Development and Standardization of Western Aphasia Battery-Revised in Tamil

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Project Investigators

Dr. Hema.N
Principal Investigator, ARF –
Assistant Professor in Speech-Language Sciences
Department of Speech-Language Sciences

All India Institute of Speech and Hearing, Mysore.

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Dr. Hema.N
Principal Investigator, ARF – 2
Assistant Professor in Speech Sciences
Department of Speech-Language Sciences
All India Institute of Speech and Hearing
Manasagangothri, Mysore-570006

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Abstract

Western Aphasia Battery (WAB) (Kertesz, 1982; 2020) is a standardized published quantification tool used in the assessment of language in individuals with aphasia. India has the third-highest stroke prevalence in Asia after China and Japan. Tamil Nadu is one of the highly populated states in India, which has an increasing stroke incidence rate (Jebasingh & Sivanesan, 2017). Validation on the Tamil version of the original Western Aphasia Battery (WAB) can be developed but recently, Kertesz and Raven (2006) introduced the WAB-Revised (WAB-R) which included several important changes; the short version of the test (Bedside record form), a new task (Supplemental writing and reading), and new test items based on the clinician feedback as well as maintaining a scoring system to derive aphasia quotient, cortical quotient, and a newly added Language quotient. Hence the present project aimed to develop by adapting the WAB-R (English version) in the Tamil language and standardize the Western Aphasia Battery- Revised (WAB-R) in the Tamil language by considering 60 neuro-typical individuals and 77 persons with aphasia. The investigator used the direct translation and reverse translation methods introduced by Brislin (1970) by a Speech-Language Pathologist and linguist. Thus, the objectives were 1). To develop by adapting the WAB-R (English version) into the Tamil language as WAB-R in Tamil. 2). To assess language aspects by administering the newly adapted WAB-R in Tamil by considering normal controls and patients with a history of Cerebrovascular Accident (CVA) or brain injury and thus implement the standardization process. 3). To differentiate between the normal control and patients with a history of CVA or diagnosed as Aphasia with reference to the scores obtained on the administration of WAB-R in Tamil and thus implement the validation process. A comparison of the mean value of parameters in Record Form 1 and Record Form 2 demonstrated better performance for neuro-typical individuals compared to persons with aphasia. More number of parameters were affected in persons with Global aphasia and the least affected were persons with anomic aphasia. With reference to the WAB-R Tamil parameters, there was no significant age and gender difference for neuro-typical individuals. Whereas, there was a significant difference between gender and age for subtypes of aphasia, male performing poorer than females and younger age range performing better than older age range. The possible major reasons for the above findings could be the overall AQ showing a slight reduction of mean scores with the age increases and this finding is in concordance with the previous findings (Chengappa & Kumar, 2008; Keshree et al. 2013; Kim & Na, 2010). The lateralization analysis provided the results of males exhibiting left-lateralized activation in Exner's area during handwriting, while females exhibited bilateral Yang et al (2019). The reason for significant less performance in older age groups were identified that older adults exhibit less gray matter volume in comparison to young adults, the prefrontal cortex is particularly susceptible to gray matter atrophy (Good et al., 2001; Jernigan et al. 2001; Raz et al., 1997, 2004; Resnick et al., 2003). The foremost reason for this is the extent of pathology in these various aphasia types, the small lesion size is Anomia and the most extended and widespread lesion is in Global aphasia. The norms are provided in this study with a very good insight into the importance of language assessment using WAB-R Tamil and its use in the classification of aphasia. It is important to consider the language-specific test in the diagnosis of persons with aphasia.

Keywords: *Cerebrovascular accident, Western Aphasia Battery- Revised, Language Quotient, Aphasia Quotient, Cortical Quotient.*

CHAPTER 1

INTRODUCTION

Aphasia is an acquired language impairment resulting from a focal brain lesion in the absence of other cognitive, motor, or sensory impairments with reference to the neurological perspective. The language impairment can be present in all the components of language like phonology, morphology, syntax, semantics, and pragmatics, across speaking, reading, writing, and signing modalities and in the expression and comprehension modes. Therefore, describing the language symptoms of a given individual with aphasia will help in identifying a particular lesion location and possibly suggest a specific brain pathology (Damasio, 1992; Goodglass & Kaplan, 1993).

Aphasia can be studied from many perspectives, from neurolinguistics perspective, aphasia is a breakdown in specific language domains resulting from a focal lesion (Lesser, 1987), from a cognitive perspective, aphasia is considered the selective breakdown of language processing itself, of underlying cognitive skills, or the necessary cognitive resources, resulting from a focal lesion (Ellis & Young, 1988; McNeil, 1982). Finally, from a functional perspective, aphasia is a communication impairment masking inherent competence (Kagan, 1995). For many years, these various schools of thought have led researchers to generate many different definitions of aphasia. However, the researchers agree on common elements to be considered in any definition of aphasia would be: aphasia is a language level problem, it includes receptive and expressive components, is multimodal, and is caused by a central nervous system dysfunction. Whereas most definitions of aphasia center on the acquired neurological impairments impeding language function, the World Health Organization's International Classification of Functioning, Disability, and Health (ICF; WHO, 2001) focuses our attention on the consequences that these impairments have on the person's communicative and social functioning and quality of life (Martin, Thompson, & Worrall, 2008). Therefore, an up-to-date working definition of aphasia should include all the above-mentioned elements. To summarise and operationally define aphasia as an acquired selective impairment of language modalities and functions resulting from a focal brain lesion in the language-dominant hemisphere that affects the person's communicative and social functioning, quality of life, and quality of life of his or her relatives and caregivers.

In general, assessment is defined as a systematic, purposeful evaluation of the variety of linguistic, cognitive, and social components of language. Such type of assessment is carried out to identify each patient's strengths and weaknesses of language and the degree to which the decrease in language strength can be modified (Chapey, 1994; Lahey, 1988). The assessment process investigates the nature of language impairment and designates what aspects of language performance are most appropriate for treatment (Byng et al, 1990). To be brief, the assessment procedure for individuals with aphasia could be a quantitative and qualitative data gathering process to circumscribe an individual's communicative function and activity limitations, understanding his or her participation restriction, and devising appropriate rehabilitation objectives. The assessment steps should use tools and procedures that allow manifesting a diagnosis and a prognosis, describing and understanding all components of language functioning, as well as related functions that may positively or negatively influence language with reference to cognitive and emotional status, gathering background information regarding the individual with aphasia and the family and seeking input from the person with aphasia and the family about rehabilitation goals. Thus, assessment in aphasia involves three interrelated components like data collection, hypothesis formation, and hypothesis testing (Chapey, 1994). Language assessment is a thoroughly structured observation based upon the use of bedside assessment and screening tools, comprehensive aphasia battery, and/or other tests of specific language functions.

Western Aphasia Battery (WAB) (Kertesz, 1982) is a standardized published quantification tool used in the assessment of language in individuals with aphasia. According to Kertesz (2020), the assessment of aphasia is large and there are about 50 or more specifically designated aphasia tests beginning with that of Broca himself. Many are brief screening assessments with a limited sampling of language. The WAB occupies a central position in a wide spectrum of language tests, ranging from examining language function in the community, for example, Functional Communication (Sarno, 1969), Communicative Activities of Daily Living (CADL) (Holland, 1980), to detailed psycholinguistic assessments (PALPA) (Kay et al., 1992), satisfying theoretical rather than clinical considerations. The National Library Data Base (Pub Med) lists the use of the WAB in abstracts or titles (n = 249), in contrast to other comprehensive aphasia tests such as the Boston Diagnostic Aphasia Examination (BDAE) n = 57 (Goodglass & Kaplan, 1972), the Porch Index of Communicative Abilities (PICA) n = 40 (Porch, 1967), the Minnesota Test for the

Differential Diagnosis of Aphasia (MTDDA) n = 8 (Schuell et al., 1962) and the Neurosensory Center Comprehensive Examination for Aphasia (NCCEA) n = 5 (Spreen & Benton, 1977). This reflects only a trend as there are many more articles that do not mention the use of the test in their title or abstract. With this review, it is a known fact that the WAB provides the investigative goals of classifying aphasia subtypes and the severity rating of aphasic impairment, and that is closely related to the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972). The structure of the WAB is shown in Figure 1.1. The flowchart also indicates the linguistic targets of the subtests.

