.

The purpose of Aim 2 was to describe fall events that occurred in the stroke rehabilitation sample. Of the 16 participants enrolled in this study, there were four individuals who fell once during their inpatient rehabilitation stay. That is an occurrence rate of 25%, which did not differ from other reported fall rates in the same population. While the sample size was limited, the number of falls experienced by the sample was proportional to what other studies have reported. While data related to the length of rehabilitation stay were not collected, the average length of stay for stroke inpatients was 14 days. Calculating fall rate for this small sample using mean length of stay resulted in a rate of six falls per 1,000 patient days, which did not differ significantly from previously published studies (Quigley, 2016).

Of the four patients who fell during the data collection period, only one patient sustained a minor injury based on NDNQI classification. This finding was congruent with other studies that suggest that while the incidence of falls in the stroke rehabilitation population is high, the chance for serious injury is small (Teasell et al., 2002). There could be injuries or sequelae to the fall that the clinician cannot discern or perceive with a post-fall assessment. For example, some patients who fall may become afraid that they are going to fall again. This can lead to a reluctance to participate in rehabilitation activities, or to even attempt simple activities of daily living that would promote feelings of independence. Consequences of this nature are not readily apparent on post-fall assessments completed after an inpatient fall.

The majority of falls occur in the patient room, are unwitnessed, and occur on the night or the evening shift (Quigley, 2016; Wong et al., 2016). The falls in this study were no different: all four of the patient falls occurred in the patient's room; three of the four falls were unwitnessed, which is quite common in the stroke rehabilitation population; and three occurred on the night or evening shift, when patients are presumed to be in bed and asleep. No study has found correlations between these variables to be significant enough to suggest a connection (Quigley, 2016; Wong et al., 2016). However, all four of the patients who fell had a discrepancy score per the VATA-m that suggests the presence of AHP. Three of the four were classified as having mild AHP, while one patient was classified as having severe AHP. There were no data with which to compare the association with AHP and falls, as the relationship has been suggested in literature, but not studied directly. One possible explanation for more falls occurring during the night shift include a reduction in the number of clinical personnel available to assist with ambulation or transfers overnight. While there was not a statistically significant difference, clinically significant differences should be considered. Maintaining adequate clinical staffing in the overnight hours, specifically on floors or units that care for patients with AHP, should be a priority for nursing leadership in order to positively impact nursing outcomes.

The purpose of Aim 3 was to explore the nature of the relationship between the presence and severity of AHP and the prevalence and severity of patient falls in the acute stroke rehabilitation population. A correlation analysis of the data collected in the current study did not provide evidence to suggest there is a link between the presence of AHP and patients that fall in stroke rehabilitation, though all four patients screened positive for the presence of AHP. Likewise, there was no statistical relationship between the severity of AHP and the severity of falls. Lastly, though it makes sense theoretically, the regression used to determine if AHP was predictive of falls reveals that the variable (AHP) does not account for variation in number or severity of falls of participants in this study. This was quite different than what was expected at the beginning of this project and may have been influenced by the small sample size.

Due to the SARS-CoV-2 pandemic, students were asked to suspend clinical activities, including research activities, for an unspecified amount of time. This occurred in the middle of the data collection phase of the project, and at the time, it was not known when clinical and research activities would be resumed. Because of the uncertainty of the situation, the decision was made to stop data collection and move into the data analysis phase of the project. With such a small sample size, it would be difficult to distinguish statistical significance, even with a significant *p* value. However, the reverse is also true: a lack of statistical significance with the current sample does not guarantee lack of statistical significance in a replication study with a larger sample size.

Additional Findings

It is important to note that clinicians were unaware of patients' AHP. Morse Fall Risk Scores were also collected for this sample. The question in the Morse Fall Risk that was of most interest asks the clinician to answer if he or she thinks that the patient is aware of his or her disabilities. In all 16 patients in this sample, 100% of the clinicians documented in the patient's medical record that the patient was aware of his or her disability. These data are not consistent with the finding that 15 of 16 patients had AHP. This finding demonstrates that there is an overestimation of awareness being made by the clinicians. There is also no quick, bedside method for assessing a patient's awareness. The clinical staff may use alertness or cognitive status erroneously as proxies for understanding one's disability in this population. Thus, incorporating the VATA-m, or a component of the VATA-m, into standard patient assessments may provide important information to help improve patient care.

