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An exploration of the relationship between aphasia therapy, depression and quality of life in post-stroke patients after rehabilitation at 12 and 26 weeks after stroke: A VERSE sub-study

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**An Exploration of the Relationship between Aphasia Therapy, Depression and
Quality of Life in Post-Stroke Patients After Rehabilitation at 12 and 26
Weeks after Stroke: A VERSE Sub-Study**

This thesis is presented in partial fulfilment of the degree of
Master of Science (Medical Science)

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2021

Abstract

Background: Depression is a common consequence of stroke, and people with aphasia (PWA) post-stroke have a higher risk of developing depression compared to stroke survivors without aphasia. However, current stroke interventions featuring aphasia therapy tend to neglect the effect of the treatment on mood. There is also a lack of evidence on the impact of stroke education and counselling on PWA in early stroke recovery. Additionally, the research on post-stroke depression often excludes or insufficiently describes PWA in study populations. The influence of direct aphasia therapy on depression in PWA is undetermined. This sub-study investigated: i) the effect of aphasia therapy, stroke education and counselling on depression as measured by the Aphasia Depression Rating Scale (ADRS) at 12 and 26 weeks after stroke in people with aphasia; ii) the effect of change in communicative ability on depression and quality of life as measured by the Stroke and Aphasia Quality of Life-39 (SAQoL-39); and iii) the relationship between depression and quality of life at 12 and 26 weeks post-stroke after controlling for covariates mentioned below.

Method: The Very Early Rehabilitation of SpeEch (VERSE) trial was a randomized controlled trial that recruited 246 participants within the first 10 days post-stroke and provided them with different regimens of direct aphasia therapy. Education and counselling were provided as part of standard usual care within the trial and the content of these sessions was left to the discretion of the therapist. This sub-study ran linear mixed effects regression models at 12 and 26 weeks using baseline data, the amount of aphasia therapy (hours) and frequency (sessions per week) provided and ADRS and SAQoL-39 scores. The models controlled for age, gender, baseline stroke severity (NIHSS), baseline aphasia severity (Western Aphasia-Battery Aphasia Quotient score) and baseline cognition. Hospital site was included as a random effect in all models.

Results: Eighteen models were run. Amount (hours) and frequency of direct aphasia therapy, stroke education and counselling had no significant effect on ADRS scores at 12 and 26 weeks

after stroke. The change of AQ scores from baseline to week 12 and from baseline to week 26 did not influence ADRS scores. The difference between AQ scores from baseline to week 12 and from baseline to week 26 was significant in predicting SAQoL-39. ADRS was a significant predictor of SAQoL-39 scores at weeks 12 and 26 after stroke.

Conclusion: The amount (hours) and frequency of direct aphasia therapy, stroke education and counselling did not significantly affect the development of depression in this cohort. Change in communicative ability and depression strongly predicted the quality of life for PWA as early as 12 weeks after stroke. There was no evidence that communication-based therapy had an effect on mood. Therapy that merges communicative and psychosocial strategies together could be explored to find a form of treatment that targets language ability and mood for people with early aphasia after stroke. Further research is required for the management of depression for PWA in the early phase of recovery.

Declaration

I certify that this thesis does not, to the best of my knowledge and belief:

- i. incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher education;
- ii. contain any material previously published or written by another person except where due reference is made in the text of this thesis; or
- iii. contain any defamatory material;

Signature of Candidate:



Date: 19/8/2020

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Introduction

Stroke is a major cause of disability (Bensenor et al., 2015) resulting in significant, life-altering changes such as paralysis (Armour et al., 2016), aphasia (Engelter et al., 2006), functional dependence (McNaughton et al., 2011) and post-stroke depression (Robinson & Jorge, 2016). Every minute, 30 people suffer a stroke worldwide, and every year about 6.2 million deaths are stroke-related (World Health Organization, 2014). Rehabilitation in post-stroke patients is vital to optimise physical, cognitive, communicative (Bhogal et al., 2003) and psychological recovery (Jeong et al., 2014), reduce morbidity outcomes (Liu et al., 2014), and to manage the complications of stroke (Lanctôt et al., 2019). Multiple factors influence stroke recovery with socio-demographic, clinical and genetic factors all having a varied effect on outcomes (Alawieh et al., 2018).

Socio-demographic factors that may positively affect stroke recovery include younger age and being male (Alawieh et al., 2018). Co-morbidities, low socioeconomic status, post-stroke depression and the initial severity and type of stroke are clinical factors that may negatively affect recovery. The provision of post-stroke rehabilitation may have an effect on recovery with timing of therapy commencement, therapy type, dosage and intensity of therapy (Alawieh et al., 2018) showing varied results for existing therapies.

Aphasia is a language disorder caused by brain damage and is one of the most common consequences of stroke (American Stroke Association, 2018). About 15% of people under the age of 65 have aphasia after stroke, while up to 43% of people aged 65 and older have post-stroke aphasia (Engelter et al., 2006). People with aphasia (PWA) may find it difficult to read, write, speak or comprehend language and are often frustrated by the disability (Cahana-Amitay et al., 2011). People with aphasia can have strained personal relationships (Hilari & Northcott, 2017), low employment re-entry rates (Tanaka et al., 2014), and depression (Hackett & Pickles, 2014). Aphasia recovery is influenced by generic stroke and aphasia specific factors, such as

initial aphasia type and severity (Watila & Balarabe, 2015). It is estimated that between 11 and 50% of PWA fully recover after accounting for initial aphasia severity and the amount of therapy the person receives (Ali et al., 2015).

Relationship between Stroke and Depression

Depression is defined by the World Health Organization (WHO) as a mental health disorder characterised by anhedonia, sadness, lethargy, poor concentration, disturbed sleep, decreased appetite, and feelings of guilt or low self-esteem for at least two weeks (World Health Organization, 2018). The phrase ‘low mood’ is also used within the research literature, with the term mood defined as ‘a prolonged subjective emotional state that influences one’s whole personality and perception of the world’ (Dorland, 2012, p. 1179). Low mood does not necessarily imply depression, as negative emotions such as anxiety and life stress could also be classified as ‘low mood’. Thomas et. al (2013) brought attention to ‘low mood’ in a randomised controlled trial that included participants with depressive symptoms that was not enough to gain a diagnosis of clinical depression based on the Visual Analog Mood Scales and the Stroke Aphasic Depression Questionnaire. Negative emotions that can arise after stroke, such as anxiety or life stress, may have a significant impact on the individual’s life (Plieger et al., 2015) and cause low mood. This study may include participants with low mood; however the term is not used throughout this study.

It should be noted that this study has defined the different time periods involved in the phases of stroke recovery, categorised as early, subacute and chronic. This study utilised the definitions established by Stinear et al. (2013) and Marsh and Hillis (2006) with some modifications. For this thesis, the early phase of recovery is defined as less than a month after stroke. The chronic phase of recovery addresses PWA beyond six months post-stroke onset, and the subacute phase of recovery is the time period in between early and chronic. These definitions will be used throughout this thesis to describe this and other studies.

Stroke survivors have around a 30% chance of developing depression within the first year after stroke onset (Kneebone & Lincoln, 2012). Systematic reviews of stroke studies completed in 2005 (Hackett et al., 2005) and 2014 (Hackett & Pickles, 2014) found the prevalence of depression after stroke to be 33% and 31% respectively. For comparison, there is a 28.1% prevalence of diagnosed depression within the general population across countries with high-income, and 19.8% for low income countries (Kessler & Bromet, 2013).

Causes of Depression After Stroke

Whyte and Mulsant (2002) concluded that post-stroke depression is multicausal. Depression may be a consequence of the negative, life-changing experience of having a stroke, or other biological, social, and psychological factors caused by stroke. Depression may also stem from a combination of these causes (Aben et al., 2002).

Depression After Stroke and Brain Injury. Depression is likely to be a probable organic reaction in stroke patients based on the severity of brain injury and the location the of brain lesion. Damage to the frontal cortex or the left dorsolateral prefrontal cortex (DLPFC) in particular, has been associated with significant rates of depression (Grajny et al., 2016). Damage to the left DLPFC may result in a person having a reduced level of control over their affect, which could lead to major depression disorder symptoms (Grajny et al., 2016). Left lobe lesions in general have been found to cause affective depression, acute adjustment disorders and communication problems (Grajny et al., 2016; Hama et al., 2007). The higher the density of the left lobe lesion, the more severe the depressive and aphasia symptoms (Hama et al., 2007).

Depression after Stroke, Cognition and Age. Depending on the lesion location, stroke can directly result in cognitive impairment (Baccaro et al., 2019) and post-stroke depression (Grajny et al., 2016). Symptoms of depression after stroke may be associated with cognitive

changes as Robinson & Jorge (2016) stated that cognitive impairment is a risk factor for post-stroke depression. The review highlighted several cognitive domains in which cognitive impairment could predict post-stroke depression including attention and language (Robinson & Jorge, 2016). Additionally, the symptoms of cognitive deficit, such as reduced attention, executive dysfunction and social withdrawal could overlap with the signs of depression in acute stroke. This overlap could make it difficult to determine whether the presentation of symptoms was caused by cognitive impairment or the presence of depression (Das & G K, 2018). For people with aphasia, differentiating cognitive and depressive symptoms may be further complicated by their communication difficulty.

Stroke most commonly occurs in the elderly (Carandang et al., 2006) and the morphological and chemical changes that may occur in the ageing brain are linked to cognitive change, depression and functional decline (Peters, 2006). With increasing age, the secretion of neurotransmitters such as dopamine and serotonin decrease (Peters, 2006). These neurotransmitters are vital in maintaining cognition as well as mood. Low levels of neurotransmitters due to age may lead to cognitive decline (Cabeza, 2004) and depressive symptoms (Alexopoulos, 2019). These changes may compound the impact of the stroke as older age is a negative predictor for aphasia and stroke recovery (Alawieh et al., 2018; Mitchell et al., 2017). The changes may also reduce the level of engagement in rehabilitation, in which the elderly have a lower rate of participation in activities that promote recovery (de Graaf et al., 2018). At the same time, cognitive impairment may diminish the engagement in rehabilitation and the consequent rate of recovery in stroke survivors (Vukovic et al., 2008). The frustration from one's inability to independently provide self-care may further worsen an individual's mood, as functional dependence is one of the strongest predictors of depression (Ayerbe et al., 2011). Hence, age and cognition are factors that may contribute to post-stroke

depression. These factors overlap and it is often difficult to pinpoint the exact cause for depressive symptoms in an elderly person after stroke.

Depression after Stroke and Aphasia. A meta-analysis investigating 108 publications ($N = 14,220$) found that the prevalence of any depressive disorders in post-stroke participants was 33.5% (Mitchell et al., 2017), similar to the prevalence found in the review by Hackett et al. (Hackett & Pickles, 2014; Hackett et al., 2005). The meta-analysis examined data from five studies, with 211 participants from both subacute and chronic phases of stroke recovery, to examine the prevalence of any depressive disorders amongst PWA. Across these studies the prevalence of all depression disorders for PWA was 52% (Mitchell et al., 2017). People with aphasia after stroke have a 50% increased risk of developing depression in comparison to stroke survivors without aphasia (Mitchell et al., 2017). Other research has suggested the prevalence of major depression for first-ever stroke participants with aphasia ($n = 106$) could increase from 11% to 33% in a 12 month period (Kauhanen et al., 2000). In studies investigating post-stroke depression in individuals following intracerebral haemorrhage and ischemic stroke, 10% of the studies - due to their aphasia and the impact of the communication impairment on their ability to complete the required questionnaires used to diagnose depression (Karamchandani et al., 2015). PWA are often excluded in studies that measure outcome variables with self-reported questionnaires.

The severity of the communication impairment, in the person with aphasia, may also have an impact on the likelihood of the individual developing depression as the greater the severity of aphasia, the more likely depressive symptoms are to appear (Døli et al., 2017). Additionally, depression in PWA is more persistent compared to depression in people without aphasia (Hilari, 2011).

The increased risk of developing depression in PWA could be attributed to multiple factors that relate to the presence of aphasia. Due to the possible, life changing nature in

communicative ability, PWA often feel isolated from their family and peers (Code & Herrmann, 2003). The deterioration of communication could also jeopardise the chance of PWA returning to work, as only 28.4% PWA successfully return to employment (Graham et al., 2011). The loss of professional and social networks often give rise to profound feelings of loneliness (Code et al., 1999) and uselessness that could negatively influence their mood and quality of life (QoL) (Code & Herrmann, 2003). The occupational loss added with newfound medical costs for stroke and aphasia rehabilitation may lead to financial distress (Ellis et al., 2012) and further worsen the person's mood.