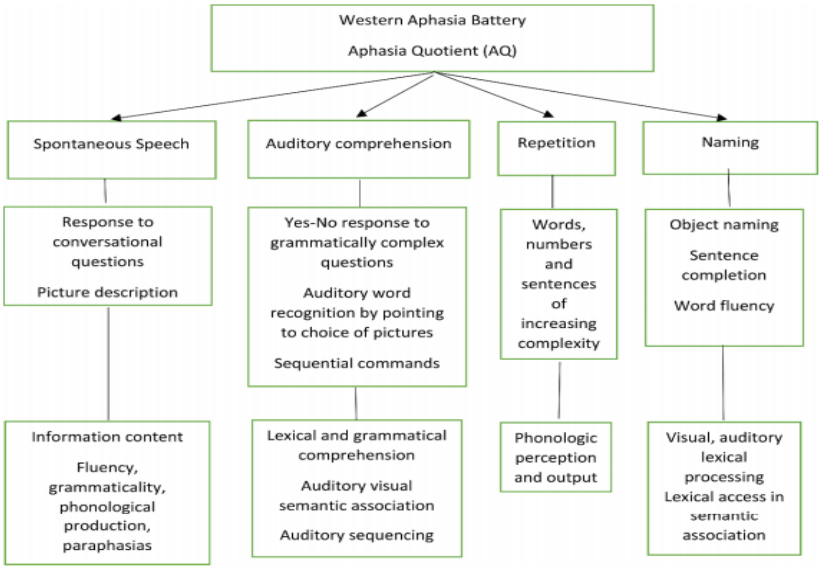


Figure 1. The structure of the Western Aphasia Battery: The first row are the essential components of the Aphasia Quotient, second row are the actual subtests and the third row the linguistic elements.

Figure 1.1: Essential components of Aphasia Quotient, the actual subtests, and the linguistic elements of WAB

The WAB is developed to evaluate clinical aspects of language function in persons with aphasia and provide the data helpful to establish a prognosis for therapy. And the procedure is based on the principle of modern neurolinguistics and the neuro-anatomical model. The WAB consists of eight (8) subtests namely spontaneous speech, auditory verbal comprehension, repetition, naming, reading, writing, apraxia, constructional, visuo-spatial, and calculation tasks. The scoring system provides the following overall measures of severity, where the Aphasia Quotient (AQ) is the summary score of the oral portion. The revised version includes a brief bedside test for acutely ill or severely affected patients who

could not manage the complete test, yet the severity score and the sub-scores are comparable to the full test. Adding reading and writing subtests provides a Language Quotient (LQ), the language-related tests of praxis and calculation, and nonverbal cognition, such as Raven's matrices and Block design provides Performance quotient, altogether the combination of Aphasia quotient and the Performance quotient forms the Cortical quotient (C.Q. = A.Q. + P.Q). The language quotient combines oral and written language scores to emphasize the relationship between two modalities and visual-verbal function, which is also as important as oral language skills in the diagnosis of aphasia. The calculation of LQ often depends on education, thus it has less prognostic value than AQ (LQ = AQ scores + Reading scores + Writing scores). The CQ includes all the non-verbal tests, such as apraxia, construction, visuospatial, and calculations with the addition of reading and writing. CQ gives more importance to the cortical functioning of performances than the oral language skills (CQ = AQ scores +LQ scores + Apraxia scores + Constructional, Visuo-spatial, and Calculations).

The cut-off scores of the subtests of speech output, comprehension, repetition, and naming determine the aphasic pattern, allowing an objective categorization of the complex spectrum of aphasic disorders (Kertesz & Poole, 1974). Based on the following four parameters: spontaneous speech, comprehension, repetition, and naming – types of aphasia are recognized. They can be classified under Broca's, Wernicke's, Transcortical sensory (TCS), Transcortical motor (TCM), Conduction, Anomic, Isolation, and Global aphasia. Tables 1.1 and 1.2, show the details of classification criteria followed in WAB by Kertesz, (1979) and WAB-R by Kertesz (2007) respectively.

Table 1.1: Classification Criteria of Western Aphasia Battery

Types of Aphasia	Fluency	Auditory verbal comprehension	Repetition	Naming
Expressive				
Global	0-4	0-3.9	0-4.9	0-6
Brocas	0-4	4-10	0-7.9	0-8
Isolation	0-4	0-3.9	5-10	0-6
Transcortical-motor	0-4	4-10	8-10	0-8
Receptive				
Wernickes	5-10	0-6.9	0-7.9	0-9
Transcortical sensory	5-10	0-6.9	8-10	0-9
Conduction	5-10	7-10	0-6.9	0-9
Anomic	5-10	7-10	7-10	0-9

Table 1.2: Classification Criteria of Western Aphasia Battery-Revised

Aphasia type	Fluency	Auditory verbal comprehension	Repetition	Naming
Global	<5	0-3.9	0-4.9	<7
Broca's	<5	4-10	0-7.9	<9
Isolation	<5	0-3.9	5-10	<7
Transcortical-motor	<5	4-10	8-10	<9
Wernicke's	>4	0-6.9	0-7.9	<10
Transcortical sensory	>4	0-6.9	8-10	<10
Conduction	>4	7-10	0-6.9	<10
Anomic	>4	7-10	7-10	<10

The Aphasia quotient less than 93.8 out of a maximum of 100 indicates the presence of aphasia which is used in research studies (Kertesz, 1979). For the neuro-typical individuals, A.Q. is considered as 98.4 (or) 99.6 (mean A.Q). The aphasia severity is mainly measured by Aphasia Quotient (AQ) in WAB-R and the details are given in Table 1.3.

Table 1.3: Severity scale of Aphasia Quotient in WAB-R

Severity	AQ scores
Very Severe	0-25
Severe	26-50
Moderate	51-75
Mild	>76

[***Note: AQ-Aphasia quotient***]

WAB- R (Kertesz, 2007) is an updated version of WAB with two new supplementary tasks (reading and writing of irregular and non-words) which aid the clinician in distinguishing between surface, deep (phonological), and visual dyslexia and bedside WAB-R provides a quick look at patient's functioning. The AQ from the WAB-R was acknowledged to assist in distinguishing between aphasic and non-aphasic test performance (Rohde et al., 2018). Eighty-two consecutive cases of patients with aphasia were evaluated to find an overall agreement of 63.4% between the patient's bedside clinical impression and the WAB classification of aphasia, but some cases had a normal language by the scoring criteria of the WAB. The clinical impression was appropriate in an acute setting, but the WAB was useful to quantify the severity of deficit, assess prognosis, monitor progression, and plan rehabilitation (John et al., 2017).

Aphasia was not classifiable using classic description or the administration of BDAE when a large percentage of 50-60% population was studied, but nearly all patients could be classified by using WAB-R by using the scores of fluency, naming, comprehension, repetition, and auditory comprehension (Ochfeld et al., 2010). There are other studies also which show less agreement between clinical impression and WAB classification (John et al., 2017). However, Kertesz (2020), in his systematic review of research and clinical applications of WAB has proved the WAB to be a useful clinical tool for the classification of aphasia and related linguistic research on aphasia. Other supporting studies are, for example, a study by Kong et al (2019), which found that naming ability at the single-word level and overall language ability on the Cantonese WAB were found to be the two strongest predictors of word-finding difficulty but not gesturing during speech. Kim et al., (2020) has found a significant correlation between function word production and aphasia severity, determined by WAB Aphasia Quotient (AQ), and differentiated between fluent and non-fluent aphasia. According to Ellis et al (2020), a relative weight analysis of the subtests of the WAB in 288 patients with aphasia indicated that the strongest contributors to the AQ were primarily the measures of expressive language. In fluent aphasia, there was more contribution of spontaneous speech when compared to non-fluent aphasia. Gonzalez et al (2020) used WAB and calculated four quotients in individuals with aphasia, the aphasia quotient (AQ), the reading-writing quotient (RWQ), language quotient (LQ), and cortical quotient (CQ). In global, mixed non-fluent, and transcortical motor aphasia the reading and writing difficulties were more severe, and in the case of amnesic, Broca, and Conduction aphasia there were fewer difficulties found in reading and writing. Thus, it can be proved that the WAB and WAB-R for the western population using English as their native language is clinically effective in diagnosing aphasia.