There are additional concerns with the use of the Morse Fall Risk Scale in the stroke rehabilitation population. The author of the scale, developed in 1989, noted that a score of 45 or above is indicative of a high risk for falls. It was originally reported that the scale had a sensitivity of 0.78 and a specificity of 0.83 (Morse, 1986). An additional study conducted in 1995 found a sensitivity of 0.96 and a specificity of 0.54 (McCollam, 1995), and the conclusion was that the Morse Fall Risk Scale was a valid instrument by which to identify those who were most likely to fall. However, more recent studies have been less supportive. Multiple studies have compared the Morse Fall Risk scores of fallers versus those who do not fall and found there was no significant difference in the scores between the samples (Chow et al., 2007; Kwan et al., 2012; O'Connell & Myers, 2002).

Additional studies have revealed that different populations require different cutoffs related to their risk. For example, in two studies conducted in 2006 and 2007, the Morse Fall Risk Scale was more accurate with a high risk for falls score of greater than 55 versus 45 as suggested by the author (Forrest et al., 2013. These concerns, when considering the Morse Fall Risk Scale, have never been validated in the stroke rehabilitation population and call into question the scale's relevance in the population. The results of the current study, specifically the incidence and severity of AHP in the stroke rehabilitation population, coupled with the evidence that clinicians are unaware of the client's AHP, further support the incorporation of the VATA-m into the standard of care. How and if the VATA-m and the Morse Fall Risk Scale can complement each other and potentiate the implementation of more beneficial fall prevention interventions when used together remains to be discerned and should be considered in future research projects.

Limitations

Although this study has served to increase what is known about AHP in the stroke rehabilitation population, there are many acknowledged limitations. It should be noted that only individuals who had an ischemic stroke were invited to participate. Individuals with hemorrhagic stroke were excluded. It should also be noted that AHP could exist in the hemorrhagic stroke population as the mechanism of injury, which is lack of blood flow to a specific cortical area, occurring in both pathologies. Hemorrhagic stroke patients were excluded in an effort to study the phenomenon in a population known to manifest the symptoms. Thus, as assessment techniques and instrumentation for measuring such a phenomenon evolve, more studies should be considered, specifically with the hemorrhagic stroke population in mind.

Although the majority of eligible individuals participated in this study, the sample for this study is not representative of the incidence at which stroke occurs in the general population. The majority of the participants were Caucasian (56.3%), while there were only five (31.3%) African American participants. In the southern part of the United States, where this study took place, the risk of having a stroke is twice as high for African Americans than it is for Caucasians. Of note, there was one African American participant who declined to participate due to mistrust in the research process. This speaks to the importance of remaining transparent and continuing to engage the African American community in clinical research, in order to have a more representative sample. It is ideal for the sample of a study to match the incidence and prevalence at which the phenomenon occurs in the general population, and this study did not achieve that goal.

A second limitation of this study is the impact that the SARS-CoV-2 pandemic imposed on the data collection process. Based on a power analysis conducted before the study began, a sample size of 34 patient and clinician dyads was needed to achieve a large effect size between the variables. Data collection was in progress when the virus emerged, and due to the unknown nature of the pathogen, and because data were being collected in a clinical setting, the decision was made to stop data collection and move forward with analyzing the data collected. Though statistical techniques were utilized to analyze the data, due to the small sample size, no conclusive determinations can be ascertained. All the statistical techniques related to the specific aims of the study were insignificant, but with a more substantial sample size, the outcomes may or may not be different.

This study was conducted on one nursing floor in an inpatient rehabilitation center that is affiliated with an academic medical center in the southern United States. This particular unit has specific admissions criteria and receives the majority of its patients from the academic medical center with which it is affiliated. Any and all conclusions concerning this sample are relevant to the participants involved and should not be generalized to any other population until more robust and thorough research is completed.