Stroke rehabilitation and recovery are also influenced by the presence of aphasia. Aphasia can negatively affect functional recovery outcomes at three months after stroke (Ali et al., 2015). The presence of a communication impairment combined with the presence of depression could largely influence functional regain, even at an early phase of stroke recovery (Worrall et al., 2017). Research indicates depression is evident in PWA at three months, or even earlier after stroke (Hama et al., 2007).

Quality of Life after Stroke

Quality of life (QoL) is defined as an individual's satisfaction with their life based on various domains such as physical and mental health, personal lifestyle and social standing (World Health Organization, 2020). One of the main aims of post-stroke therapy is to ensure a better life for people after surviving a stroke (Stroke Foundation, 2019a). However, people frequently report having poor QoL after a stroke (Lee et al., 2015), influenced by the presence of depression, impaired cognition and reduced functional recovery (Carod-artal & Egidio, 2009). For people with aphasia, poor functional dependence and a high depression score strongly predict a low QoL up to a year after stroke (Koleck et al., 2017). A study by Cruice, Worrall and Hickson (2010) found that people with chronic aphasia and depression had a significantly worse QoL in comparison to non-depressed PWA. A systematic review conducted

by Hilari et al. (2012) only found 14 of 1791 stroke studies that investigated QoL in an aphasia population, and 11 out of the 14 study populations only consisted of people with chronic aphasia. Within the small pool of evidence featuring people with acute aphasia, research found that PWA in the subacute phase of recovery have a lower QoL in comparison to people who have had aphasia more than six months (Manders et al., 2010). The findings suggest that the QoL of PWA in the subacute phase of recovery is worse than PWA in the chronic phase of recovery. However, little is known of the relationship between depression and QoL in people with aphasia in the early stages of recovery.

The Effect of Depression on Stroke Recovery

Stroke and depression are known to have a two-way relationship (Dong et al., 2012). While stroke survivors have an increased chance of developing depression post-stroke, depression can also be a hindrance in post-stroke recovery. The presence of depression may decrease the level with which an individual engages with rehabilitation, which may result in a slower rate of recovery (Robinson et al., 2008). A six-month study of stroke patients in the early, acute and chronic stages of recovery found that high functional regain was associated with decreased depressive symptoms (Saxena et al., 2007). However, improvement in physical functioning heavily depended on the person's neurological and cognitive abilities. There is also evidence of an inverse relationship between depression and functional recovery, in which the decrease of depressive symptoms is associated with an increased rate of functional recovery (Parry et al., 2017). This relationship was supported by the findings of a study (Kawada & Goto, 2017) exploring factors associated with individuals' prognosis in relation to completing activities of daily living (ADLs) and whether this was correlated with depression scores. In the study of 13 people admitted with stroke, there was a significant correlation between the Geriatric Depression Short-Scale Version and Functional Independence Measure scores at eight weeks after hospital admission (Kawada & Goto, 2017). Tateno and Robinson (2002)

concluded that post-stroke depression could lead to poor physical recovery, increased symptoms of cognitive deficit and a low ability to carry out activities of daily living (ADL).

Although limited information is available, in relation to the effect of depression on engagement with post-stroke rehabilitation, the findings of a systematic review investigating critically ill patients and their engagement in physical rehabilitation provides some relevant insight (Parry et al., 2017). The review of 89 studies found that people with depression tended to use rehabilitation services less than non-depressed patients (Parry et al., 2017). Consequently, patients with depression made functional progress at a slower rate than non-depressed patients (Parry et al., 2017). Andrenelli et al. (2015) investigated activity limitations in first-time stroke patients in their chronic phase of recovery and found that physical functional outcomes were reduced by a person's lack of participation in therapy. Reduced participation in therapy may result in the person experiencing difficulty carrying out activities of daily living (Fernandes et al., 2012). It is suggested that to facilitate optimal language recovery, one must be psychologically prepared to engage in rehabilitative activities to improve the impairment (Knollman-Porter et al., 2015; Wepman, 1953), therefore mood disorders could inhibit PWA from seeking out rehabilitation. However, current research often lists the presence of aphasia as exclusion criteria in studies that investigate engagement in rehabilitation, resulting in a lack of related evidence for PWA (Baker et al., 2018).

Overview of Interventions for Depression in Stroke Survivors with Aphasia

Given the increased prevalence of depression amongst individuals who have experienced a stroke, including those with aphasia, and the impact depression can have on the individual's QoL, functional recovery and engagement in rehabilitation, it is important to develop effective ways to prevent and manage depression post-stroke. However, there is little evidence currently available to guide the clinical management of people with post-stroke depression other than through pharmaceutical management. The Australian Clinical Guidelines

for Stroke Management (Stroke Foundation, 2019a) provide guidance for evidence-based management of mood disturbances after stroke. From the evaluation of available literature the guidelines currently make: 1) a weak recommendation for the use of psychological approaches to prevent post-stroke depression; ii) a strong recommendation for the use of antidepressants for people with depression or depressive symptoms; iii) a weak recommendation for the use of exercise programs to treat people with depression or depressive symptoms; and, iv) a weak recommendation for acupuncture to treat depression (Stroke Foundation, 2019a). Additionally, the Canadian Stroke Best Practices and Quality Advisory Committee states that initial stroke management may include cognitive-behavioural therapy or interpersonal psychotherapy as a single therapy for PWA with depression. It is also suggested that psychological therapy may be more effective when prescribed in combination with antidepressants (Lanctôt et al., 2019). Current -reviews suggest the provision of psychological interventions together with multidisciplinary care in the management plan for people with aphasia after stroke (Baker et al., 2018).

In reviewing interventions for depression in stroke survivors with aphasia, Baker et al. (2018) classified the interventions into three categories: *preventive*, *treatment* and *stroke rehabilitation interventions*. *Preventive interventions* used various techniques to prevent depression in their respective populations and included people with a high risk of depression after stroke but did not fulfil the diagnostic criteria for depression. *Treatment interventions* were those that focused on psychosocial approaches to directly treat depression in PWA diagnosed with depression. *Stroke rehabilitation interventions* were different forms of therapy which aimed to restore or improve function, in other areas such as communication, and had an effect on depression in stroke survivors with aphasia (Baker et al., 2018). These categories provide a useful framework for classifying interventions for depression when examining the broader literature and have been applied in this thesis. Within these categories, this sub-study

will specify the nature of the strategies implemented in the various interventions, such as communication, psychosocial or other forms. The current study focused on *stroke rehabilitation interventions* with a focus on communication strategies, also known as direct aphasia therapy, and aimed to investigate the effect of direct aphasia therapy on depression in PWA.

Overview of Findings in Relation to Existing Interventions for PWA After Stroke

Research that explores depression as an outcome for people with stroke often investigates the effectiveness of therapy that aims to improve depression. The following sections provide a brief overview of findings related to *treatment* and *stroke rehabilitation interventions* with psychosocial approaches. *Treatment* studies that aim to directly treat depression often introduce and implement psychosocial functioning strategies with their participants (Baker et al., 2018) and there was some evidence of reduced depression scores within aphasia populations. The Communication and Low Mood (CALM) study by Thomas et al. (2013) showed that behavioural therapy may positively influence mood and reduce depression symptoms for PWA from three to six months post-therapy allocation. The participants were in both acute and chronic stages of recovery, and their mood improved as assessed by the Stroke Aphasic Depression Questionnaire (Sutcliffe & Lincoln, 1998) and by the investigating clinicians' observations.

While *treatment* and *preventive* interventions have an effect on depression, *stroke rehabilitation* strategies may also have an indirect effect on depression. However depression is often investigated as a secondary outcome and findings from current *stroke rehabilitation* studies are varied and inconclusive (Baker et al., 2018). In the pool of *stroke rehabilitation* research involving PWA, from the Baker et al., (2018) review, PWA were often excluded or were not described in detail in terms of participant numbers and aphasia severity. There were

many mood assessment tools with different cut-off points used by these studies for a diagnosis of depression. Within the broader category of *stroke rehabilitation* studies, apart from the Baker et al. systematic review (2018), some investigated the impact of language therapies, while others investigated the outcomes of other approaches to rehabilitation without using communication strategies, with depression included as an outcome measure. The outcomes of rehabilitation with communication strategies are outlined in the next section however it is also useful to note the outcomes of rehabilitation using other approaches. These rehabilitation strategies are geared towards recovering body functions affected by stroke, other than communication, and may have a secondary effect on mood. One study that listed psychological outcomes as a primary outcome found a significant decrease in participants' depression and anxiety scores when stroke patients in the subacute phase of recovery ($n = 38$) were exposed to active music therapy (Raglio et al., 2017). However, *stroke rehabilitation* studies often investigate mood as a secondary outcome, especially in research that primarily intends to treat functional recovery. A study that utilised drama classes for PWA in the chronic phase of recovery ($n = 7$) found improved scores for mood after 18 weeks of therapy (Cherney et al., 2011). A review article on music therapy and its application within stroke rehabilitation studies involving PWA have also positively influenced depression scores (Leonardi et al., 2018). Research that included self-management workbooks (Jones et al., 2009) found both quantitative and qualitative evidence of reduced depression scores from stroke survivors in the acute and chronic phases of recovery. However, the results were not statistically significant. There is some evidence that *stroke rehabilitation* studies may have an effect on the mood of stroke participants with aphasia. It is still unclear if the effect would be evident in a larger population for PWA in the early phase of recovery.

Stroke Rehabilitation Interventions with Communication Strategies

In line with the inconclusive findings regarding broader *stroke rehabilitation* interventions and the manner in which they may impact on depression, the effect of *stroke rehabilitation* with a focus on communication strategies for PWA is also unclear.

As mentioned, depression is not a common primary outcome for research involving stroke rehabilitation for PWA or research focused specifically on improving the communicative ability of PWA. In the review by Baker et al. (2018), six studies had depression scores as an outcome for various studies featuring a communicative approach. Four out of the total six studies were conducted in the chronic phase of recovery (Brumfitt & Sheeran, 1997; Corsten et al., 2015; Hartke et al., 2007; Murray & Ray, 2001), one study (Ross et al., 2006) had a mixed population of PWA in both the subacute and chronic phases of recovery, and one study (Lincoln et al., 1985) investigated participants at ten weeks after stroke. Four of those studies had depression as a primary outcome (Hartke et al., 2007; Lincoln et al., 1985; Murray & Ray, 2001; Ross et al., 2006), and the other two investigated depression as a secondary outcome (Brumfitt & Sheeran, 1997; Corsten et al., 2015).

None of the studies exploring depression as a primary outcome found a significant relationship between their interventions and a change in depression scores. Five out of six studies had small study populations of less than 30 participants. Hartke et al. (2007) ($n = 26$) and Ross et al. (2006) ($n = 7$) used group therapy for aphasia as an intervention, focusing on writing groups and social communication respectively. Murray and Ray (2001) ($n = 1$) implemented relaxation and syntax stimulation therapy over eight weeks and did not find clinically or statistically significant results. Similarly, the sole study ($n = 191$) that investigated PWA in the subacute phase of recovery post-stroke found no significance in outcomes involving mood (Lincoln et al., 1985). Additionally, the studies involving depression measures as a secondary outcome did not find a significant relationship between their interventions and depression scores. Brumfitt and Sheeran (1997) ($n = 6$) provided group therapy while Corsten

et al. (2015) ($n = 27$) used individual and group therapy for people in the chronic phase of recovery. Both studies found improved depression scores, despite the lack of statistical significance. Mood was a secondary outcome for both studies and was measured using the Hospital Anxiety and Depression Scale (HADS) and the Visual Analogue Mood Scale (VAMS) respectively.