With reference to the present scenario of south Asia countries like India, the integral product of globalization and social mobility with reference to language use is resulting in the interesting concept called bilingualism. Compare to western countries, there are differences in grass-root bilingualism in India. Since India has been a multilingual country right from the earliest times and English bilingualism has become an integral part of India's consciousness. Individuals using two languages especially as spoken with the fluency characteristics of a native speaker and a person using two languages habitually with control like that of a native speaker and having a constant oral use of two languages is diagnosed with aphasia will affect

their language abilities differently or equally. The persons with aphasia in the non-English population have to be investigated for their language symptoms /deficits and recovery patterns in each bi/multilingual combination in the Indian subcontinent (Chengappa, 2001). For example, it is well established now that language-specific impairments and recoveries take place as evidenced by the growing literature on Agrammatism (Paradis, 1987). Apart from the English version of WAB, Indian adaptation in Kannada (Chengappa & Kumar, 2008), Malayalam (Jenny, 1992), Telugu (Pallavi, 2010), Hindi (Kaur et al 2017), Bengali (Keshree et al 2013), and Bangla (Mazumdar et al. 2017) are being used extensively for clinical purposes in India. From the above review, we can conclude that the language content and expressive ability of the persons with aphasia determines the severity of the problem. Thus, the language structure and the nature of the use of the language(s) by the native speakers are crucial in devising a test material for the assessment of any language disability, especially in the area of aphasia. Hence, an attempt is made to adapt the WAB- R into the Tamil language suiting the aphasia population belonging to the south Indian State of India, Tamil Nadu. Thus, the present study aimed to adapt the WAB-R in the Tamil language.

CHAPTER II

REVIEW OF LITERATURE

Stroke or cerebrovascular accidents (CVA) may result from different health conditions, such as high blood pressure, diabetes, and hypertension, and it causes disability. Aphasia, an acquired language disorder, occurs in 25%–40% of stroke survivors (Ryglewicz, Hier, Wiszniewska, Cichy, Lechowicz, & Czlonkowska, 2000) and occurs due to focal brain lesions and can impair any or all language modalities – listening, speaking, reading, and writing. Aphasia is not defined as a disorder of cognition or motor functioning.

Aphasia is defined as "the loss or deterioration of verbal communication due to an acquired lesion of the nervous system involving one or more aspects of the processes of comprehending and producing verbal messages" (Basso & Cubelli, 1999). Related disorders of articulation, reading, and writing are usually included in the description of aphasia. Furthermore, it is a multimodality disorder (Helm- Estabrooks & Holland, 1998). Post-stroke language intervention in aphasia patients has been found to assist in optimizing patient outcomes (Godecke, Hird, Laylor, Rai, & Phillips, 2012), consequently, accurate aphasia diagnosis is crucial in ensuring patients receive the rehabilitation they require (Hachioui, et al 2017).

In any stroke care center, the accuracy of aphasia diagnostic procedures is very important. With respect to the diagnostic criteria for aphasia, there is variation due to the epidemiological studies and resulting in variation in incidence and prevalence statistics. However, the stroke studies estimate between 15-42% of acute stroke patients experiencing language impairment. There is a high global burden caused due to stroke (Feigin, 2013), in 2013 the prevalence of stroke was 25.7 million and with 10.3 million people experiencing a first-time stroke. Internationally, if the incidence of 10.3 million new strokes is noted and this differ epidemiological statistics and results in significant implication at a global level and causes differences in estimated affected global populations anywhere between 1.5 and 4 million annually. It is essential to ensure appropriate, accurate, methodologically sound diagnostic validation of post-stroke aphasia assessment procedures as one of the important components of global stroke healthcare.

The post-stroke language functioning is currently evaluated through a range of clinical measures and assessments in acute clinical care using neuro-imaging and behavioral assessment. The site and size of the lesion are important factors in predicting the recovery in neuroimaging studies by proving the correlations between lesion site and aphasia (Heiss, Thiel, & Kessler, 2003; Watila, & Balarabe, 2015). However, the neuroimaging findings contribute to understanding the loss of language functions by characterizing the lesion and would not report on the nature and individual profile of language impairment. The profile of language impairment depends on the bedside testing and clinical assessment procedures involved in assessing language functioning (LaPointe, 2011). The language assessment tests currently used for post-stroke care are very wide in range. To mention few are, the European Stroke Scale (ESS) (Hantson, De Weerdt, De Keyser, Diener, Franke, Palm, et al, 1994), Canadian Neurological Scale (CNS) (Cote, Hachinski, Shurvell, Norris, & Wolfson, 1986) and National Institutes of Health Stroke Scale (NIHSS) (Goldstein, Bertels, & Davis, 1989) will assess the acute stroke severity and include the subtest items evaluating acute language functioning and which do not assist with diagnostic differentiation between aphasic and non-aphasic stroke populations. At the screening level, the Frenchay Aphasia Screening Test (Enderby, Wood, Wade, & Hewer, 1987) and Language Screening Test (Flamand-Roze, Falissard, Roze, Maintigneux, Beziz, Chacon, et al., 2011) have been used especially for assessing post-stroke language performance. These screening tools are designed for general use by multiple 'non-specialist' health professionals to facilitate the identification of at-risk patients and ensure a sincere referral for a speech-language pathologist. Speech-language pathologists are the professional experts typically responsible for the diagnosis of aphasia caused by stroke using a screening procedure, diagnostic assessment, descriptive testing in rehabilitation and counseling, progress evaluation, assessment of functional or pragmatic communication, and assessment of related disorders (Spreen & Risser, 2003).

A diagnostic test aims at the thorough examination of a patients' language performances to arrive at both a diagnostic impression and a detailed description of areas of associated strengths and weaknesses. Western Aphasia Battery- Revised (Kertesz, 2007) is the test used to assist in clinical decision making and evaluate a range of language skills in terms of expression and comprehension and this identifies the communicative strengths and weaknesses. The WAB-R assists with a definitive diagnosis of language impairment in a brief window and frequently around 30 minutes. Following the evaluation, the findings of the

evaluation thereby aid in planning treatment and also facilitate classification, placement, and programming to certification and research.

3.1 Assessment of aphasia using Western Aphasia Battery- Revised

According to Shewan and Kertesz (1980), "the Aphasia Quotient (A.Q) is a functional measure of severity of the spoken language deficit in aphasia." Each subtest provides a different percentage to the calculation of the A.Q. Information content; fluency and repetition of each subtest has 20% contribution. Object naming contributes 12%. Sequential commands contribute 8%. Yes-No Questions and auditory word recognition each contribute 6%. Word fluency contributes 4%. Finally, sentence completion and responsive speech each contribute 2%. These percentages demonstrate that the WAB aphasia quotient is weighted to a greater degree towards expressive tasks (80% of the A.Q.). Because the AQ is weighted more by scores from expressive tasks, it might be interpreted predominantly to represent a patient's expressive language ability. This weightage questions the relative contributions of the various expressive tasks to the prediction of the AQ. Given that information content, fluency, and repetition scores contribute most to the calculation of the AQ, they might be expected to be the best predictors of severity as measured by the AQ. The same has been reported by Kertesz, (1979) that the score for information content has the strongest correlation with the AQ; however, he presented no data to substantiate this claim. Thus, although the AQ is entrusted as an index of the severity of aphasic impairment, the relationship between AQ and the ten individual subtests of the WAB has not been investigated.

The changes in expressive language errors were reported in a patient who was followed for 12 months with the WAB according to Crary and Kertesz (1988). Some patients, specifically those presenting global or severe Broca aphasia, demonstrated changes in the type of expressive errors noted on naming and repetition tasks in the absence of change in the AQ. Such results suggest that patients' communication abilities and/or the form of language errors may change over time without change in the overall severity of aphasia as measured by a total score like the AQ.

With reference to information content, Crary and Rothi (1989) reported that "information content" was the best predictor of the severity of the aphasic impairment as measured by the AQ. The information content score reflects several dimensions of a patient's communicative abilities and contributes a high percentage to the calculation of the Aphasia

Quotient. Time post-onset did not influence the relationships among the subtests or between the 10 subtests and AQ. This was supported by Kertesz (1979) suggesting that the information content score represents a measure of functional communication where the patient must possess some degree of both comprehension and expression abilities to respond appropriately to the task.

From the above review, aphasia assessment variables like the "language content" and "expressive ability" of an aphasic patient determines the severity of the language problem. Thus, the structure of the language and the nature of the use of the language(s) by the native speakers are crucial in devising a test material for the assessment of any language disability, especially in the area of aphasia.

The above studies quoted were carried out in the English language and mention few studies carried out in different languages other than English are as follows. Kim & Duk (2004) studied the Normative Data on the Korean Version of the Western Aphasia Battery which aimed to describe the properties of the Korean version of the Western Aphasia Battery (Kn-WAB) presenting the data of normal individuals and patients. The Kn-WAB contained the same test contents and structure as the original WAB and the general test administration method was maintained. Korean-WAB was administered in two hundred and twenty-four normal adults in seven age groups, of five different educational levels and two hundred thirty-eight persons with aphasia were also evaluated using the Korean-WAB. The age and educational levels were more influential in the Korean-WAB performance. The highest aphasia quotient (AQ), language quotient (LQ), and cortical quotient (CQ) were achieved by the younger age group with more than seven years of education. Thus, the AQ, LQ, and CQ values, cut-off scores were obtained to prove optimally in differentiating between the normal and the aphasic individuals.