One of the specific aims of the study was to understand the severity and number of patient falls experienced on the inpatient rehabilitation unit. During the 3 months of data collection, there were a total of four falls. Though falls per patient day for this time period is comparable to other sources, there are measures in place on every nursing unit that are implemented in an attempt to prevent patient falls. Such measures include completing a fall risk assessment every shift, or with a patient transfer or change of condition. Based on the result of the fall risk assessment, any number of fall prevention interventions can be implemented. Universal fall precautions should be used for all patients. This includes frequent orientation, patient and family education, frequent rounding and toileting, and keeping the patient bed and chair in the lowest position possible with the brakes locked. Other interventions for patients who are considered moderate or high risk include responding promptly to the patient's call light, scheduled toileting, the use of bed or chair alarms, and the use of low beds with protective mattresses on the floor to cushion vulnerable anatomical parts should the patient fall out of bed. While the majority of these precautions, like patient education and call light instructions, may not be helpful for individuals with AHP, the other interventions may have prevented falls that would have occurred otherwise. This will always be a limitation with falls research as it would be unethical to stop any practice that is known to prevent a patient from being harmed.

Implications for Nursing Practice

Due to the limitations addressed above, more work is needed to explore the relationships between AHP and falls in rehabilitation patients. The difference in mean scores in the VATA-m between the clinician and the patient supports that the phenomenon exists, but the overarching effects of the condition remain to be explored. Findings from this study support a more extensive exploration of the effects of AHP on stroke rehabilitation outcomes. One incidental finding concerns how the clinical staff answered the questions on the Morse Fall Risk Scale. This is important because the clinicians' answers determine the level of risk at which that patient is considered. A lower score indicates that the patient is at a lower risk for falling, while a higher score indicates a higher risk for falling. If a clinician answers that a patient is aware of his or her deficit when the patient is not, the score will be lowered by 15 points, which is enough to place the patient in a lower category of risk. With the lower category of risk, there are fewer interventions recommended to keep the patient safe from falls. Also, if a clinician believes that the patient is aware of his or her condition, there may be a difference in how that clinician responds or reacts if the patient needs something. The delayed response from the clinician may not be intentional, but one that is made subconsciously based on an erroneous proxy for cognition. An objective assessment technique that can be quickly administered at the bedside, like the VATA-m, could enhance the clinician's understanding of patient awareness or unawareness and influence the interventions put in place to keep the patient safe.

Directions of Future Research

This study should be considered a preliminary pilot study that supports the need for a more robust clinical study with a larger sample. The specific aims for this work were focused on the outcome of patient falls in a limited stroke population. However, according to the literature, the morbidity that is associated with AHP affects more than patient fall events. For example, stroke rehabilitation patients who refuse to participate in rehabilitative activities or miss rehabilitation days will not physically improve as much as they could. This could affect disposition, with the patient being discharged to a long-term facility instead of home. Future studies should have specific aims that examine additional variables, and not just patient fall events. Other variables of interest include length of stay, missed rehabilitation hours and days, functional improvement over the rehabilitation period, and disposition. AHP, as a multifaceted phenomenon, should be examined and researched in a manner that captures the entirety of its effects on the stroke survivor.

Another direction for future research includes understanding how clinicians, specifically nurses, decide whether a patient is or is not aware of limitations at the bedside. The difference in mean scores of the VATA-m between clinician and patient supports the notion that the phenomenon exists. The fact that 100% of the clinical staff believed that the patient was aware of his or her disability suggests that some form of subjective assessment technique is being used as a proxy of awareness. The first step would be to understand why and how that decision is made at the bedside. Then, work should be completed to incorporate the VATA-m into the Morse Fall Risk Scale. The objective assessment would not necessarily be separate from the Morse Fall Risk Scale but would be a sub-scale within the instrument that would help clinicians more accurately answer the question concerning awareness of limitations.