The 2016 Cochrane review (Brady et al., 2016) examined speech language therapy (SLT) trials to investigate the effect of SLT on PWA across a range of different areas including mood. Based on the categorisation of therapies implemented within this thesis, the SLT trials in this review were considered *stroke rehabilitation* interventions as they do not directly treat or prevent depression but may have an indirect effect on depression. In the Cochrane review (Brady et al., 2016), there were five trials that compared the effect of SLT to no SLT on PWA post-stroke that included mood as a secondary outcome. Only one study ($n = 123$) had a population of stroke survivors in the early phase of recovery (Laska et al., 2011), while the remaining four investigated people in both subacute and chronic phases of stroke recovery. The trials were Smith et al. (1981) [$n = 133$], Lyon et al. (1997) [$n = 30$] and Lincoln et al. (1984; 1984) [$n = 191$]. Lincoln et al. ran two studies using the same population. None of these studies found a significant difference in mood for the study populations after the intervention period. Smith et al. (1981) [$n = 133$] and Martins et al. (2013) [$n = 30$] investigated the effect of high-intensity and low-intensity therapy and neither yielded significant results. Martins et al. (2013) also compared the effect of short-duration therapy with long-duration therapy on mood and found no effect. The study populations involved PWA in the subacute phase of recovery (Martins et al., 2013; Smith et al., 1981).

More recently research has started to examine combination therapies that implement communication strategies in rehabilitation programs for PWA. This approach to therapy has the potential to improve language skills, mood and QoL outcomes for people after stroke (Ryan

et al., 2019) as they address both the communication impairment and low mood simultaneously. Speech language pathologists' have preferred prescribing aphasia therapy combined with psychosocial components to address both the functional language recovery and psychological health improvement for PWA. .

Education and Counselling in Aphasia and Stroke Rehabilitation. While previous studies have investigated the effect of treatment and stroke rehabilitation on depression, strategies such as the use of stroke education and counselling may also have an effect on preventing or treating depression. Stroke education for post-stroke patients with aphasia should at least include information about stroke and its possible complications. Stroke prevention, risk reduction and stroke management are also important content for stroke education. The information would be beneficial for the stroke patient and their families or caregivers (Forster et al., 2012). The Australian Stroke Guidelines (Stroke Foundation, 2019a) provide consensus-based recommendations for education especially for rehabilitation purposes and post-stroke complication management. Education is recommended mainly to promote a positive attitude towards rehabilitation programs and establish a feeling of belonging for PWA using aphasia-friendly education material (Stroke Foundation, 2019a). Counselling can be defined as giving stroke patients information or advice, guiding the patient to explore their emotions and discussing options and alternatives to their problems (Simmons-Mackie & Damico, 2011). Counselling has weak recommendations in the Guidelines as an aid to increase patient adherence to pharmacotherapy (Stroke Foundation, 2019a). The Heart & Stroke Canadian Stroke Best Practices and Quality Advisory Committee recommend ongoing supervision and education for the patient and their families on the possible consequences of stroke, while counselling is recommended for lifestyle and behavioural changes to adhere to pharmacotherapy and to prevent stroke complications such as fatigue (Lanctôt et al., 2019). Additionally, the comprehensive supplement to the Aphasia Rehabilitation Best Practice

Statements (2014) states that stroke education could be beneficial for both the PWA and their caregivers to improve their stroke knowledge, satisfaction and mood. The stepped psychological care model recommends information provision and counselling content at level one of the rehabilitation program, targeting most participants with emotional changes after stroke. Psychosocial education within a group is recommended at level two for participants with mild to moderate symptoms of depression (Kneebone, 2016). A recent review found that most post-stroke PWA in subacute and chronic recovery felt as if they were given little to no information regarding psychological health and any available support or services related to psychological health during their rehabilitation period (Baker et al., 2020).

Stroke education may help patients develop health beliefs that serve as initiative to engage in recovery strategies (Sullivan & Katajamaki, 2009). The increased individual drive to pursue recovery may have a positive effect on mood (Knollman-Porter et al., 2015). Counselling may affect mood in a similarly constructive manner. Previous research highlighted the importance of patient education in a stroke population to alleviate depression. A Cochrane review exploring randomised trials found that stroke education reduced depression scores and increased patient and caregiver satisfaction in relation to the given information (Smith et al., 2008). The reduction in depression scores was small however it was suggested that stroke education could be adapted and modified to elicit a stronger effect (Smith et al., 2008). Similarly, counselling has been shown to be psychologically beneficial for people with stroke and aphasia (van der Gaag et al., 2005). An existing qualitative study in the United Kingdom, that included people with chronic aphasia, provided evidence that counselling could improve QoL in areas such as self-confidence and the desire to participate in therapy (van der Gaag et al., 2005). However, there is a lack of evidence for the benefits of stroke education and counselling for people with acute aphasia after stroke. An ongoing study that features these therapy elements is the Aphasia ASK trial (Worrall et al., 2016). While there are no findings

currently available, this randomised controlled trial is using a tailored, experimental intervention which aims to improve QoL and mood for people with acute aphasia (Worrall et al., 2016). Worrall et al. (2016) suggested that education may have an effect on mood and QoL in the early stages of recovery, and that the concept should be explored further.

Current Gap in the Literature on Rehabilitation for Stroke Survivors with Aphasia and Depression

There are several key issues that can be derived from the existing studies involving PWA with depression after stroke. Current evidence emphasises communication therapy without taking mood into account. If depression is involved, it is often a secondary finding for studies implementing communication therapy with a small sample size that are generally underpowered to detect significance in the outcomes used (Baker et al., 2018). Studies that investigate depression mainly featured psychosocial approaches which typically lacked information on how treatment and assessments were adapted to suit PWA (Baker et al., 2018). These topics of research often exclude or insufficiently describe PWA in study populations despite PWA having an increased risk of depression in comparison to stroke survivors without aphasia, reducing the pool of available evidence when examining the impact of interventions on depression (Baker et al., 2018; Brady et al., 2013). A systematic review by Townend, Brady and McLaughlan (Townend et al., 2007a) reported 71% of 129 studies on post-stroke depression excluded people with aphasia to some extent. At the same time, PWA may have inadequate support and services for mental health due to the nature of their disability making it difficult for psychosocial aid to be administered effectively (Baker et al., 2020). While there are many published studies on post-stroke depression and QoL, there is a dearth of information on the association between the two variables for PWA. It is vital to gain a better understanding on the relationship between mood and QoL in an acute aphasia population as depression negatively predicts long term QoL (Koleck et al., 2017).

While current research has indicated that aphasia-based rehabilitation does not have an impact on mood, the studies completed to date have small populations. Additionally, the few studies that investigate therapy elements such as therapy type, intensity and dosage on mood for aphasia patients were underpowered. Therapy intensity and dosage have been widely discussed in stroke literature with high intensity therapy potentially influencing predicted motor related functional gain for patients in the chronic phase of recovery (Mozeiko et al., 2016) and post-stroke mortality (Hsieh et al., 2018). However, high therapy intensity seemed to have no effect the mood of PWA with depression in the acute stage of recovery (Brady et al., 2016). The question arises whether any amount of direct aphasia therapy could influence depression in the early stages of recovery within a larger study population. As the presence of depression and increased therapy intensity may both have an influence on recovery, the relationship between therapy intensity and depression for PWA requires further investigation. Baker et al. (2018) highlighted the importance of exploring physical, cognitive and communication functioning intervention strategies that may have a positive effect on depression outcomes. This study intended to explore the possibility of an effect from direct aphasia therapy on mood.

Research on depression also tends to explore the mood of stroke patients without specifying the time period from stroke for their respective populations (Baker et al., 2018). There is a lack of evidence and information on aphasia rehabilitation during the very early phase of recovery (up to two weeks) (Godecke et al., 2012) related to mood.

The varied assessments used to measure mood in PWA also adds to the scarcity of valid evidence. Most of the assessments in the previously listed studies and reviews (Baker et al., 2018; Brady et al., 2016) are non-aphasia specific, and the validity of the findings for people with aphasia could be questioned. The Cochrane review (Brady et al., 2016) included six studies that had depression outcomes and the measures to assess mood were the Multiple Affect

Adjective Checklist (MAACL) (Zuckerman et al., 1983), the General Health Questionnaire (GHQ) (Williams & Goldberg, 1988), the Affect Balance Scale (ABS) (Bradburn, 1969), the Psychological Wellbeing Index (Ryff & Keyes, 1995), the EuroQoL (Brooks, 1996) and the Nottingham Health Profile (NHP) (Ebrahim et al., 1986). None of the previously mentioned assessments were deemed to be suitable to assess depression in PWA based on a recent review (van Dijk et al., 2015). The review investigated the psychometric properties of six different aphasia specific assessments including the ADRS. The three most feasible assessments to be used in a clinical setting based on the review were the Stroke Aphasic Depression Questionnaire-10 (Sutcliffe & Lincoln, 1998), the Stroke Aphasic Depression Questionnaire-H10 (Lincoln et al., 2000) and the Signs of Depression Scale (Hammond et al., 2000). However, all six of the assessments included in the review were derived from studies with poor to fair methodological quality with limited evidence of psychometric properties. A separate systematic review explored the different methods used to diagnose depression (Townend et al., 2007b). Within the review, 48% of the 60 studies examined had adjusted their diagnostic methods to better suit their respective study populations without reporting the validity of the adjustments (Townend et al., 2007b). The studies that did not modify the assessments for depression suggested that language-based methods of assessment are only fit for people with mild aphasia. The usage of aphasia-specific measurements for depression are recommended for the most accurate results (Berg et al., 2009).

In summary, the field needs more research investigating the influence of rehabilitation with communication strategies on depression and QoL for people with aphasia in the early phase of recovery after stroke in a large study sample in order to gain further evidence. The role of education and counselling in aphasia management and how they affect mood in PWA on a short and long-term basis should also be explored. The use of aphasia-specific assessments in aphasia studies are vital to ensure valid results and current evidence is mostly not geared

towards PWA. Previous research has introduced the concept of language rehabilitation and its effect on mood, but limited definitive evidence is available.

Purpose of the Study

This study provided further information on the effect of aphasia therapy on post-stroke depression and quality of life while using assessments that are specific to the early recovery periods in the post-stroke aphasia population.

Research Aims

This project investigated the nature of the relationship between aphasia intervention and post-stroke depression within the first six months of stroke recovery. The primary aim was to determine the effect of amount of aphasia therapy on depression in PWA at 12 weeks and 26 weeks post-stroke after controlling for age, gender, baseline stroke and aphasia severity and cognitive function. The secondary aims were to investigate the effect of stroke education and counselling on depression at 12 weeks and 26 weeks post-stroke after controlling for age, gender, baseline stroke and aphasia severity, cognitive function, amount and frequency of aphasia therapy. We also explored how the change in communicative ability affected the participants' scores on the Aphasia Depression Rating Scale (ADRS) (Benaim et al., 2004) and Stroke and Aphasia Quality of Life-39 (SAQoL-39) (Hilari et al., 2003) scores at 12 weeks and 26 weeks post-stroke after controlling for age, gender, baseline stroke and aphasia severity, cognitive function, amount and frequency of aphasia therapy. Lastly, this study also aimed to ascertain whether Aphasia Depression Rating Scale (ADRS) (Benaim et al., 2004) scores predict Stroke and Aphasia Quality of Life-39 (SAQoL-39) (Hilari et al., 2003) scores at 12 weeks and 26 weeks post-stroke after controlling for age, gender, baseline stroke and aphasia severity, cognitive function, amount and frequency of aphasia therapy. The participants in this

study were enrolled in the Very Early Rehabilitation of SpeEch (VERSE) trial (Godecke et al., 2016).

Specifically, the following research questions were addressed:

1. Does the amount of direct aphasia therapy affect depression measured by the Aphasia Depression Rating Scale (ADRS) at 12 weeks and 26 weeks of post-stroke after controlling for baseline age, gender, stroke severity (NIHSS), baseline aphasia severity and baseline cognitive status?
 - a. Does the frequency of direct aphasia therapy influence depression measured by the Aphasia Depression Rating Scale (ADRS) at 12 and 26 weeks of post-stroke after controlling baseline age, gender, stroke severity (NIHSS), baseline aphasia severity and baseline cognitive status?
2. Does the amount of stroke education provided by a speech language pathologist influence depression measured by the ADRS at 12 and 26 weeks of post-stroke after controlling for baseline age, gender, stroke severity (NIHSS), baseline aphasia severity, baseline cognitive status, amount and frequency of aphasia therapy?
 - a. Does the frequency of stroke education provided by a speech language pathologist influence depression measured by the ADRS at 12 and 26 weeks of post-stroke after controlling for baseline age, gender, stroke severity (NIHSS), baseline aphasia severity, baseline cognitive status, amount and frequency of aphasia therapy?
3. Does the amount of counselling provided by a speech language pathologist effect depression measured by the ADRS at 12 and 26 weeks of post-stroke after controlling for baseline age, gender, stroke severity (NIHSS), baseline aphasia severity, baseline cognitive status, amount and frequency of aphasia therapy?