An attempt was made to assess the reliability and validity of the Bedside version of the Persian WAB (P-WAB-1) adapted from Western Aphasia Battery (WAB-R) by Nilipour et al (2014). P-WAB-1 was a clinical linguistic measuring tool to determine the severity and type of aphasia in brain-damaged patients based on Aphasia Quotient (AQ) as a functional measure. For a quick clinical screening of aphasia in Persian, they have adapted the bedside version of WAB-R to assess the performance of Persian aphasic patients. The data were reported on adaptation, validity, and reliability of P-WAB-1 based on faithful translation and

criterion validity ratio (CVR) taken from the expert panel and the performance of 60 consecutive brain-damaged patients referred from different university clinics for rehabilitation and 30 healthy subjects as norms and 40 age-matched epileptic patients as the control group. Based on the results of this study, P-WAB-1 has internal consistency (a=0.71) and test-retest reliability (r=.65 P<0.001) and the subtests are sensitive enough to contribute to Aphasia Quotient (AQ) as a functional measure of severity of aphasia in Iranian brain-damaged patients. Based on AQ results, our aphasic patients were classified into four distinct groups of severity. This tool was considered as a valid baseline for screening and diagnosis of aphasia among Persian-speaking brain-damaged patients. This study was the initial step on the adaptation of different versions of WAB-R to measure the severity of aphasia using AQ, LQ, and CQ as operational measures and to classify Persian-speaking aphasic patients into different types.

With reference to the Indian context, a study by Philip and Karanth (1992) was conducted to develop an aphasia test in Malayalam and assess the communication skills in aphasics and thus an attempt was made to construct a test based on WAB (Kertesz,1979). The new test thus developed for aphasics in Malayalam consists of 4 language subtests. (1) Spontaneous speech: Information content, Fluency. (2) Auditory comprehension (3) Repetition (4) Naming and 3 performance tests (5) Reading (6) Writing (7) Praxis, and a subtest to measure intelligence and visuospatial performance. (8) Construction: Drawing Block Design Calculation Raven's matrices. To cross-validate this aphasia test with English WAB (Kertesz, 1979), it was given to 5 bilingual normal adults and compare this performance with the performance of the same subjects on English WAB. After validating this test, to obtain clinical norms on this test, the test was given to 100 normal adults, age ranging from 20-70 years, and 8 aphasics with definite brain lesion and language disorders. To see the type of dysphasia on individual bilinguals, the Malayalam aphasia test was administered along with the English WAB on 3 bilingual aphasics and compare their performance with the performance of the same aphasics on English WAB. There was a high correlation between the Malayalam aphasia test and English WAB (Kertesz, 1979) with reference to the scores obtained from 5 bilingual normal adults. The aphasia test in Malayalam could distinguish aphasics from a normal population. The test has proved itself to be capable of differentiating non-fluent aphasics from fluent aphasics. This test also enables one to assign patients to classic aphasic syndromes such as Global, Brocas, Wernicke's,

Conduction, Transcortical motor, Transcortical sensory, Isolation, Conduction, and Anomic based upon their scores on each language subtest. And also proved that there was no significant difference between the performance of bilingual aphasics on Malayalam WAB and English WAB. Thus this research concluded that it can be used in clinics and for research purposes to assess the communication skills of aphasics in Malayalam.

India is a multilingual country and with reference to the Kannada language, Kumar and Shyamala (2008) aimed to standardize the Kannada version of Western Aphasia Battery (hereinafter K-WAB) and provided with the normative data of neurotypical individuals and persons with aphasia. The Kannada version of WAB consisted of the same set of test contents and structure of the module as the original WAB (Kertesz & Poole, 1974) that is the widely used assessment tool for aphasia by Speech-Language Pathologists (SLP). The test was modified with cross-cultural and linguistic adaptations and the method of test administration was maintained. The Kannada version of WAB was administered on 22 neurotypicals (16 males and 6 females) and 90 persons with aphasics in the age range of 30 –70 years. The Aphasia Quotient (AQ) was calculated for different age groups and gender. The cut-off scores and AQ were obtained to optimally differentiate between the neurotypicals and individuals with aphasia. The present study reported that there was no significant effect with respect to different age groups and gender. But the variation was significant among neurotypicals and different categories of persons with aphasia within themselves in all parameters of WAB (AQ- spontaneous speech, repetition, comprehension, and naming). It was proved beyond doubt that WAB differentiates normal and aphasic performance, finding support from the well-established trend in literature.

In continuation with the previous study in the Kannada language, Pallavi and Shyamala (2010) aimed to develop the Telugu version of Western Aphasia Battery and provided the normative data of normal individuals and patients with aphasia. The test was modified with the same procedure which was maintained in the previous study. The Telugu version of WAB was administered on 100 neurotypicals (20 males and 20 females) in five different age groups and 20 individuals with aphasia in the age range of 40 –70 years. The Aphasia Quotient (AQ) was evaluated for different ages and gender groups. The AQ and cut-off scores were obtained to optimally differentiate between the normal and aphasic individuals. This study also proved that there was no significant effect with respect to age and gender and significant variation was found in normal and different types of aphasics within

themselves in all parameters of T-WAB (AQ- spontaneous speech, repetition, comprehension, and naming).

Keshree et al 2013 adapted the original WAB in the Bengali language to give the Bengali WAB (B-WAB). The study was completed in three phases: development, standardization, and validation of the B-WAB. The test material was developed preserving the total number of items, however, minor changes were made wherever necessary so that it matched the sociolinguistic norms of Bengal State. It was standardized in a group of 150 normal individuals in five different age groups ranging from 18-70 years, and normative values were provided for each subtest for each group. For establishing validity, it was administered to 30 aphasic subjects and the results indicated that the B-WAB was a valid tool for testing individuals with aphasia.

The Western Aphasia Battery-Revised (WAB-R) (Kertesz & Raven, 2006), an English aphasia assessment was studied to complete a sociolinguistic adaptation and validation into the Bangla language by Mazumdar et al (2018). This study had two steps: first, three professional translators performed the translation and back-translation processes on the WAB-R. Second, to validate the adaptation, 27 neurologically normal individuals and 36 patients with a history of cerebrovascular accidents participated in this study. The three types of adaptation processes were the introduction of new words or phrases, direct translation, and direct translation replacing concepts. As per different adaptation processes, Record form Part 1 (derives aphasia quotient [AQ]) achieved 25% of sociocultural and linguistic changes whereas Record Form Part 2 (derives cortical quotient and language quotient) achieved 57% of sociocultural and linguistic changes. The items of the Bedside record form (shorter version of the test) were taken from Record Form Part 1 and Part 2. Normal controls completed the test with scores of 100% on most of the sub-tests while the patients' performance was significantly lower. Eighty percent of the patients had aphasia, based on their test scores, and investigators could categorize the patients by aphasia type based on the AQ and bedside aphasia score. There is a high correlation between the subtest scores of Record Form Part 1 and Bedside record form. The investigators reported that some changes were needed to adapt the WAB-R for Bangla speakers and here the preliminary validation study demonstrated that the Bangla WAB-R could differentiate the normal population from the patients with aphasia by their language performance. In the future, the investigators will attempt to standardize the test in the next phase of the study.

However, there is a lack of published psychometric information for longer, more comprehensive stroke language measures for speech pathologists. But for a brief screening measure for 'non-specialist' clinicians have diagnostic validation studies published in the peer-reviewed research literature according to El Hachioui (2017). While the diagnostic tests are frequently used in stroke care (Vogel, Maruff & Morgan, 2010), the extensive and more comprehensive language diagnostic assessments often report their psychometric properties within their purchased test manuals or through online sources and not within peer-reviewed journals. As a consequence, the diagnostic capabilities of these language tests have not been systematically evaluated. On the other hand, and with reference to the diagnosis of mild aphasia component in any individuals with a history of stroke was studied by Ross and Wertz (2010). They found that the overall scores derived from diagnostic aphasia tests are accurate but may or may not be important in confirming the presence or absence of mild aphasia, depending on the pre-test probability of a positive diagnosis. Hence there is a need to adapt the existing test material to the required language to achieve a good clinical diagnostic implication.