Finally, to address the limitation of the small sample size, a larger, more robust study must be conducted. The sample size required to address the research question concerning the relationship between variables was calculated utilizing the power analysis software G*Power. With power set at 0.80, a medium effect size of 0.15, and a type I error probability of 0.05, the suggested sample size is 34. A sample of this size would be sufficient to capture a medium relationship between AHP and the additional variables addressed above.

Clinical research and, specifically, pilot studies in the clinical area have a unique role in the development of interventions and larger projects that test hypotheses. To quote Porta (2014), a pilot study is "a small-scale test of the methods and procedures to be used on a larger scale" (p. 2). Pilot studies are often used to evaluate the feasibility of recruitment, retention, assessment procedures, and methods utilized (Leon et al., 2011). While not the intended purpose of this study, through the work that was accomplished, there is enough evidence to support a larger, more robust project. There is also evidence that supports the feasibility of the recruitment plan, the protection of human subjects, the use of the VATA-m, and the statistical methods utilized.

Clinical research that can be can translated into quality care at the bedside is a priority for all scientists. This concept, known as translational research, serves as the link between laboratory theories and quality clinical care delivered at the bedside. Translation comes through developing theories, the testing of theories, and then application of practice change through dissemination and education. Continued evaluation of long-term outcomes and refinements of interventions should continue as the state of the science changes (Hastings et al., 2012). As a healthcare profession, nursing has a duty and responsibility to conceptualize and develop practices that contribute to patient well-being and prevent harm during hospitalization (Forbes, 2009). For decades, fall reduction interventions, bundles, and strategies have been implemented across various inpatient hospital settings, but there has been little improvement in the stroke inpatient rehabilitation population. By aiming to understand the mechanism behind patient falls, and developing a specialized risk stratification system or an intervention to prevent falls, the current research can be translated into care that prevents harm and improves the health and well-being of an entire sub-population of patients. By examining and studying specific nursing quality indicators, nurse scientists have an opportunity to transform care at the bedside to be more patient and population specific.

Conclusions

Anosognosia for hemiplegia is a common phenomenon that occurs after ischemic stroke. Because the patient believes that he or she can perform movements adequately, this often results in longer rehabilitation stays, patient refusal to participate in rehabilitation activities, and the initiation of dangerous transfers or unsupervised ambulation that could contribute to patient falls in the inpatient rehabilitation setting. Though this study did not identify any significant relationships or variables that prevent falls, a major limitation was the sample size. Additional research, with differing specific aims and a larger sample size is needed before practice-changing conclusions can be made. The significant difference between the VATA-m scores between the clinician and patient supports the conclusion that the phenomenon does exist and supports the need for future research into the potential effects and interventions for the phenomenon. There is also evidence to support that nurses at the bedside who use the Morse Fall Risk Scale need an objective method by which to measure a patient's ability to discern his or her limitations. The VATA-m, because of its ease of use and efficiency, is the recommended method supported by this work. Ongoing work and research in both areas should continue to be a priority in order to decrease the morbidity and mortality associated with fall events in the inpatient stroke rehabilitation setting.

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APPENDIX A

IRB APPROVAL

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM
Office of the Institutional Review Board for Human Use

470 Administration Building
701 20th Street South
Birmingham, AL 35294-0104
205.934.3789 | Fax 205.934.1301 |
irb@uab.edu

APPROVAL LETTER

TO: Byrd, Sarah Elizabeth

FROM: University of Alabama at Birmingham Institutional Review Board
Federalwide Assurance # FWA00005960
IORG Registration # IRB00000196 (IRB 01)
IORG Registration # IRB00000726 (IRB 02)

DATE: 29-Feb-2020

RE: IRB-300003792
The Relationship between Anosognosia for Hemiplegia after Stroke and Fall Events in the Acute Inpatient Rehabilitation Population

---

The IRB reviewed and approved the Revision/Amendment submitted on 20-Feb-2020 for the above referenced project. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services.