- a. Does the frequency of counselling provided by a speech language pathologist effect depression measured by the ADRS at 12 and 26 weeks of post-stroke after controlling for baseline age, gender, stroke severity (NIHSS), baseline aphasia severity, baseline cognitive status, amount and frequency of aphasia therapy?
4. What is the effect of change in communicative ability as measured by the Aphasia Quotient (AQ) score change on the Western Aphasia Battery Revised (WAB-R) on the ADRS scores at 12 and 26 weeks of post-stroke after controlling for baseline age, gender, stroke severity (NIHSS), baseline aphasia severity, baseline cognitive status, amount and frequency of aphasia therapy?
5. What is the effect of change in communicative ability as measured by the AQ score change on the WAB-R on the Stroke and Aphasia Quality of Life (SAQoL) scores at 12 and 26 weeks of post-stroke after controlling for baseline age, gender, stroke severity (NIHSS), baseline aphasia severity, baseline cognitive status, amount and frequency of aphasia therapy?
6. Does the ADRS predict SAQoL scores at 12 and 26 weeks of post-stroke after controlling for baseline age, gender, stroke severity (NIHSS), baseline aphasia severity, baseline cognitive status, amount and frequency of aphasia therapy?

Method

Very Early Rehabilitation in SpEech (VERSE) Trial

This project is a sub-study of the VERSE trial (Godecke et al., 2016) and utilised a repeated measures design. VERSE was a prospective randomised controlled trial (RCT) that aimed to determine whether very early aphasia therapy was more effective than usual ward care at 12 and 26 weeks after stroke. Participants were randomised to one of three arms:

- **Usual Care:** Standard aphasia care provided by treating, usual care speech language pathologists, at their discretion. These services may have included counselling and stroke education.
- **Usual Care-Plus (UC-Plus):** Standard direct aphasia therapy provided five days per week for 45 - 60 minutes for 20 sessions in addition to usual care. The therapy regimen consisted of any of the following: 1:1 communication-based therapy, communication-based computer training, social training, group communication-based therapy, group social training or Augmentative and Alternative Communication (AAC) training. The therapy was selected at the discretion of the treating clinician. These services may have included counselling and stroke education.
- **VERSE intervention:** Prescribed and standardised aphasia therapy based on the VERSE RCT intervention protocol, provided five days per week for 45- 60 minutes for 20 sessions in addition to usual care. These services may have included counselling and stroke education.

The trial intervention period commenced the day after baseline assessment and randomisation, which occurred within 14 days post-stroke, and ended after 20 sessions of aphasia therapy (UC-plus or VERSE) or a maximum of 50 days post-stroke. Follow up assessments were carried out at 12 weeks and 26 weeks post-stroke. Further details of the

intervention and statistical analysis plan (Godecke et al., 2018) are provided in the VERSE Trial protocol (Godecke et al., 2016).

VERSE-Aphasia Therapy on Depression and Quality of Life (VERSE-ADQ)

Participants

A total of 246 participants were recruited to the VERSE RCT; 81 to the Usual Care arm, 82 to the UC-Plus arm and 83 to the VERSE arm. The VERSE inclusion criteria were: diagnosis of aphasia caused by acute stroke, as diagnosed by a speech language pathologist and a score of below 93.7 on the Aphasia Quotient (AQ) of the Western Aphasia Battery – Revised (WAB-R) (Kertesz, 2007); a minimum age of 18 years old; medically stable; able to interact for 30 consecutive minutes within two weeks of stroke onset and normal hearing or vision. Patients were excluded from the study if they had been diagnosed with premorbid aphasia; had a history of neurosurgery; had a previous diagnosis of dementia, major depression, or a progressive neurological disorder; were unable to participate in therapy in English or were enrolled in a different trial. The information on previous diagnoses or conditions was collected from the participants' medical history. Please refer to the VERSE protocol paper (Godecke et al., 2016) for further details on the inclusion and exclusion criteria.

This sub-study, VERSE-ADQ, used data from 245 participants as one participant withdrew consent. The CONSORT flow diagram outlines the study progress below (Godecke et al., 2020). The information in the diagram is produced with permission by the VERSE Trial Coordinator.

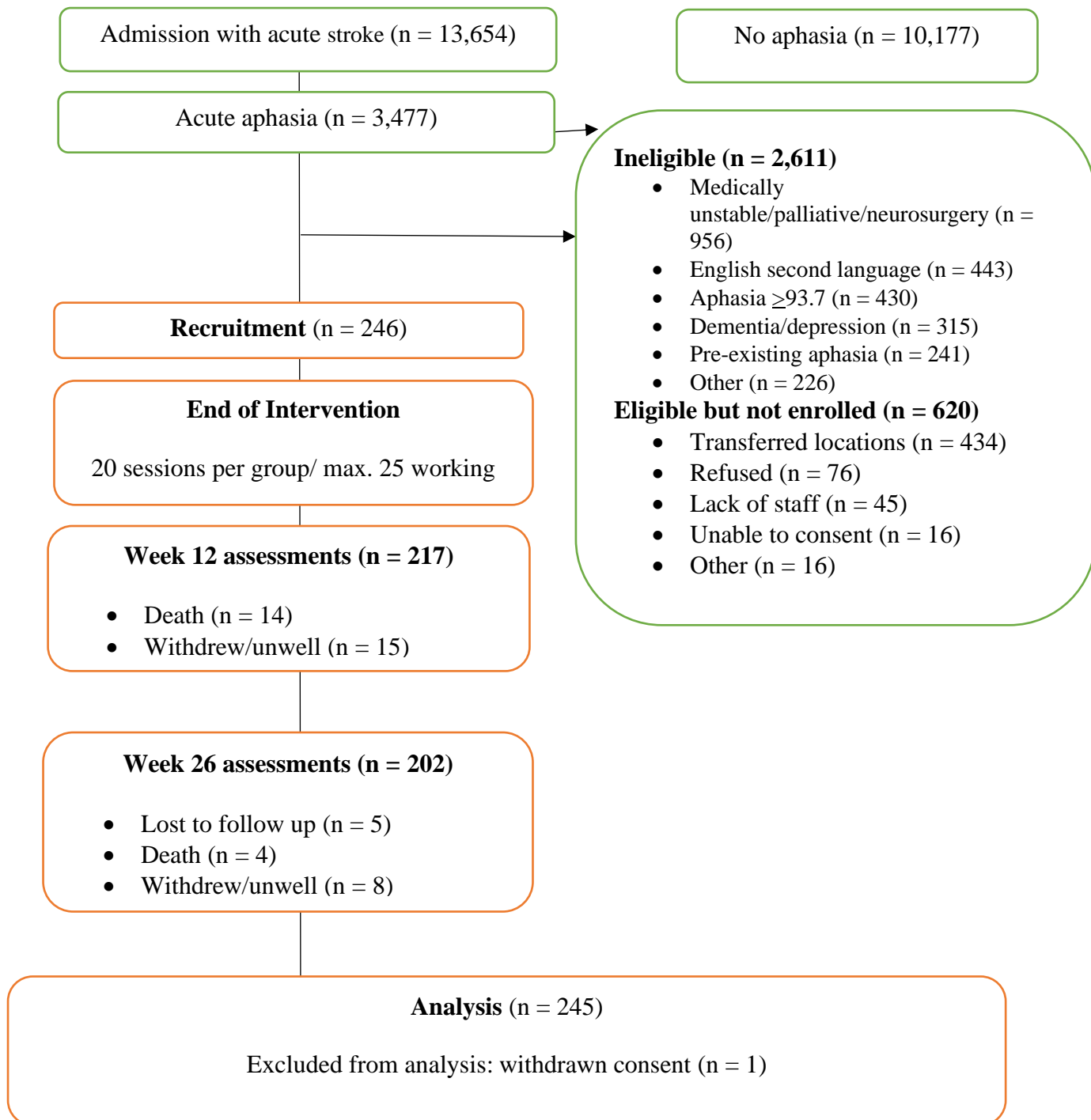


Figure 1: Consort Flow Diagram (Godecke et al., 2020)

Data Collection

VERSE - Baseline and Follow-Up Assessments

Baseline assessment for VERSE included the collection of demographic details, assessment of stroke severity with the National Institute of Health Stroke Scale (NIHSS)

(Goldstein & Samsa, 1997), assessment of disability using the modified Rankin Scale (mRS) (Rankin, 1957), assessment of language function using the Western Aphasia Battery- Revised (WAB-R) (Kertesz, 2007) including the diagnosis of aphasia severity (Kertesz, 2007), evaluation of word naming using the Boston Naming Test (Kaplan et al., 1983), assessment of cognition using the Clock Drawing Test (Agrell & Dehlin, 1998) and the collection of discourse samples for analysis.

Follow up assessments were completed by a blinded trained speech language pathologist in the hospital clinic or in the participants' homes at 12 weeks and 26 weeks post-stroke. The blinded assessors were qualified speech language pathologists who received training in the administration of all assessments. The follow up assessments were the WAB-R (Kertesz, 2007), the Boston Naming test (Kaplan et al., 1983), the collection of discourse samples, the Aphasia Depression Rating Scale (ADRS) (Benaim et al., 2004) and the Stroke and Aphasia Quality of life questionnaire 39 item version (SAQoL-39) (Hilari et al., 2003). The ADRS was chosen as the depression tool for the VERSE trial as it had low assessment burden, high affordability and availability at the beginning of the trial period.

VERSE-ADQ Assessments

For this study, the ADRS and SAQoL-39, were the primary outcome measures. The baseline WAB-R AQ, NIHSS and Clock Drawing Test were used as covariates in analysis of all models.

Aphasia Depression Rating Scale (ADRS) (Benaim et al., 2004). The ADRS is a reliable measure of depression designed for PWA. It is an observer-rated assessment administered by an interviewer and contains nine components that examine insomnia, psychic and somatic anxiety, gastrointestinal somatic symptoms, hypochondriasis, weight loss, visible sadness, slow facial mobility and fatigue. A score of $\geq 9/32$ is a strong indicator of the presence

of depression. The higher the ADRS score, the greater the level of depression. Benaim et al., (2004) reported excellent inter-rater reliability with kappa coefficients for the nine items in the ADRS, as well as excellent correlation for its global score. The ADRS was the most suitable assessment for the trial to reduce the assessment burden in early recovery when it began in 2012.

Stroke and Aphasia Quality of Life 39 items (SAQoL-39) (Hilari et al., 2003). The SAQoL-39 is a reliable measure of quality of life for people with post-stroke aphasia. It is a measure, administered by an interviewer with 39 items that cover four domains: physical, psychosocial, communication and energy. All items have a maximum of five points, with one point indicating an individual is unable to complete an activity and five points meaning the participant has no difficulty with an activity. The average score for all the items is calculated and a higher score indicates a higher quality of life.

Western Aphasia Battery-Revised Aphasia Quotient (WAB-RAQ) (Kertesz, 2007). The WAB-R is a linguistic assessment of aphasia for people with acquired neurological disorders and can be used to obtain a differential diagnosis. The assessment includes eight subtests involving 32 tasks. The Aphasia Quotient (AQ) is derived from the first four subtests; Spontaneous Speech, Auditory Verbal Comprehension, Repetition and Naming and Word Finding; and provides an indication of aphasia severity. Lower AQ scores suggest more severe aphasia (Kertesz, 2007). In VERSE, participants were required to have an AQ of less than 93.7 to be included in the study

National Institute of Health Stroke Scale (NIHSS) (Goldstein & Samsa, 1997). The NIHSS contains 11 items representing the following abilities: level of consciousness, horizontal eye movement, visual fields, facial palsy, motor arm, motor leg, limb ataxia, sensory, language, speech, extinction and inattention. Each item has a score between zero and

four. A score of zero suggests a normally functioning ability and an increase in score indicates impairment severity. The NIHSS has a maximum score of 42.