3.2 Need for the study

India has the third-highest stroke prevalence in Asia after China and Japan. Tamil Nadu is one of the highly populated states in India, which has an increasing stroke incidence rate (Jebasingh & Sivanesan, 2017). Tamil is the native language of Tamil Nadu. Worldwide, it is the most leading language, spoken by 300 million people. Considering the incidence and prevalence of stroke and aphasia, it is clear that there may be a significant number of Tamil speakers with aphasia. Aphasia can be treated to improve communicative effectiveness and thus the quality of life. A speech and language assessment must be completed to identify the type and severity of aphasia which will lead to proper treatment. It is the speech-language pathologists' (SLPs) job to select the most appropriate assessment tools. There are numerous aphasia assessments developed for English speakers and later translated into other languages. However, many countries still lack valid and reliable aphasia assessments. There are two ways to create – develop a new test or adapt an existing test in the target language. Sometimes, adapting an existing test is preferable because the adaptation process appears to be more efficient than developing a new test.

In the test adaptation, task structure, scoring, and scaling models have been established, saving further time. However, adaptation is not a simple translation of a test when the source language and target language are different and spoken in two diverse communities/cultures. With the meticulous work, adaptation provides a more culturally and linguistically equivalent version of a test. For adaptation, clinician-offered changes have to be linguistically compatible with the existing test items. Otherwise, the results will produce a high rate of error. The spontaneous translation is not an optimal way to assess aphasia because it may differ with time and person which leads to invalid results. Due to the absence of standardized aphasia tests in Tamil, SLPs in Tamil Nadu have had to resort to the spontaneous translation of existing English aphasia assessments in Tamil for the assessments. Adapted aphasia tests have been completed for other Indian languages, such as Kannada, Malayalam, and Telugu, Hindi, Bangla, but most of these tests remain unpublished or have limited circulation. The published literature includes little to no discussion on the actual adaptation processes used for these tests. This research provides progress in aphasia test adaptation for Tamil speakers. Validation on the Tamil version of the original Western Aphasia Battery (WAB) can be developed but recently, Kertesz and Raven (2006) introduced the WAB-Revised (WAB-R) which included several important changes; the short version of the test (Bedside record form), a new task (Supplemental writing and reading), and new test items based on the clinician feedback as well as maintaining a scoring system to derive aphasia quotient, cortical quotient, and a newly added **Language quotient**. In addition, the WAB-R underwent broader standardization, further improving the aphasia classification and severity metrics for people with aphasia. Thus, the WAB-R is now considered a more valid aphasia test. By considering this newly modified or revised version of Western Aphasia Battery (WAB-R) the current study was undertaken to adapt and develop a Tamil Aphasia Test Battery and validate it with the Tamil aphasics. Thus, the following points will be focused on in the present study. First, the WAB/WAB-R was already the most adapted test in Indian languages. Yet, there are no published studies have developed a validated tool in Tamil. Here is an attempt as a project study for the one in the series to adapt, develop and validate the Western Aphasia Battery- Revised in Tamil. Second, the best clinical implication of WAB-R is it is easy to administer and takes only 45–60 min to complete the assessments. Third, the WAB-R helps to identify the aphasic types which may provide clinicians with treatment direction and provide researchers a path to study aphasia in Tamil speakers.

CHAPTER III

METHOD

3.1 Aim

The present project aimed to develop by adapting the WAB-R (English version) in the Tamil language and standardize the Western Aphasia Battery- Revised (WAB-R) in the Tamil language by considering neuro-typical individuals and persons with aphasia.

3.2 Objectives

a) To develop by adapting the WAB-R (English version) into the Tamil language as WAB-R in Tamil.
b) To assess language aspects by administering the newly adapted WAB-R in Tamil by considering normal controls and patients with a history of Cerebrovascular Accident (CVA) or brain injury and thus implement the standardization process.
c) To differentiate between the normal control and patients with a history of CVA or diagnosed as Aphasia with reference to the scores obtained on the administration of WAB-R in Tamil and thus implement the validation process.

3.3 Research Design

This was a descriptive study reporting to develop by adaptation and preliminary validation of the WAB-R for Tamil speakers.

3.4 Participants

The total number of participants chosen for the study was 167 participants constituting Group 1, Group II, and Group III. Group, I was 60 neuro-typical individuals forming a control group. Group II was 77 persons with aphasia forming the clinical group and Group III was 30 bilingual neurotypical individuals in the age range of 30-70 years. Group, I, Group II, and Group III was further subdivided into different groups with reference to the gender and age range as shown in Table 3.1. All the participants were right-handers and none of the participants had any sensory, motor, cognitive, or language impairment. Both monolingual and bilingual speakers were recruited; the proficient language or L1 had to be Tamil (Mother tongue). L2 and/or L3 could be English (most frequently used/or medium of

instruction at school/college) and/or Hindi and/or Kannada. The frequently used language for communication in their day-to-day life was noted to be Tamil language and also had the knowledge of reading and writing in the Tamil language. However, some of the participants were exposed to English as a single subject or their medium of instruction in their academic training. As per the rating on the re-adapted version of the National Institute of Mental Health (NIMH) Socioeconomic Status Scale, (Venkatesan, 2011), all the participants were ensured to belong to a middle/high socioeconomic status. These were the general selection criteria for all three groups (Group II- before the pathology). The demographical details of each participant of all three groups are shown in Table 3.2. and 3.3.

Table 3.1: *Number of participants from Group I, II, and III and their sub-groups*

Group I (Neuro-typical individuals				
Sub-groups	Age range	Male (N)	Female (N)	Total
Group A	30-40 years	10	10	20
Group B	41-60 years	10	10	20
Group C	61-70 years	10	10	20
	Total	30	30	60
Group II (Persons with Aphasia)				
Sub-groups	Age range	Male (N)	Female (N)	Total
Group D	30-40 years	8	10	18
Group E	41-60 years	16	17	33
Group F	61-70 years	14	12	26
	Total	38	39	77
Group III (Bilingual neurotypical Individuals)				
Sub-groups	Age range	Male (N)	Female (N)	Total
Group G	30-40 years	5	5	10
Group H	41-60 years	5	5	10
Group I	61-70 years	5	5	10
	Total	15	15	30

Table 3.2: *Demographic details of the Group I (Neuro-typical individuals)*

Sl No	**Age/Sex**	**Language Known**	**Education Level**
1.	34/M	Tamil/English	Under graduate
2.	56/M	Tamil	Diploma
3.	48/M	Tamil/English	Under graduate
4.	42/M	Tamil/English	Under graduate
5.	60/M	Tamil	Under graduate
6.	30/M	Tamil/English	Under graduate
7.	30/M	Tamil/English	Under graduate
8.	38/M	Tamil/English	Under graduate
9.	34/M	Tamil/English	Under graduate

Table 3.2 continuation..

10.	35/M	Tamil/English	Under graduate
11.	35/M	Tamil/English	Under graduate
12.	39/M	Tamil/English	Under graduate
13.	36/M	Tamil/English	Under graduate
14.	35/M	Tamil/English	Under graduate
15.	49/M	Tamil/English	Under graduate
16.	45/M	Tamil/English	Under graduate
17.	56/M	Tamil/English	Under graduate
18.	54/M	Tamil/English	Under graduate
19.	56/M	Tamil/English	Under graduate
20.	45/M	Tamil/English	Under graduate
21.	64/M	Tamil	PUC
22.	63/M	Tamil	Diploma
23.	68/M	Tamil/English	Under graduate
24.	60/M	Tamil/English	PUC
25.	62/M	Tamil/English	Under graduate
26.	60/M	Tamil/English	Post graduate
27.	61/M	Tamil	PUC
28.	64/M	Tamil/English	Diploma
29.	62/M	Tamil	10^{th} std
30.	66/M	Tamil/English	Under graduate
31.	40/F	Tamil/English	PUC
32.	60/F	Tamil/English	Under graduate
33.	58/F	Tamil/English	Under graduate
34.	53/F	Tamil	PUC
35.	42/F	Tamil/English	Under graduate
36.	44/F	Tamil/English	Under graduate
37.	49/F	Tamil/English	Post graduate
38.	50/F	Tamil/English	Diploma
39.	52/F	Tamil	Diloma
40.	47/F	Tamil/English	Diploma
41.	38/F	Tamil	12^{th} std
42.	39/F	Tamil/English	Under graduate
43.	36/F	Tamil/English	Under graduate
44.	37/F	Tamil/English	Under graduate
45.	39/F	Tamil	12^{th} std
46.	40/F	Tamil/English	Diploma
47.	31/F	Tamil/English	Diploma
48.	30/F	Tamil/English	Post graduate
49.	33/F	Tamil/English	Under graduate
50.	32/F	Tamil/English	Post graduate
51.	64/F	Tamil	10^{th} std
52.	63/F	Tamil/English	Under graduate
53.	66/F	Tamil/English	PUC
54.	62/F	Tamil/English	PUC
55.	61/F	Tamil/English	Diploma
56.	68/F	Tamil	10^{th} std
57.	66/F	Tamil/English	Diploma