Type of Review: Expedited
Expedited Categories: 4, 5, 7
Determination: Approved
Approval Date: 29-Feb-2020
Expiration Date: 28-Feb-2023

Although annual continuing review is not required for this project, the principal investigator is still responsible for (1) obtaining IRB approval for any modifications before implementing those changes except when necessary to eliminate apparent immediate hazards to the subject, and (2) submitting reportable problems to the IRB. Please see the IRB Guidebook for more information on these topics.

The following apply to this project related to informed consent and/or assent:

- Waiver (Partial) of HIPAA

Documents Included in Review:

- praf.200220

APPENDIX B

NDNQI FALL INJURY DEFINITIONS

Appendix B. NDNQI Fall Injury Definitions

None	Patient had no injuries (no signs or symptoms) resulting from the fall, if an x-ray, CT scan or other post fall evaluation results in a finding of no injury.
Minor	Resulted in application of a dressing, ice, cleaning of a wound, limb elevation, topical medication, bruise or abrasion.
Moderate	Resulted in suturing, application of steri-strips/skin glue, splinting or muscle/joint strain.
Major	Resulted in surgery, casting, traction, required consultation for neurological (basilar skull fracture, small subdural hematoma) or internal injury (rib fracture, small liver laceration) or patients with coagulopathy who receive blood products as a result of the fall.
Death	The patient died as a result of injuries sustained from the fall (not from physiologic events causing the fall).

Montalvo, I. (2007)

APPENDIX C

VATA-M INSTRUMENTATION

Appendix B. VATA-M Instrumentation

1A. Example Question: Do/would you have difficulty driving?

1. Do you have difficulty clapping your hands?

2. Do you have difficulty walking?

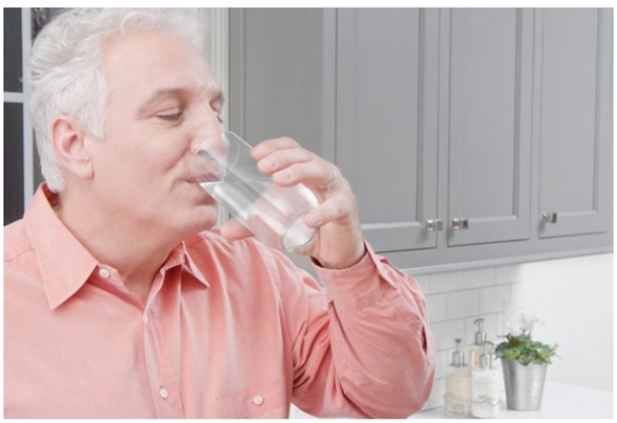
2. Do you have any difficulty in washing your hands?

3. Check question: Do you have any difficulty in jumping over a car?

4. Do you have any difficulty in washing the dishes?

5. Check question: Do you have any difficulty in drinking from a glass? (Left Hemiplegia)

(Right Hemiplegia)



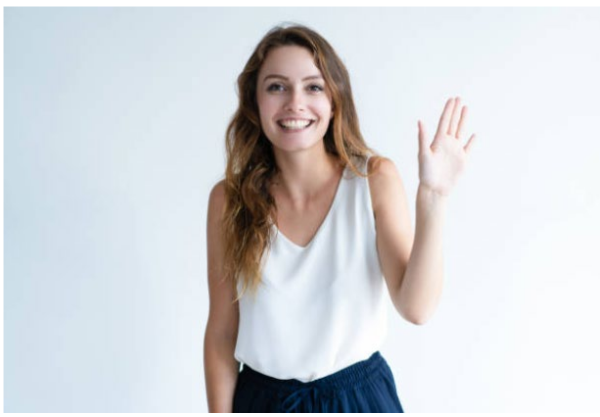
6. Do you have any difficulty in putting on a pair of gloves?