Clock Drawing Test (Agrell & Dehlin, 1998). The Clock Drawing Test assesses cognitive functioning and dementia. The test requires a person to draw a clock from memory by freehand, complete with numbers and hands, most commonly set to 10 minutes past 11 o'clock. For this study, a scoring system between zero to five was implemented, with the cut-off of 3 points and above to indicate good cognition (Shulman et al., 1993). The participants were allocated zero points if the clock was incomplete or was not in a circle. A score of one was given to a drawing only including a circle. Two points were given if the clock numbers were absent or drawn outside of the circle. Three points were given a clock drawn with all numbers but no hands. Four points were given if the numbers drawn were partially absent or wrong. Five points were given for a complete, correct clock.

VERSE-ADQ Therapy Data

Within the VERSE trial, treating clinicians from across all arms of the trial, completed a Therapy Recording form, which included a therapy log for each participant, for every session from stroke onset to 26 weeks. For each therapy session key information was included in the therapy log such as: date, intervention content and duration of the session for each disorder type (communication and swallowing). The disorder types noted by clinicians were aphasia, apraxia of speech and dysarthria. In this study, only the data for aphasia therapy was used. In recording therapy content, clinicians selected from the following options: communication-based therapy, social training, group training, AAC training, stroke education and counselling. Direct aphasia therapy was defined as therapy that focused on the improving communication using approaches that involve the four modalities of functional language: listening, speaking, writing and reading (National Aphasia Association, 2020). Social training for aphasia involved

the social components of communication, and group training was defined as treatment procedures involving a group of aphasia patients and group-based activities. Augmentative and Alternative Communication (AAC) training involved treatment that focused on the participation and communication skills for patients with severe aphasia according to their environments (Jacobs et al., 2004). Usual Care therapists may have provided stroke education and counselling at their discretion. Stroke education involved the therapist providing information about aphasia and/ or stroke through face to face or telephone-based conversations and/or the distribution of general written information, demonstration of therapy techniques and communication strategies and discussions regarding therapy goals. Counselling involved the therapist providing emotional support to the individual or family members, discussions regarding patient prognosis or predicted outcomes and supportive listening to the patient and/or their family. In addition to the prescribed aphasia therapy per group, the *UC-Plus* or *VERSE* therapists may have also included education and counselling for the participants throughout the intervention period at their discretion. This study extracted data that only involved communication-based therapy, aphasia/stroke education and counselling for analysis. It is important to note that amount of direct aphasia therapy was the independent variable in this study, while amount of stroke education and counselling were part of the standard care prescribed by the speech language pathologists at their own discretion.

The data used in this study was provided by the *VERSE* trial. The study data were collated by the *VERSE* Trial Operations Manager into Excel spreadsheets that contained the baseline information, amount of direct aphasia therapy, education and counselling (hours) for all 245 participants throughout the intervention period up to week 26 after stroke. The four time frames in the dataset were: 1) from admission to end of intervention; 2) from the date of randomisation to the end of intervention; 3) from the end of intervention to week 12 after stroke; and 4) from the week 12 date to week 26 date after stroke. Additionally, the data from

the VERSE trial were divided based on the type of therapy received, so the dataset was separated across the UC, UC-*Plus*, and VERSE arms.

For this study, two final time frames were created from the dataset provided. The first time period was calculated from the day of admission to the completion of the week 12 (or Day 84 ± 7 days) follow up assessments. The second time period was counted from the day of admission to the completion of the week 26 (Day 182 ± 7 days) assessments. Following the development of the two new timeframes the data was modified to reflect these timeframes. Additionally, the data from the VERSE trial was divided based on the type of therapy received in the that is data from across the UC, UC-*Plus*, and VERSE arms were separated within the dataset. For this study, the amount and frequency of therapy, education and counselling was combined across all therapy arms and the total minutes of therapy time were converted into hours across all types of interventions per participant. The frequency of aphasia therapy, education and counselling were calculated by determining the number of sessions provided per week (seven days). To do this, the number of sessions were calculated up to 12 weeks and divided by 12 to gain the frequency of therapy at week 12. Similarly, the number of sessions up to week 26 after stroke was calculated and divided by 26 for the frequency of therapy at week 26 post-stroke. VERSE-ADQ's variable involving change in communicative ability was determined by using the WAB-R AQ scores at 12 and 26 weeks after stroke. The AQ score change at week 12 was calculated by subtracting the baseline AQ score from the week 12 AQ score. Similarly, the baseline AQ score was subtracted from the week 26 AQ score to indicate change in communicative ability at week 26 after stroke. The data were then further transformed into a file that could be imported into R for analysis.

VERSE Sample Size

VERSE was powered to detect a 4.4% difference for improvement of communicative ability, as measured as maximal potential recovery on the WAB-R AQ. VERSE had a sample of 246 participants (82 per arm) to account for a type one error of 0.05 ($\alpha = 0.05$), a power of 0.80 ($\beta=0.08$) after adjusting for a 20% loss to analysis due to death, drop out and non-adherence to treatment (Godecke et al., 2018). This study used 245 participants (one withdrawal of consent) from VERSE.

VERSE-ADQ Analysis

All study questions were investigated using linear mixed effects regression models (LMM) in R Version 3.6.1 and R Studio Version 1.2.5001. In total, 18 regression models were run with all models adjusted for the following covariates:

- Demographic data
 - Age
 - Gender
- Stroke severity at baseline using the NIHSS (Goldstein & Samsa, 1997)
- Aphasia severity at baseline using the WAB-R AQ (Kertesz, 2007)
- Cognitive status at baseline using the Clock Drawing Test (Agrell & Dehlin, 1998)
- Hospital site as a random effect

Research questions two to six included total amount (hours) and frequency (sessions per week) of direct aphasia therapy at either 12 or 26 weeks as covariates.

All study questions were tested by refuting the null hypothesis. The null hypothesis stated that the investigated variables had no significant effect on primary outcomes at 12 and 26 weeks. The effect of the predictor variables was reported as a significance (p-value: <0.05) on ADRS and SAQoL-39 scores. The estimate, as well as the corresponding 95% confidence

intervals, were calculated and outlined. Group allocation within the VERSE trial was not used as a predictor as counselling and aphasia/stroke education service were provided by Usual Care Therapists and the usual care services across the arms of the study were not significantly different (Godecke et al., 2020).

Four separate models were used to complete the analysis for question one to three. Model 1A investigated the relationship between total amount of aphasia therapy (hours) provided during and after the active intervention phase and depression scores, as measured on the ADRS, at 12 weeks after stroke. Model 1B investigated the same variable at 26 weeks after stroke. Model 1C and 1D investigated aphasia therapy frequency (sessions per week) and the effect on the ADRS scores, at 12 and 26 weeks respectively.

In addition of the previously mentioned covariates, the rest of the research questions also included amount and frequency of therapy at 12 and 26 weeks post-stroke as covariates. Model 2A investigated the relationship between the total amount of aphasia therapy (hours) of aphasia/stroke education provided during and after the active intervention phase and on scores on the ADRS at 12 weeks post-stroke. Model 2B explored the same variable at week 26 after stroke. Model 2C examined frequency of aphasia/stroke education (sessions per week) and depression scores at week 12 into the model, while model 2D investigated the relationship at 26 weeks after stroke.

Model 3A examined the total amount of counselling (hours) and its influence on ADRS scores at 12 weeks after stroke. Model 3B used the same variables but looked ADRS scores at week 26 after stroke. Model 3C and 3D investigated frequency of counselling (sessions per week) and its effect on scores in the ADRS at week 12 and 26 after stroke, respectively.

Questions four and five used AQ score change as a primary predictor. The difference in AQ score change at week 12 was calculated by subtracting the baseline WAB-R AQ score from the week 12 WAB-R AQ score. The AQ score change at 26 weeks was calculated by

subtracting the baseline AQ score from the week 26 WAB-R AQ score. Questions four and five had two models each for the two different timepoints. Model 4A investigated the AQ score change at 12 weeks and its effect on scores on the ADRS, while model 4B explored the influence of AQ score change at week 26 on scores on the ADRS. Model 5A and 5B investigated the AQ score change on quality of life, as measured by the SAQoL-39, at week 12 and week 26 after stroke, respectively.

Question six was addressed by running two linear mixed effects regression models. Model 6A investigated if depression could predict quality of life at 12 weeks after stroke. Model 6B investigated the same relationship at 26 weeks after stroke.

Ethical Considerations

The study has gained approval from the Edith Cowan University Human Research Ethics Committee (HREC) and was assigned the REMS number: 2019-00294-RASHIDKHAN. The Executive Committee of the parent study, VERSE, approved the usage of the trial data for analysis in this project. The confidentiality and anonymity of all participants in VERSE was respected and maintained with deidentified information used for the current study.

Results

Baseline Findings

Demographic information, stroke characteristics and baseline scores for participants are outlined in Table 1.

Table 1

Baseline and Stroke Characteristics of VERSE Trial Patients (Godecke et al., 2020)

Baseline and Stroke Characteristics	Participants	
	<i>n</i>	%
Patient Age		
<65	63	26
65-80	104	42
>80	78	32
Patient Gender		
Male	122	49
Female	123	51
Recruitment Region		
Australia	230	93
New Zealand	16	7
Pre-morbid History (Living arrangements prior to stroke)		
Home alone	69	28
Home with other	168	69
Supported accommodation	1	<1
Unknown	7	3
Stroke Risk Factors		
Hypertension	125	51
Ischaemic Heart Disease	71	29
Atrial Fibrillation	69	28
Hypercholesterolaemia	26	11
Diabetes	34	14

Baseline and Stroke Characteristics	Participants	
	<i>n</i>	%
Current smoker	28	11
Western Aphasia Battery - Revised AQ		
Mild (93·6–62·6)	72	29
Moderate (62·5–31·3)	73	30
Severe (0–31·2)	100	41

Note. AQ = Aphasia Quotient.

N=246 total participants.

Therapy Outcomes

Table 2 below displays the number of participants receiving the intervention in the first 12 and then 26 weeks post-stroke, and Table 3 illustrates the characteristics of the intervention received.

Table 2

Types of Intervention Participants Received Across the Treatment Period

Types of intervention	Onset to Week 12		Onset to Week 26		Week 12 to Week 26	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Direct aphasia therapy						
Participants who received therapy	241	98	241	98	102	41
Stroke education						
Participants that received education	222	90	225	91	47	19
Counselling						
Participants that received counselling	180	73	185	75	40	16

Note. N=245.

Table 3*Amount of Intervention Participants Received Across the Treatment Period*

Types of intervention	Onset to Week 12		Onset to Week 26		Week 12 to Week 26	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Direct aphasia therapy						
Average hours	21.31	12.32	24.08	15.13	2.77	5.78
Average number of sessions	27.98	15.42	31.34	18.18	3.36	6.19
Average frequency of sessions	2.33	1.28	1.20	0.70	0.24	0.44
Stroke education						
Average hours	1.03	0.99	1.13	1.13	0.10	0.36
Average number of sessions	6.21	5.29	6.87	5.97	0.66	1.92
Average frequency of sessions	0.52	0.44	0.26	0.23	0.05	0.14
Counselling						
Average hours	0.54	0.86	0.61	0.95	0.07	0.28
Average number of sessions	3.53	4.58	3.93	5.00	0.40	1.17
Average frequency of sessions	0.29	0.38	0.15	0.19	0.03	0.08

Note. N=245.

During follow up: 50 participants (20.3%) and 59 participants (24%) did not complete the ADRS at week 12 and 26 respectively; 40 participants (16.3%) at week 12 and 53 participants (21.5%) at week 26 did not complete the SAQoL-39; and 28 participants (11.5%) and 43 (17.5%) participants did not complete the WAB-R AQ at 12 and 26 weeks respectively.

The average score and standard deviation for the SAQoL-39, ADRS and WABR-AQ at each timepoint are outlined in Table 4.

Table 4*Overall VERSE outcomes at Week 12 and 26 Post-Stroke (Godecke et al., 2020)*

Assessments	Baseline		Week 12 ^a		Week 26 ^b	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Aphasia Depression Rating Scale	-	-	5.40	3.8	4.39	3.53
Stroke and Aphasia Quality of Life Scale	-	-	3.4	0.9	3.56	0.81
Western Aphasia Battery – Revised AQ	41.13	28.13	68.1	29.5	73.0	27.9
AQ Score difference from Baseline	-	-	26.43	19.94	28.49	22.41

Note. N = 245 at baseline. Data not obtained for Aphasia Depression Rating Scale, Stroke and Aphasia Quality of Life -39 at baseline.

^an = 217 participants completed assessments at week 12. ^bn = 202 participants completed assessments at week 26.