Table 3.2 continuation..			
58.	65/F	Tamil/English	Post graduate
59.	62/F	Tamil/English	Diploma
60.	64/F	Tamil/English	Under graduate

Note: M-Male, F-Female, PUC-Pre University College

Table 3.3: *Demographic details of the Group II (Persons with Aphasia)*

Sl No.	Age/ Sex	Language Known	Education Level	AQ score	Aphasia Type	Duration of illness
1.	48/M	Tamil/English	12th std	24.1	Broca's Aphasia	6 Months
2.	62/M	Tamil/English	Under graduate	13.5	Broca's Aphasia	4 Months
3.	48/M	Tamil/English	Under graduate	13.4	Broca's Aphasia	2 Months
4.	70/M	Tamil/English	Under graduate	22	Broca's Aphasia	6 Months
5.	61/M	Tamil/English	12th std	19.4	Broca's Aphasia	4 Months
6.	35/M	Tamil/English	Diploma	19.8	Broca's Aphasia	6 Months
7.	42/M	Tamil/English	Diploma	22.2	Broca's Aphasia	3 Months
8.	34/M	Tamil/English	Post graduate	20.3	Broca's Aphasia	6 Months
9.	40/M	Tamil/English	Under graduate	29.9	Broca's Aphasia	4 Months
10.	70/M	Tamil/English	Post graduate	24.7	Broca's Aphasia	4 Months
11.	64/M	Tamil/English	10th std	19.2	Broca's Aphasia	6 Months
12.	60/M	Tamil/English	Under graduate	28.6	Broca's Aphasia	5 Months
13.	58/M	Tamil/English	PUC	22.6	Broca's Aphasia	2 Months
14.	70/M	Tamil/English	PUC	23	Broca's Aphasia	4 Months
15.	50/M	Tamil/English	Diploma	20.5	Broca's Aphasia	2 Months
16.	40/M	Tamil/English	10th std	20.9	Broca's Aphasia	4 Months
17.	64/M	Tamil/English	Diploma	24.7	Broca's Aphasia	6 Months
18.	70/M	Tamil/English	Post graduate	27.8	Broca's Aphasia	6 Months
19.	57/M	Tamil/English	Diploma	25.1	Broca's Aphasia	3 Months
20.	70/M	Tamil/English	Under graduate	24.1	Broca's Aphasia	4 Months
21.	40/M	Tamil/English	Diploma	23.7	Broca's Aphasia	2 Months
22.	55/M	Tamil/English	Undergraduate	23.3	Broca's Aphasia	2 Months
23.	52/M	Tamil/English	Undergraduate	24.7	Broca's Aphasia	6 Months
24.	60/M	Tamil/English	Undergraduate	23.8	Broca's Aphasia	3 Months
25.	34/M	Tamil/English	Post graduate	19.9	Broca's Aphasia	6 Months
26.	65/M	Tamil/English	Under graduate	30.7	Broca's Aphasia	4 Months
27.	60/M	Tamil/English	Under graduate	23.2	Broca's Aphasia	5 Months
28.	58/M	Tamil/English	Under graduate	24.8	Broca's Aphasia	2 Months
29.	30/M	Tamil/English	Under graduate	28.9	Broca's Aphasia	2 Months
30.	56/F	Tamil/English	12th std	28.1	Broca's Aphasia	4 Months
31.	50/F	Tamil/English	Under graduate	38.4	Broca's Aphasia	4 Months
32.	48/F	Tamil/English	12th std	38	Broca's Aphasia	2 Months
33.	68/F	Tamil/English	Under graduate	31.8	Broca's Aphasia	3 Months
34.	58/F	Tamil/English	PUC	29.1	Broca's Aphasia	5 Months
35.	54/F	Tamil/English	PUC	19.2	Broca's Aphasia	6 Months
36.	36/F	Tamil/English	Under graduate	25.6	Broca's Aphasia	3 Months
37.	62/F	Tamil/English	Diploma	19.6	Broca's Aphasia	6 Months
38.	48/F	Tamil/English	10th std	16.5	Broca's Aphasia	2 Months
39.	61/F	Tamil/English	Diploma	20.8	Broca's Aphasia	2 Months

Table 3.3 continuation..

40.	42/F	Tamil/English	Diploma	31.1	Broca's Aphasia	4 Months
41.	33/F	Tamil/English	Diploma	24.8	Broca's Aphasia	2 Months
42.	42/F	Tamil/English	Under graduate	18.7	Broca's Aphasia	4 Months
43.	50/F	Tamil/English	Under graduate	26	Broca's Aphasia	3 Months
44.	43/M	Tamil/English	Under graduate	35.9	Wernicke's Aphasia	4 Months
45.	35/M	Tamil/English	Post graduate	27.6	Wernicke's Aphasia	4 Months
46.	70/M	Tamil/English	Under graduate	24.9	Wernicke's Aphasia	5 Months
47.	60/M	Tamil/English	Under graduate	35	Wernicke's Aphasia	1 Month
48.	54/M	Tamil/English	Under graduate	23.5	Wernicke's Aphasia	1 Month
49.	40/M	Tamil/English	Under graduate	27.3	Wernicke's Aphasia	2 Months
50.	42/F	Tamil/English	Post graduate	23.5	Wernicke's Aphasia	4 Months
51.	47/F	Tamil/English	Under graduate	31.7	Wernicke's Aphasia	6 Months
52.	37/F	Tamil/English	Under graduate	28.4	Wernicke's Aphasia	5 Months
53.	62/M	Tamil/English	10^{th} std	3.9	Wernicke's Aphasia	3 Months
54.	72/M	Tamil/English	Under graduate	1.8	Global Aphasia	2 Months
55.	36/M	Tamil/English	Post graduate	11.3	Global Aphasia	4 Months
56.	61/M	Tamil/English	Under graduate	6.4	Global Aphasia	5 Months
57.	65/M	Tamil/English	Under graduate	5.2	Global Aphasia	2 Months
58.	45/M	Tamil/English	Under graduate	8.3	Global Aphasia	2 Months
59.	55/M	Tamil/English	Under graduate	3.3	Global Aphasia	1 Month
60.	65/M	Tamil/English	PUC	6.1	Global Aphasia	1 Month
61.	34/F	Tamil/English	Post graduate	7	Global Aphasia	5 Months
62.	55/F	Tamil/English	Under graduate	10.1	Global Aphasia	5 Months
63.	35/F	Tamil/English	Under graduate	13.8	Global Aphasia	3 Months
64.	42/F	Tamil/English	Diploma	5.5	Global Aphasia	3 Months
65.	70/F	Tamil/English	PUC	3.1	Global Aphasia	3 Months
66.	55/F	Tamil/English	Under graduate	5.1	Global Aphasia	2 Months
67.	54/F	Tamil/English	Under graduate	8	Global Aphasia	1 Month
68.	50/M	Tamil/English	Under graduate	73.8	Anomic Aphasia	5 Months
69.	62/M	Tamil/English	Under graduate	68.2	Anomic Aphasia	4 Months
70.	52/M	Tamil/English	Under graduate	63.1	Anomic Aphasia	6 Months
71.	40/M	Tamil/English	Diploma	66	Anomic Aphasia	4 Months
72.	46/M	Tamil/English	Under graduate	63.6	Anomic Aphasia	5 Months
73.	52/M	Tamil/English	Under graduate	65.6	Anomic Aphasia	3 Months
74.	55/F	Tamil/English	Post graduate	54.2	Anomic Aphasia	2 Months
75.	34/F	Tamil/English	Post graduate	60.7	Anomic Aphasia	2 Months
76.	70/F	Tamil/English	PUC	64.6	Anomic Aphasia	4 Months
77.	67/F	Tamil/English	10^{th} std	52.4	Anomic Aphasia	3 months

Note: M-Male, F-Female, PUC-Pre University College

3.4.1 Location of Participant Selection

All the participants from the clinical group were chosen from the Thanjavur Government Medical College, Thanjavur, Tamil Nadu, India, and also from Meenakshi Mission Hospital, Thanjavur, Tamil Nadu, India. The participants from the control group

were drawn from work/residential places in and around Chennai, Tamil Nadu, India. Participants were included in the study only on fulfilling certain specific criteria. The criteria were different for the clinical and the control groups, with a few common criteria for the three groups.

3.4.2 Inclusion criteria for the control group

The additional inclusionary criteria for the neuro-typical individuals after following the general selection criteria as participants for the present study were:

1. No history of speech, language, and hearing impairment.
2. A WHO Ten-Question Disability Screening Checklist (Singhi, Kumar, Prabhjot & Kumar., 2007) was used to screen all the subjects for hearing, intelligence, motor functions, behavioral and emotional factors.
3. These individuals should have a minimum of 10 years of formal education.