7. Do you have any difficulty in jumping?

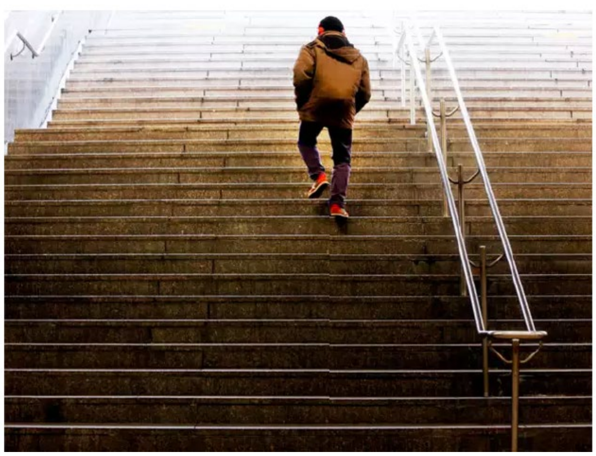
8. Do you have any difficulty in opening a jam/jelly jar?

9. Check question: Do you have any difficulty in waving? (Left Hemiplegia)

(Right Hemiplegia)



10. Do you have any difficulty in climbing the stairs?



11. Do you have any difficulty in opening a bottle?

12. Do you have any difficulty in dealing a pack of cards?

13. Do you have any difficulty in riding a bicycle?

14. Do you have any difficulty in tying a knot?

15. Check question: Do you have any difficulty in juggling five balls in the air?

Visual analogue scale used for each question:

No Problem **Problem**

0--------------------1--------------------2--------------------3

Della Sala, S., Cocchini, G., Beschin, N., & Cameron, A. (2009).
Adaption request granted by original authors.

APPENDIX D

PERMISSION TO USE VATA-M

Re: VATA-M

Gianna Cocchini <G.Cocchini@gold.ac.uk>
Wed 6/12/2019 6:55 AM

To:
Byrd, Sarah Elizabeth

Dear Dr. Byrd,

I also have no objections provided the conditions mentioned by Prof. Della Sala.

I'm pleased that our studies on anosognosia have been well received.

I wish you all the best for your final project, Gianna Cocchini

****

Dr. Gianna Cocchini

Senior Lecturer

Psychology Department

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UK

Websites: https://www.gold.ac.uk/psychology/staff/cocchini/

http://homepages.gold.ac.uk/gcocchini

Body Representation Network: BRNet

Workshop - 29 June 2018- Edinburgh

https://bodyrepresentation.wixsite.com/brnet

From: Byrd, Sarah Elizabeth <ebet@uab.edu>
Sent: Tuesday, June 11, 2019 6:29:51 PM
To: DELLA SALA Sergio; Gianna Cocchini
Subject: Re: VATA-M

Dr. Della Salla and Dr. Cocchini,

Thank you for your consideration. I will absolutely provide the proper referencing and acknowledgment of your original instrument. I can't tell you how you both have profoundly impacted my interest and focus during my dissertation work.

Elizabeth Byrd

From: DELLA SALA Sergio <sergio@ed.ac.uk>
Sent: Tuesday, June 11, 2019 12:07
To: Byrd, Sarah Elizabeth; Gianna Cocchini
Subject: RE: VATA-M

Dear Dr Byrd, I have no objections provided the usual referencing and acknowledgements. However, I have passed on your request to my colleague and collaborator Dr Gianna Cocchini. Best wishes. Sergio Della Sala

Sergio Della Sala
Professor
Human Cognitive Neuroscience
University of Edinburgh, UK
sergio@ed.ac.uk

---- Byrd, Sarah Elizabeth wrote ----

Dear Dr. Della Salla,

My name is Elizabeth Byrd, and I am a PhD student at the University of Alabama at Birmingham School of Nursing. I have completed my course work and I am working on my IRB/HSP application for approval to move forward with my dissertation study. The reason I am writing is because I would like to incorporate your tool, the VATA-M, with a few minor adjustments, as an assessment for stroke rehabilitation patients in the inpatient rehabilitation setting. I am writing to ask permission to use and adapt your tool, the VATA-M. I appreciate your consideration and will answer any questions you have.

Thanks for your time.
Elizabeth Byrd

Elizabeth M. Byrd, RN, MSN, CCNS | Instructor, PhD(c)
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Knowledge that will change your world