As a post-study analysis, the number of participants with depression as measured by the ADRS (indicated by a score of $\geq 9/32$) were recorded. There were 34 participants (14%) and 28 participants (11%) with depression at week 12 and week 26 after stroke, respectively. A total of fourteen participants had increased ADRS scores ($\geq 9/32$) at week 26. There were eleven participants who maintained an ADRS score of nine or higher at both week 12 and week 26 after stroke. A total of 15 participants had a drop in their ADRS scores ($< 9/32$) at week 26.

Statistical Analysis

The following analyses were all linear mixed effects regression models. All the models controlled for baseline age, gender, stroke severity (NIHSS), baseline AQ and clock drawing test scores. Models 2A onwards included therapy amount (hours) and frequency (sessions/week) at each time point (12 and 26 weeks) as a control variable alongside the variables listed previously. The results are presented in the 18 models outlined below:

Model 1A – Aphasia Therapy Amount (Hours) and Depression at Week 12 Post-stroke

Total direct aphasia therapy amount (hours) did not have a significant effect on the ADRS scores at week 12 after stroke (est. = -0.02, $p = 0.41$, 95% CI = [-0.06, 0.03]).

Model 1B - Aphasia Therapy Amount and Depression at Week 26 Post-stroke

Total amount of direct aphasia therapy (hours) did not have a significant effect on the ADRS scores at week 26 after stroke (est. = 0.2×10^{-2} , $p = 0.92$, 95% CI = [-0.04, 0.03]).

Model 1C – Aphasia Therapy Frequency and Depression at Week 12 Post-stroke

Direct aphasia therapy frequency (sessions per week) did not have a significant effect on the ADRS scores 12 weeks after stroke (est. = 1.4×10^{-3} , $p = 0.94$, 95% CI = [-0.04, 0.04]).

Model 1D – Aphasia Therapy Frequency and Depression at Week 26 Post-stroke

Direct aphasia therapy frequency (sessions per week) did not have a significant effect on the ADRS scores at week 26 after stroke (est. = 0.01, $p = 0.64$, 95% CI = [-0.02, 0.04]).

Model 2A – Stroke Education Amount (Hours) and Depression at Week 12 Post-stroke

Total stroke education amount (hours) did not have a significant effect on the ADRS scores 12 weeks after stroke (est. = 0.34, $p = 0.23$, 95% CI = [-0.21, 0.89]).

Model 2B – Stroke Education Amount (Hours) and Depression at Week 26 Post-stroke

Total stroke education amount (hours) at week 26 did not have a significant effect on the ADRS scores (est. = 0.19, $p = 0.40$, 95% CI = [-0.27, 0.66]).

Model 2C – Stroke Education Frequency and Depression at Week 12 Post-stroke

The frequency of stroke education (sessions per week) did not have a significant effect on ADRS scores at 12 weeks after stroke (est. = 0.05, $p = 0.35$, 95% CI = [-0.05, 0.32]).

Model 2D – Stroke Education Frequency and Depression at Week 26 Post-stroke

The frequency of stroke education (sessions per week) did not have a significant effect on the ADRS scores at 26 weeks after stroke (est. = 0.08, $p = 0.08$, 95% CI = [-0.02, 0.18]).

Model 3A – Counselling Amount (Hours) and Depression at Week 12 Post-stroke

Total counselling hours did not have a significant effect on the ADRS at 12 weeks after stroke (est. = 0.63, $p = 0.13$, 95% CI = [-0.19, 1.44]).

Model 3B – Counselling Amount (Hours) and Depression at Week 26 Post-stroke

The total amount of counselling therapy (hours) did not have a significant effect on ADRS scores 26 weeks following stroke (est. = -0.01, $p = 0.97$, 95% CI = [-0.74, 0.71]).

Model 3C – Counselling Frequency and Depression at Week 12 Post-stroke

The frequency of counselling therapy (sessions per week) did not have a significant effect on the ADRS scores at 12 weeks post-stroke (est. = 0.07, $p = 0.24$, 95% CI = [-0.05, 0.20]).

Model 3D – Counselling Frequency and Depression at Week 26 Post-stroke

The frequency of counselling therapy (sessions per week) did not significantly affect the ADRS scores at 26 weeks post-stroke (est. = 0.03, $p = 0.56$, 95% CI = [-0.08, 0.15]).

Model 4A – AQ Score Change and Depression at Week 12 Post-stroke

The difference in AQ scores from baseline to week 12 post-stroke did not have a significant effect on the ADRS scores at 12 weeks post-stroke (est. = -0.02, $p = 0.28$, 95% CI = [-0.05, 0.01]).

Model 4B – AQ Score Change and Depression at Week 26 Post-stroke

The change in AQ score from baseline to week 26 after stroke did not have a significant effect on the ADRS scores at 26 weeks post-stroke (est. = -3.11×10^{-2} , $p = 0.05$, 95% CI = [-0.06, -6.61×10^{-5}]).

Model 5A – AQ Score Change and Quality of Life at Week 12 Post-stroke

The difference in AQ scores from baseline to 12 weeks post-stroke had a significant effect on SAQoL-39 scores at 12 weeks post-stroke (est. = 0.01, $p = 9.08 \times 10^{-7}$, 95% CI = [0.01, 0.02]).

In the model, multiple control factors were also significant on SAQoL-39 scores at 12 weeks after stroke. NIHSS displayed a strong significant effect ($p = 4.57 \times 10^{-8}$, 95% CI = [-0.07, -0.04]) on SAQoL-39. Baseline AQ ($p = 0.3 \times 10^{-3}$, 95% CI = [0.04×10^{-1} , 0.01]), gender ($p = 0.01$, 95% CI = [0.05, 0.41]) and frequency of aphasia therapy ($p = 0.05$, 95% CI = [-0.24, -0.02×10^{-1}]) were significant in predicting SAQoL-39 scores at week 12 as well. The findings are outlined in Table 5 below.

Table 5*The Effect of AQ Score Change on Quality of Life at Week 12*

Predictors	Estimate	SE	95% CI		p
			LL	UL	
Intercept	3.39	0.42	2.55	4.24	1. x 10 ⁻¹³ ***
Score Change	0.01	0.02 x 10 ⁻¹	0.01	0.02	9.08 x 10 ⁻⁷ ***
NIHSS	-0.05	0.01	-0.07	-0.04	4.57 x 10 ⁻⁸ ***
Baseline AQ	0.01	0.02 x 10 ⁻¹	0.04 x 10 ⁻¹	0.01	0.28 x 10 ⁻³ ***
Age	-0.03 x 10 ⁻¹	0.04 x 10 ⁻¹	-0.01	0.04 x 10 ⁻¹	0.39
Gender	0.23	0.09	0.05	0.41	0.01 *
Clock Drawing Test	-0.04	0.12	-0.27	0.20	0.76
Total amount of direct aphasia therapy hours	0.01	0.01	-0.02 x 10 ⁻¹	0.02	0.10 .
Direct aphasia therapy frequency	-0.12	0.06	-0.24	-0.02 x 10 ⁻¹	0.05 *

Note. N = 217 participants completed assessments at week 12. CI = confidence interval; LL = lower limit; UL = upper limit.

Model 5B – AQ Score Change and Quality of Life at Week 26 Post-stroke

The AQ score change from baseline to 26 weeks had a highly significant effect on SAQoL-39 scores at 26 weeks (est. = 0.02, $p = 1.52 \times 10^{-10}$, 95% CI = [0.01, 0.02]).

In the model, NIHSS ($p = 7.04 \times 10^{-6}$, 95% CI = [-0.06, -0.03]) had a strong effect in predicting SAQoL-39 scores at 26 weeks post-stroke. Baseline AQ ($p = 2.79 \times 10^{-6}$, 95% CI = [0.01, 0.02]) and age ($p = 0.02$, 95% CI = [-0.02, -0.01×10^{-1}]) also significantly affected SAQoL-39 scores at week 12 after stroke. The findings are illustrated in Table 6.

Model 6A – Depression and Quality of Life at Week 12 Post-stroke

ADRS scores had a highly significant effect on the SAQoL-39 scores at 12 weeks post-stroke (est. = -7.63×10^{-2} , $p = 5.44 \times 10^{-10}$, 95% CI = [-0.10, 0.02]).

NIHSS ($p = 2.17 \times 10^{-7}$, 95% CI = [-0.07, -0.03]), amount of therapy hours ($p = 0.05$, 95% CI = [0.1×10^{-3} , 0.02]) and therapy frequency ($p = 0.01$, 95% CI = [-0.26, -0.04]) displayed significance in predicting SAQoL-39 scores 12 weeks after stroke. The model is presented in Table 7.

Model 6B – Depression and Quality of Life at Week 26 Post-stroke

ADRS scores had a significant effect on SAQoL-39 scores at week 26 following stroke (est. = -0.09, $p = 2.74 \times 10^{-13}$, 95% CI = [-0.12, -0.07]).

Age ($p = 9.21 \times 10^{-5}$, 95% CI = [-0.02, -0.01]) and NIHSS ($p = 8.66 \times 10^{-6}$, 95% CI = [-0.06, -0.02]) were variables that strongly affected SAQoL-39 scores at 26 weeks. Following this, controlled baseline AQ ($p = 0.04$, 95% CI = [0.02×10^{-2} , 0.01]) was also significant to SAQoL-39 scores at week 26 after stroke. The findings are shown in Table 8.

Table 6*The Effect of AQ Score Change on Quality of Life at Week 26*

Predictors	Estimate	SE	95% CI		p
			LL	UL	
Intercept	3.56	0.42	2.74	4.38	4.01 x 10 ⁻¹⁵ ***
Score Change	0.02	0.02 x 10 ⁻¹	0.01	0.02	1.52 x 10 ⁻¹⁰ ***
NIHSS	-0.04	0.01	-0.06	-0.03	7.04 x 10 ⁻⁶ ***
Baseline AQ	0.01	0.02 x 10 ⁻¹	0.01	0.02	2.79 x 10 ⁻⁶ ***
Age	-0.01	0.04 x 10 ⁻¹	-0.02	-0.01 x 10 ⁻¹	0.02 *
Gender	0.16	0.09 x 10 ⁻¹	-0.01	0.34	0.07 .
Clock Drawing Test	-0.03	0.11	-0.24	0.19	0.81
Total amount of direct aphasia therapy hours	0.04 x 10 ⁻¹	0.05 x 10 ⁻¹	-0.01	0.01	0.47
Direct aphasia therapy frequency	-0.15	0.11	-0.37	0.06	0.05 *

Note. N = 202 participants completed assessments at week 26. CI = confidence interval; LL = lower limit; UL = upper limit.

Table 7*The Effect of ADRS on SAQoL-39 at Week 12*

Predictors	Estimate	SE	95% CI		p
			LL	UL	
Intercept	4.68	3.60×10^{-1}	3.97	5.39	$< 2 \times 10^{-16}$ ***
ADRS	-7.63×10^{-2}	1.16×10^{-2}	-0.10	0.02	5.44×10^{-10} ***
NIHSS	-4.96×10^{-2}	9.22×10^{-3}	-0.07	-0.03	2.17×10^{-7} ***
Baseline AQ	3.35×10^{-4}	2.14×10^{-3}	-0.04×10^{-1}	0.04×10^{-1}	0.88
Age	-5.47×10^{-3}	3.32×10^{-3}	-0.01	0.01×10^{-1}	0.10
Gender	1.20×10^{-1}	8.40×10^{-2}	-0.05	0.29	0.15
Clock Drawing Test	5.19×10^{-2}	1.04×10^{-1}	-0.16	0.26	0.62
Total amount of direct aphasia therapy hours	1.06×10^{-2}	5.30×10^{-3}	0.1×10^{-3}	0.02	0.05 *
Direct aphasia therapy frequency	-1.50×10^{-1}	5.48×10^{-2}	-0.26	-0.04	0.01 **

Note. $N = 217$ participants completed assessments at week 12. CI = confidence interval; LL = lower limit; UL = upper limit.