3.4.3 Inclusion criteria for the clinical group

The additional inclusionary criteria for individuals with aphasia were:

1. Individuals with a diagnosis of aphasia caused due to the cerebrovascular accident and this diagnosis were indicated by a Neurologist with the help of neuroimaging data or by a Speech-Language Pathologist diagnosing aphasia on the administration of Western Aphasia Battery (Kertesz, 1979). The administration of the test was carried out by translating in to Tamil.
2. No reported history of cognitive or speech and language impairment prior to aphasia onset.
3. Post onset duration of at least six months to twelve months. Seventy-seven participants with aphasia were considered for the present study and underwent Western Aphasia Battery (WAB) to characterize the nature and severity of language deficits. The Aphasia Quotient (AQ) of WAB was calculated and a score less than 93.8 was included for the study. From a Speech-Language Pathologist, they received confirmation regarding the presence of the aphasia

component. Only participants who had aphasia due to the cerebrovascular accident were considered.

3.4.4 Inclusion criteria for the bilingual neurotypical group

1. No history of speech, language, and hearing impairment.
2. A WHO Ten-Question Disability Screening Checklist (Singhi, Kumar, Prabhjot & Kumar., 2007) was used to screen all the subjects for hearing, intelligence, motor functions, behavioral and emotional factors.
3. These individuals should have a minimum of 8 years of formal education in English and Tamil.

3.5 Assessment Procedure

3.5.1 Data collection: Phase I

3.5.1.1 Informed consent form including the verbal information sheet

Informed consent proposed by AIISH (All India Institute of Speech and Hearing) Ethical committee (2009) was used to obtain consent from each of the participants. The informed consent form consisted of two parts: the verbal information sheet and the consent form (Appendix A).

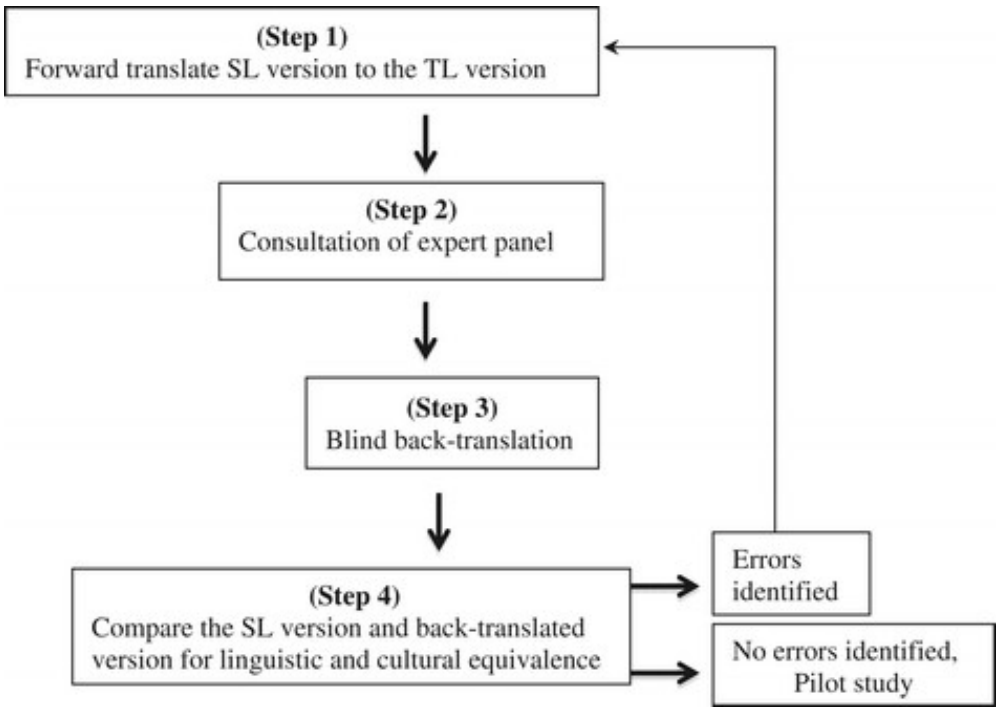
The information sheet included information on the title and objective of the study being undertaken along with the type and number of participants. They were highlighted risks/benefits for human research subjects willing to participate in the study. The assurance was provided to the participants that they would be clarified of any doubts at any time during the data collection/study. Emphasize is made on privacy confidentiality- the anonymity of participating human subjects. The information sheet also consisted of a clear appreciation and understanding about the introduction to the study, procedures and protocol, duration, confidentiality, sharing the results, right to refuse or withdraw, and whom to contact. The certificate of consent consisted of a written statement in the first person, in bold. The consent form was signed by all the participants in the group with neuro-typical individuals (NTI) and persons with aphasia/guardians of the same.

3.5.1.2 General information

All the participants were interviewed individually and the general history was taken. The participants were made to sit in front of the examiner. Interviews were in the form of interactive sessions with questions and answers. General history included name, age/sex, address and contact, languages known, handedness, education, occupation, information about hearing and vision, history of neurological/psychological illness, presenting illness, and address and contact number. Detailed medical history (if any) which included presenting symptoms, details of medical and non-medical treatments and information about tests which they had undergone was obtained from the participants. However, the similar general information of the clinical group were collected from both persons with aphasia and their guardians.

3.5.1.3 Development and adaptation of WAB-Revised (English Version) to the Tamil language

This can be explained in three phases, **Phase I**- the preparation of test stimuli from point of syntactic and semantic aspects of the Tamil language. Initially, the investigator used the direct translation and reverse translation methods introduced by Brislin (1970) and the flow chart of this Brislin method is shown in Figure 3.1.



Note: SL-Source language; TL-Target language

Figure 3.1: Brislin method of adaptation

The initial direct translation (Step 1) from source language (English) to target language (Tamil) was done by two professional experts, one is by the Speech-Language Pathologist (Project Officer) who is a native speaker of Tamil and proficient in reading and writing the Tamil language. The other is the Linguistic (Step 2), with the affiliation of Ph. D in linguistics who is a native speaker of Tamil and proficient in reading and writing Tamil language. The translation was done in three categories as mentioned below:

1. Direct translation: English test items were translated into Tamil, retaining the semantic concepts and linguistic structure of the actual test items/stimuli.

2. Direct translation replacing concepts: Semantic concepts were replaced while maintaining the linguistic structure of the actual test items/stimuli.

3. Introduction of new words or phrases: Both the semantic concepts and linguistic structures were replaced with new phrases and words.

After the direct translation, the expert panel discussion (Step 2) was conducted to identify and replace the linguistic variations from WAB-R (English) to WAB-R (Tamil). Then, the blind back-translation was done by another Speech-language pathologist who is a native Tamil speaker (Step 3). Later, the Tamil-translated versions of WAB-R were compared with the actual WAB-R (Kertesz, 2007-English version) (Appendix B) by the SLP (Project officer) (Step 4). This comparison was necessary to investigate the linguistic and sociocultural differences between English and Tamil. After identifying the differences (errors present or absent), the back-translated WAB-R (Kertesz, 2007-English version) was adapted in Tamil. The Project officer adapted the entire WAB-R in Tamil including (1) Record Form Part 1, (2) Record Form Part 2.

In **Phase II-** The Western Aphasia Battery-Revised test in Tamil had subtests that were based on the original version WAB-R (Kertesz, 2007-English version). Under each subtest, materials were mainly translated from WAB -R (Kertesz, 2007-English version) in Tamil language as WAB-R in Tamil (Appendix C & D) and if only required to incorporate the modifications based on the socio-cultural and linguistic principles of Tamil and adhering to Indian cultural context.

Western Aphasia Battery-Revised in Tamil (version) consisted of the following sub-tests as most important to diagnose the individuals with aphasia is described below and in the

Record form 1 and Record form 2 (Appendix C & D) and the other complete domains. Record form 1 contains spontaneous speech, auditory verbal comprehension, repetition, and naming whereas Record form 2 has reading and writing, apraxia, constructional visuo-spatial, and calculations, also the supplementary reading and writing tests. Test stimuli in the form of pictures, written orthographical forms, blocks, and designs, etc are present corresponding to their respective domains as mentioned in the final test material- stimulus book (Appendix E).

The test description of Record Form 1 are as follows:

(1) Spontaneous speech:

Rationale: This task is designed to elicit conversational speech from the patient in reply to questions asked in the context of an interview and a picture description. The important aspects to be examined in spontaneous speech are the 'information content' and 'fluency'. It consisted of six questions which were mainly the translation of the original WAB-R along with a picture card. The spontaneous speech tasks were under conversation and picture description. The description of the spontaneous speech task is as follows:

a) Conversational Questions: The person had to verbally respond to six questions. (eg., name, address, occupation, and reason for being in the hospital).

b) Picture description: The person had to describe the picture given in the stimulus book.