Table 8*The Effect of ADRS on SAQoL-39 at Week 26*

Predictors	Estimate	SE	95% CI		p
			LL	UL	
Intercept	5.20	0.36	4.49	5.92	< 2 x 10 ⁻¹⁶ ***
ADRS	-0.09	0.01	-0.12	-0.07	2.74 x 10 ⁻¹³ ***
NIHSS	-0.04	0.01	-0.06	-0.02	8.66 x 10 ⁻⁶ ***
Baseline AQ	0.04 x 10 ⁻¹	0.02 x 10 ⁻¹	0.02 x 10 ⁻²	0.01	0.04 *
Age	-0.01	0.03 x 10 ⁻¹	-0.02	-0.01	9.21 x 10 ⁻⁵ ***
Gender	-0.01	0.08	-0.17	0.16	0.92
Clock Drawing Test	-0.01	0.10	-0.20	0.20	0.96
Total amount of direct aphasia therapy hours	0.04 x 10 ⁻¹	0.04 x 10 ⁻¹	-0.01	0.01	0.39
Direct aphasia therapy frequency	-0.15	0.10	-0.35	0.04	0.12

Note. N = 202 participants completed assessments at week 26. CI = confidence interval; LL = lower limit; UL = upper limit.

Summary of Results. The models involving the effect of total aphasia therapy amount (hours) [$M = 21.31$, $SD = 12.32$ at 12 weeks; $M = 24.08$, $SD = 15.13$ at 26 weeks] and frequency did not have a significant effect on depression at 12 and 26 weeks following stroke. Similarly, total amount of stroke education (hours) [$M = 1.03$, $SD = 0.99$ at 12 weeks; $M = 1.13$, $SD = 1.13$ at 26 weeks], stroke education frequency, total amount of counselling (hours) [$M = 0.54$, $SD = 0.86$ at 12 weeks; $M = 0.61$, $SD = 0.95$ at 26 weeks] and counselling frequency did not have a significant effect on depression at 12 and 26 weeks after stroke. AQ score difference from baseline to week 12 ($M = 26.43$, $SD = 19.94$) and AQ score difference from baseline to week 26 ($M = 28.49$, $SD = 22.41$) after stroke also did not significantly influence depression scores. Both AQ score changes at the two different time periods had a highly significant effect on quality of life at 12 and 26 weeks post-stroke. Depression scores also had a highly significant effect on quality of life scores at 12 and 26 weeks after stroke.

The models exhibited two patterns involving the control variables. Baseline AQ had a consistent, significant in seven out of nine models for depression scores at 12 weeks after stroke. Age had a significant effect in five out of nine models involving week 26 outcomes.

Discussion

Primary Findings

This study investigated the nature of the relationship between aphasia intervention and post-stroke depression within the first six months of stroke recovery with a specific focus on the way in which the amount and frequency of direct aphasia therapy (directed by the trial), education and counselling provided as part of standard care, affected depression at 12 and 26 weeks after stroke. It was the first study of this kind to examine these variables in a large cohort of people with aphasia in the early phase of recovery. There were no significant relationships between the amount or frequency of aphasia therapy and the level of depression for participants at either 12 or 26 weeks after stroke. Similarly, amount of stroke education and counselling did not have a significant effect on the depression scores of all participants at 12 or 26 weeks after stroke. That means, the amount and frequency of direct aphasia therapy, stroke education or counselling provided in this study within the first 26 weeks after stroke did not influence depression for the participants within this trial.

Approximately 98% of the study population received therapy during the first 26 weeks post-stroke with an average of 21 hours of direct aphasia therapy in the first 12 weeks after stroke, and an average of 24 hours of direct aphasia therapy, in total, at 26 weeks after stroke. Most of the study participants received consistent, regular direct aphasia therapy throughout the intervention period with a large decline in therapy hours 40 days after stroke. On average, the participants only received an additional three hours of direct aphasia therapy after the intervention period ended. Around 41% of the study population received direct aphasia therapy during the period of time in between the week 12 assessment and the week 26 assessment. In the VERSE trial, the participants who were randomised to the VERSE and UC+ arms of the trial received an average of 22.7 hours of direct aphasia therapy, while the participants of the UC group received 9.5 hours of direct aphasia therapy (Godecke et al., 2020).

At week 12 after stroke, 90% of the study population had received stroke education, with an average of one hour of stroke education provided across the time period. By week 26 post-stroke, 91% of the participants were provided with an average of one hour of stroke education as well. Approximately 73% of participants received 0.5 hours of counselling overall at 12 weeks after stroke and 75% of participants received 0.6 hours of counselling at 26 weeks post-stroke. It is important to note that stroke education and counselling were provided at the discretion of the speech language pathologist as part of standard care within the trial. It should be noted that this study did not investigate whether or not stroke education and counselling, as a prescribed component of an intervention, had an impact on depression post-stroke. Nor did it examine the nature of the stroke education and counselling provided. Instead, it investigated the relationship between the amount of education and counselling provided together with the frequency with which these components were provided.

There were 34 participants (14%) with an ADRS score indicative of depression 12 weeks after stroke, and 28 participants (11%) with depression based on the ADRS at week 26. The gradual decrease of depressed participants over time was similar to the findings of Kauhanen et al. (2000), in which the prevalence of minor depression in 27 acute stroke PWA dropped from 59% (16 participants) at three months after stroke to 29% (six participants) at 12 months after stroke. The prevalence of depression in PWA within the Kauhanen et al. (2000) study population was much higher than VERSE-ADQ, most likely due to the exclusion of depressed participants during recruitment for VERSE-ADQ. The VERSE trial also analysed a much larger study population consisting of 245 PWA in comparison to the 27 PWA in Kauhanen et al. (2000). Both VERSE-ADQ and the Kauhanen et al. (2000) did not investigate psychological outcomes at baseline. In addition, the prevalence of minor depression disorder for post-stroke participants in an acute hospital was 10.9% (Mitchell et al., 2017), a similar amount of possibly depressed participants in VERSE-ADQ. Most existing acute stroke studies

exclude PWA or do not investigate depression within their populations, thus there are limited studies that provide a direct comparison to the prevalence of depression as found in VERSE-ADQ. It appears that the development of depression after stroke at different time points is a complex area and should still be investigated in further research.. The VERSE trial results found that 35 (21%) participants from the high intensity group and 19 (23.5%) participants in the UC group were diagnosed with depression throughout the study period. These findings further strengthen the evidence that different amounts, frequencies or intensities of aphasia therapy provided in this study may not have a varied effect on mood.

The change in communication scores, as measured by the difference between baseline and week 12 and 26 AQ scores, significantly affected the participants' SAQoL-39 scores, but not the ADRS scores. On average, the effect of the AQ score change at each timepoint from baseline was positive, implying that an improvement in communicative ability of participants resulted in the improvement in quality of life during the study period. The improvement in communication ability may have influenced participant's perception of their quality of life however it did not have an effect on to their level of depression at 12 and 26 weeks. Additionally, ADRS scores had a significant association with SAQoL-39 scores in the study population at both 12 and 26 weeks with depression being a strong predictor of quality of life within this study. The findings in this study are in-line with previous research on PWA and mood and will be expanded on in the next section.

Communication Therapy and Depression

This study explored the possibility of an effect of communication therapy on the mood of PWA and found no such effect between the two domains. Aphasia therapy provided at the amount, frequency and intensity in this study appears to be insufficient to elicit a meaningful change in mood. These results build on existing evidence that direct aphasia therapy, regardless

of intensity and duration, may not contribute to a change in mood during the subacute phase of stroke recovery (Martins et al., 2013; Smith et al., 1981) and are aligned with previous research investigating therapy intensity and duration included in the Cochrane review by Brady et al. (2016). Ryan, Bohan and Kneebone (2019) suggested that the prioritisation of communication improvement over psychological issues might contribute to the higher rates of depression in PWA after stroke. While depression could stem from the frustration of being functionally impaired (Hilari & Northcott, 2017), the recovery of function by itself may not be enough to reduce the risk of developing depressive symptoms. As seen in this sub-study, direct aphasia therapy mainly focuses on regaining communicative ability in PWA and the amount of therapy may not contribute greatly to the change in the person's mood after stroke. While loss of function could worsen depressive symptoms, functional recovery does not necessarily have an impact on depression. Instead, the improvement of mood with therapies using a psychosocial approach are likely to be better placed to address mood (Thomas et al., 2013).

Education and Counselling on Depression

The results of VERSE-ADQ indicated that the amount of education and counselling received by the participants in this study did not have a significant influence on their depression scores. The amount of education and counselling received by the participants, as part of standard care, is likely to have been too small and potentially subtherapeutic. At 12 and 26 weeks after stroke, the participants only received an average of one hour of stroke education and less than an hour of counselling. This may not have been sufficient to generate a significant change in the individuals' mood as reflected in their ADRS scores. In addition, the content of stroke education and counselling was provided at the discretion of the treating speech language pathologist, and the focus and nature of the information provided is likely to have varied across participants.

Education and counselling are recommended for PWA after stroke in regard to the prevention and management of stroke-related complications (Lanctôt et al., 2019; Stroke Foundation, 2019a). A Cochrane review that investigated the provision of information for stroke patients and their caregivers (Smith et al., 2008) found a small reduction in depression scores and improved participant and caregiver satisfaction with the received information within the included studies. Information based psychological support is a vital element of therapy and speech language pathologists argue that the combination of aphasia information provision and counselling may influence a person's drive and commitment to engage with rehabilitation activities (Sekhon et al., 2015). The increased participation in rehabilitation due to stroke education and counselling may consequently improve mood (Parry et al., 2017). In a study investigating the experiences of PWA after stroke, there was a general consensus that insufficient information was given regarding psychological health and the services or support available to assist with psychological issues. It may be that the lack of information has led to reduced patient awareness and their drive to seek out services pertaining to mood and psychology (Baker et al., 2020). The current recommendations for stroke education mainly focus on secondary and tertiary prevention such as pharmacotherapy and complication management (Lanctôt et al., 2019; Stroke Foundation, 2019a). There were no recommendations within these guidelines mentioning the provision of stroke education for the psychological benefit of stroke survivors. To our knowledge, existing research has not established the minimum amount of stroke education required to have a meaningful impact on people after stroke in regard to rehabilitation and recovery.

Counselling is often neglected in a clinical setting due to a lack of speech language pathologists' confidence (Sekhon et al., 2015) and to our knowledge, lacks evidence regarding its implementation with PWA after stroke (Baker et al., 2018). Sekhon et al. (2015) has reported that counselling training for therapists were generally non-specific and did not inspire

confidence in speech language pathologists to implement counselling in therapy. In Australia, 62% of speech language pathologists claim to have no supplementary training for counselling skills after receiving their qualifications (Sekhon et al., 2015). Additionally, counselling may be an individualised component of therapy and further research needs to be done to pinpoint the specific form of therapy that would improve mood. The Thomas et al. (2013) trial found some evidence to support the individualised provision of knowledge and behavioural training for PWA with favourable results. Counselling may have an impact on mood and quality of life when communication strategies are included as part of the counselling content and so further work needs to be completed to explore the use of counselling with PWA (van der Gaag et al., 2005).

Quality of Life and Depression in PWA

This study found that the change in communicative ability at 12 and 26 weeks had a significant effect on quality of life for PWA after stroke as measured by the SAQoL-39. The finding supports the established concept that recovery of function is positively associated with quality of life in stroke survivors from four months after stroke (Jönsson et al., 2005). Multiple studies investigating the influence of communicative ability on quality of life in PWA in the chronic phase of recovery after stroke reported similar results (Baumann et al., 2014; Chang et al., 2016). This is the first study to explore the link between quality of life and aphasia in the early phase of recovery within a large population of PWA. The results of this study were in line with current knowledge and adds to the evidence that language function is important in predicting quality of life after stroke during the early phases of recovery.

The study results also confirm that depression is a strong predictor for quality of life at 12 and 26 weeks after stroke for PWA. This finding is similar with other research (Lee et al., 2015) that reports the same pattern with the SAQoL-39 in PWA six months after stroke. PWA

have a decreased level of social interaction and rate of reintegration into the community in comparison to stroke survivors without aphasia (Lee et al., 2015). These factors may directly contribute to the rate of depression and consequently, quality of life. Evidence indicates depression negatively predicts quality of life for PWA up to a year after stroke (Koleck et al., 2017). The results of VERSE-ADQ were found in the early phase of recovery and suggests that depression predicts quality of life as early as 12 weeks after stroke. These results were observed within a large population of PWA and could serve as strong evidence for other, similar research.

Additional Findings

Aphasia Severity on Depression in Acute Stroke

Baseline AQ significantly predicted depression in all of the analysis models at 12 weeks after stroke. In this study, baseline AQ was used as a measure for aphasia severity. This association has been previously identified in other studies investigating people with aphasia in all phases of recovery (Døli et al., 2017; Hilari, 2011) which found that a low baseline AQ score corresponded with a high depression score. But as depressive symptoms could emerge in stroke survivors as early as two weeks after stroke (Berg et al., 2001), and stroke severity could determine aphasia severity (Hama et al., 2007), the poor communicative ability of PWA may contribute to a higher level of depression in acute stroke recovery compared to people without aphasia.

Age on Depression in Chronic Stroke

Age was a significant predictor for depression at 26 weeks after stroke. A study completed in the Netherlands found increasing age was a significant factor to decreased engagement in society and lower participation in activities of daily living for stroke patients

over the age of 70. Younger participants within the study were more actively engaged in society roles and activities of daily living (de Graaf et al., 2018). The previously established relationship between an ageing brain, cognition and depression (Das & G K, 2018) may provide an explanation for the association in the study for participants at week 26 after stroke. Previous research has shown that elderly stroke survivors are more prone to depression as early as two weeks after stroke (Berg et al., 2001) however age wasn't a significant predictor, within the current study, until 26 weeks post-stroke.

Clinical Implications

The findings of this study suggest that current therapy guidelines, for managing depression for PWA in the early phase of stroke recovery, may need revision. Current guidelines recommend mood assessment for people after stroke if they are suspected to have an altered mood however in practice, the screening of mood may be neglected. In 2019, the acute services report as part of the national stroke audit stated that only 16% ($N = 4,176$) people had their mood assessed (Stroke Foundation, 2019b). This study found that depression was present in PWA as early as 12 weeks post-stroke, if not earlier. Stroke health professionals also acknowledge that managing the mood of a stroke survivor is often secondary to the rehabilitation of functional loss caused by stroke (Baker et al., 2019). This study found that aphasia therapy at the levels provided, did not have an effect on mood. Conversely, psychosocial interventions have shown to have an effect on the depression scores of PWA after stroke (Thomas et al., 2013; van der Gaag et al., 2005). Therapy that utilises tasks specific to mood may be the most effective strategy to improve mood for PWA. Therapies with a psychosocial approach should be adapted to people with communication difficulties following stroke as they are vulnerable to mood problems due to the added burden of aphasia (Mitchell et al., 2017). Better psychosocial approaches prescribed in larger doses may need to be

developed and implemented within the rehabilitation plans for PWA at an early phase of recovery to reduce the rate of depression within the population.

A screening test for depression in early stroke recovery is vital, particularly for PWA across Australia to improve service delivery and long-term recovery. Depression also strongly predicts quality of life for PWA in the early phase of recovery, which further strengthens the importance of early depression screening and management during this time. While mood assessment too early after stroke could be unreliable (NHS, 2011), it is vital to prepare preventive measures and management plans to ensure a good quality of life for PWA after stroke. Post-stroke depression is commonplace in the aphasia population, but a consistent approach to the management of post-stroke depression has yet to be developed.

This study also adds to the evidence that the amount of stroke education and counselling provided in usual care may be insufficient to influence depression in PWA after stroke. Within this study the provision of both stroke education and counselling were left to the therapists' discretion, however it is not known if these components of therapy could have had a significant effect on depression if they were part of a regular, standardised management plan for PWA. Stroke education generally had a positive influence on patient knowledge and satisfaction within a systematic review (Smith et al., 2008), while there is a lack of evidence on counselling post-stroke to our knowledge. It would be important to further investigate both of these elements in the future.

Future Directions

VERSE-ADQ is the first study to investigate aphasia therapy and depression outcomes within a large population in early stroke recovery. The results of this study may provide the groundwork for future research that explores similar themes in the field. VERSE-ADQ adds to the evidence of depression in PWA at 12 weeks after stroke. Treatment options for depression

in the early phase of recovery should be investigated further with a focus on psychosocial functioning therapy in varying amounts.

There is a dearth of information regarding the effect of combination therapies in an acute aphasia setting, thus further exploration of therapy plans that implement both communicative functioning and psychosocial functioning strategies may add to the evidence, especially for the early stage of recovery. The stepped psychological care guidelines have recommended both stroke education and counselling at varying levels of the rehabilitation programme, however assessments for depression are suggested to be carried out at least a month after stroke (Kneebone, 2016; NHS, 2011). Depression has been detected in participants as early as two weeks after stroke (Parry et al., 2017), therefore more research on very early recovery is vital. A number of feasibility studies have been carried out to implement talk-based psychosocial functioning approaches to therapy for PWA as they often have difficulty accessing services for post-stroke patients without aphasia (Parr et al., 2006). Aphasia therapy with psychosocial functioning elements such as motivational interviewing (Holland et al., 2018) and solution-focused brief therapy (Northcott et al., 2015) can be adapted to suit PWA and have shown promising results. Within solution-focused brief therapy, therapists explore the participants' skills and strengths and encourage them to verbally express their hopes for the future to maximise their current communicative ability (Northcott et al., 2015). Motivational interviewing involves raising the awareness of participants on the contrast between their current condition and their future goals via communication. The increased awareness may encourage participants to have more confidence in adjusting themselves towards functional improvement (Holland et al., 2018). Northcott et. al (2015) studied the effect of solution-focused brief therapy on chronic stroke patients while Holland et. al (2018) ran the motivational interviewing study for participants in an acute stroke unit. Both strategies have investigated through successful feasibility studies for PWA with positive communication recovery and a

reduction in depression scores. It is suggested by speech language pathologists that the use of psychosocial therapies, as part of acute aphasia rehabilitation, could benefit mood and quality of life while improving communication (Ryan et al., 2019). The adaptations of aphasia therapy intended to improve language function should take the psychosocial component of therapy into consideration as well to manage depression in PWA. Future research should explore these forms of therapy to add to the existing therapeutic evidence in larger populations of people with acute aphasia after stroke.

Stroke education and counselling are therapy elements that still need to be studied within an acute aphasia population. The amount of stroke education and counselling provided needs to be explored as part of future research in order to examine the potential effect on mood for PWA. The modification of stroke education and counselling for people with acute aphasia may be a worthwhile investigation to determine how it could significantly influence mood (Smith et al., 2008). Future investigations should ensure that research regarding stroke education and counselling applies a much higher therapy amount, using a standardised approach, in comparison to VERSE-ADQ.

The majority of research involving communication-therapy for aphasia is conducted within a population with who are in the chronic phase of recovery. More research on the factors influencing depression in PWA in the subacute phase of recovery should be explored to ensure rehabilitation and recovery could be facilitated as early as possible. As there is evidence of post-stroke depression in PWA during the early phases of recovery, identifying the factors that contribute to its progression would be beneficial for further therapy planning. In addition, a consistent monitoring of the participants' depression may be beneficial in future research, instead of assessing mood a few times throughout a study period. Mood may fluctuate for PWA after stroke from early recovery to late recovery, therefore a more frequent recording of depression scores could reflect the changes in mood for post-stroke PWA more accurately.

There are also extra hurdles in administering mood-specific assessments to people with severe communication disabilities. It is important to use assessment tools that are suited for PWA, however there needs to be more research on possible, valid adaptations for PWA with a severe communication difficulty. VERSE-ADQ used tools that were catered to PWA, but there were a number of participants who could not be assessed due to communication difficulties, nevertheless. As the PWA with the lowest functional capability might have the highest risk of impaired mood, future research should look into developing and adapting other assessment tools that would overcome the severe communication difficulties that may impede a diagnosis of depression.

An important point that this study did not address is the financial disadvantages faced by individuals with depression. There is evidence that PWA have extra financial burdens due to the need for language rehabilitation (Ellis et al., 2012). The presence of depression that requires psychosocial strategies and possible pharmacological options for their management plans may add to the cost of rehabilitation. The additional approaches would be considerably more expensive than the management plan of a non-depressed PWA. At the same time, PWA has low functional recovery and low return to work rates even in an acute setting due to communication difficulties, which is an added burden if paired with the possibility of increased medical expenses (Ali et al., 2014; Lee et al., 2015). Research that addresses the potential financial issues for depressed PWA after stroke would be highly beneficial moving forward.

Study Limitations

Stroke education and counselling were not the focus of the larger VERSE trial study and therefore the content provided was left to the discretion of the treating clinicians as part of usual care and not controlled through the research design. This means variability will have occurred in relation to the content covered and the manner in which both stroke education and counselling were provided. The amount of stroke education and counselling provided across

26 weeks after stroke was also likely to have been too small to elicit a change in mood. Previous research has suggested that adapted stroke education and counselling may influence mood (Smith et al., 2008) but this study's results could not confidently confirm nor deny the possible relationship.

This study has also encountered at least 18 cases throughout the follow up period in which mood could not be assessed due to communication difficulty, even though the assessments were geared towards PWA. The ADRS and SAQoL-39 were suited for the study population, however there were still barriers to the effective measurement of mood and quality of life. As such, there may be some loss of information throughout the follow up period that has been accounted for in the analysis. It is also acknowledged that the van Dijk et al., (2015) review reported that most assessments for PWA are considered to lack validity and reliability due to the quality of their methodological studies (van Dijk et al., 2015). The VERSE trial began in 2012 and the ADRS was deemed to be the most appropriate tool for the large-scale stroke study for PWA. It had a low burden on the participants and was affordable after consideration of the trial's budget. The ADRS was reported to have excellent inter-rater reliability and adequate to excellent correlations to depression assessment tools in terms of validity (Benaim et al., 2004). However, the van Dijk et al. (2015) study has reported that most studies testing the psychometric properties of the ADRS were of poor methodological quality. The ADRS also requires training and while the VERSE trial has provided training to its assessors, the risk of insufficient training may still be present. VERSE-ADQ also used therapy recording forms which have an inherent risk of human error in how the information was recorded. To implement this, a treatment integrity monitor crosschecked every data point in the database with the paper record.

This study acknowledges that the ADRS and SAQoL scores for the participants were not assessed at baseline. The recording of the study population's initial depression and quality

of life may have outlined the progression of depression in the participants more clearly, however, it seemed inappropriate and impractical to assess the participants' psychological outcomes immediately after a stroke incident. There is likely a high variability in depression and QoL results taken in the first weeks following stroke (NHS, 2011). To maintain the baseline assessment burden at an acceptable level, VERSE chose not to administer baseline ADRS and SAQoL-39. Both depression and quality of life were secondary outcomes of the VERSE trial, and the main aim of VERSE was improvement in communication, as recorded by the WAB-R AQ (Kertesz, 2007). VERSE-ADQ was used to take a closer look on the change of mood at 12 and 26 weeks after stroke, and if amount and frequency of aphasia therapy had any effect on the possible development of depression at those time points. VERSE-ADQ's aphasia therapy prescription had no significant effect on depression, but it is vital for future research to carry out a more detailed study on PWA with depression after stroke with shorter intervals of assessment.

Conclusions

In summary, the amount and frequency of direct aphasia therapy, stroke education and counselling provided at the amount, frequency and intensity in the VERSE study did not have a significant influence on the development of depression in PWA at 12 and 26 weeks after stroke. However, this study provides further evidence on the importance of communication improvement on the quality of life of PWA as early as 12 weeks after stroke. It also highlighted that the presence of depression in PWA has a significant effect on individuals' quality of life post-stroke. There is a need to investigate and implement rehabilitation programs for mood, which may involve education and counselling, into the initial therapy plan for people with acute aphasia after stroke to prevent the emergence of depression and to treat existing depressive symptoms to promote optimal recovery and quality of life for people with aphasia.

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Appendix



Speech Therapist Recording Form

Patient Study Number:

Patient Initials:

Goal:(VERSE only)

Date of session: / /

Start time of session: :

Total duration of session: (minutes) :

Therapist Initials:

or CSP (if no REDCap initials)

SP TA/Student

Record (minutes) the time spent for any of the components of your speech session. Enter "0" on the form and on REDCap where no time was spent.

	Aphasia	AOS	Dysarthria	Dysphagia
Education				
Counselling				
Assessment				
Direct Intervention				
• 1:1 imp based
• Social training
• Group imp based
• Group social
• AAC training
Goal setting /consultation with patient/family				
Session Planning				
Therapy Programming				
Documentation				
Consultation/Handover with healthcare provider				
Travel to treatment area				

V2.2-28/4/15 Entered into REDCap: Date: _____ By: _____