Scoring: Information content and fluency were scored according to the rating scale which was given for Task A and B in spontaneous speech.

(2). Auditory Verbal Comprehension:

Rationale: Most of the person with aphasia have difficulties in comprehending verbal expression and intellectual functions, thus this comprehension task attempts to assess the various aspects of comprehension features at the yes/no question level, auditory word recognition level, and sequential command level. The description of the auditory-verbal comprehension is as follows:

(a) "Yes-No" Question: The patient was asked to reply or nod "Yes or "No" to 20 questions. The first nine questions were the most relevant to the patient's person.

The next five questions were related to the environment and the last six were more general in their coma', yet refrain semantically simple and short, although there was an increase in linguistic complexity requiring more comprehension of syntax, such as relational words. The use of Yes/No responses avoids to some extent the pointing difficulty or *praxis that may interfere with the other task of comprehension.

Instruction: The patient should be instructed to answer with yes or no only. If the patient continues to say an answer in sentences, the instruction should be repeated. If it is difficult to establish a consistent verbal or gestural Yes or No response. Then an eye closure for 'Yes" should be established. The instructions should be repeated, if necessary when the test is administered.

Scoring: Score-3 points for each correct answer. Should mention the responses in an appropriate column whether it is verbal, gestural, or eye blink. If the patient self-corrects, the final answer should be scored. If the response was inconsistent or ambiguous, Score-0.

(b) . Auditory Word Recognition: The patient was asked to point to an item, spoken by the examiner, from an array in the same category. Materials of this task were six objects, six-line drawings of objects, six letters, six numbers, six geometric forms, six colors, six items of wooden furniture, six body parts of the patient, five items of finger recognition, and seven of right and left orientation.

Instructions: The investigator asks the patient to point to each item by a carrier phrase as ‘point to the ___’ or ‘show me the ___’ in the order of the names of the material listed.

Scoring: Score-I point for each correct response and Score-0 for incorrect response. For the left and right discrimination, the patient must go through both the sides and body parts and provide the correct answer to acknowledge the credit.

(c) . Sequential Commands: The patient was examined for the execution of 11 oral commands which included the comprehension of syntax. The initial commands and sequences would be very simple and short to establish rapport, place the patient, and allow the examiner to understand that the patient was able to follow and is willing to perform the commands. Most of the sequential commands have the manipulation of touching one object with another. The use of prepositions, length of the sentences,

and the number of clauses were also increased based on the linguistic rules of the Tamil language.

Instruction: On the table before the patient line up the pen, comb and book in the respective order and label each. The patient was instructed to "see the pen, the comb, and the book". I will ask you to point to them and do things with them just as instructed. If the patient doesn't seem to understand the task, point with the comb to the pen, to demonstrate and start again.

Scoring: A total of 80 scores and each command has a different score based on the complexity of the tasks. Scoring was similar as given in the original WAB-R.

(3). Repetition:

Rationale: This test assesses oral agility and irregular articulatory breakdown, a test sentence that contains all the letters and a test sentence that consists specifically of short grammatical words would be used as test stimuli. The repetition was assessed using the high-frequency words by increasing length, composite words, numbers, number and word combinations, high and low probability sentences, and sentences of increasing length and grammatical complexity which was constructed based on the linguistic principles of Tamil Language.

Instruction: Ask the patient to repeat the words listed below then record the responses. The stimulus may be repeated once.

Scoring: For each recognizable word a score of 2 points is given. Minor dysarthric errors or colloquial pronunciations were scored as correct. Reduce score 1 for each incorrect word and errors in order of word sequence or each literal paraphasias (phonemic error). Similar scoring was maintained as given in the original WAB-R.

(4). Naming:

Rationale: The naming and word-finding score was important for the measurement of lexical access in persons with aphasia. Anomia and word-finding difficulty would be universal features of all types of aphasia. The four tasks to assess naming were object naming, word fluency, sentence completion, and responsive speech.

(a). Object naming: A list of twenty common prototypical objects were presented individually on visual confrontation, which should be more familiar and easily

available. The objects consisted of various categories of materials with different shapes and sizes. The patient first was asked to name the object on visual presentation and in the case of no response or incorrect response, "the patient was allowed to touch and use it and if necessary". If there is no response, the phonemic or semantic cue would be given to identify an object. A total of 20 seconds was allowed for each object.

Scoring: Scored 3 points if named correctly or with minor articulatory error, 2 points for a recognizable phonemic paraphasia, and 1 point if a phonemic or tactile cue was required.

(b) Word Fluency: It was measured by naming as many animals as the patient can in 1 minute. The patient should be prompted by being given examples at the beginning (not to be counted if the patient repeats them) and again at 30 seconds if no responses were forthcoming.

Scoring: Scored 1 point for each animal named, even presented with literal paraphasia.

(c) **Sentence completion**: It consisted 5 incomplete questions. Here the patient was asked to complete the sentence what the examiner says.

Scoring: Scored 2 points for correct responses and I point for phonemic paraphasias.

(d) Responsive speech: It consisted of 5 questions. Here the patient was asked to answer the question for what the examiner asks.

Scoring: Scored 2 points for correct responses, 1 point for phonemic paraphasias, and 0 for unreasonable responses.

The test description of Record Form 2 are as follows:

(1). Reading

Rationale: The reading tasks were designed to assess the visual-verbal function, which was also important as oral language skills in the diagnosis of aphasia. These sub-tests include 9 tasks;

(a) Reading comprehension of sentences
(b) Reading commands
(c) Written word-object choice matching
(d) Written word-picture choice matching
(e) Picture-written word choice matching
(f) Spoken word-written word choice matching
(g) Letter discrimination
(h) Spelled Word Recognition
(i) Spelling

(a). Reading comprehension of sentences: This task includes sentence completion with four-way multiple choices. There are 8 sentences, which range in complexity from 3 words to all small paragraphs of two sentences. Here the person would be instructed to read the sentences and point to the missing word using the given four choices. Instructions may be repeated if the patient does not seem to understand.

Scoring: Each correct response should be given 5 scores and incorrect would be 0.

(b). **Reading commands:** It consists of 6 commands which are increasing in length and complexity. The person has to read and do the commands which were given.

Scoring: These tasks were rated for reading aloud and for doing the commands separately. Each command has a different score based on the complexity of the task. Scoring was similar as given in the original WAB-R.

Note: If the combined score of (a) and (b) is 50 or more, discontinue reading tests.

(c). Written word-object choice matching: Here the objects are placed in a random order in front of an individual, and the person would be asked to point to the object that corresponds to the word presented on cards.

Scoring: Score 1 point for each correct response and 0 for incorrect response.

(d). Written word-picture choice matching: The picture would be placed before the person and they were instructed to point to a picture that matches the word presented individually on cards.

Scoring: Score 1 point for each correct response and 0 for incorrect response.

(e) . Picture-written word choice matching: The card which has the words listed on it is placed before the patient. The patient is then requested to point to the word that is the same as the picture. The pictures are presented individually on cards.

Scoring: Score 1 point for each correct response and 0 for incorrect response.

(f) . Spoken word-written word choice matching: The person would be presented with cards and asked to select the orally presented target word from a choice of 5 items.

Scoring: Score 1 point for each correct response.

(g) . Letter discrimination: Six individual letters would be spoken by the examiner and the person has to choose from the printed choice of six letters.

Scoring: Score 1 point for each correct response and 0 for incorrect response

(h) Spelled Word Recognition: Here the person would be asked to name the word which was spelled orally by the examiner.

Scoring: Score 1 point for each correct response and 0 for incorrect response.

(i) Spelling: Six common stimulus words are spoken. 2-7 letters in length. The Person has to spell each of them.

Scoring: Score I point for each correct response and 0 for incorrect response.

(2) Writing

Rationale: The writing tasks were designed to assess the orthographical representation, which was also important as oral language skills in the diagnosis of aphasia. These sub-tests include 7 tasks;

(a) Writing on request
(b) Writing output
(c) Writing to dictation
(d) Writing dictated words
(e) Alphabet and Numbers
(f) Dictated letters and numbers
(g) Copying a sentence

(a). Writing on request: The person would be asked to write their name and address.

Scoring: Score 1 point for each recognizable word or number. Deduct 1/2 point for each spelling mistake or paraphasic error.

(b). Writing on request: The person would be asked to write their name and address.

Scoring: score 1 point for each recognizable word or number. Deduct 1/2 point for each spelling mistake or paraphasic error.

(c). Written output: The person would be asked to write as much as he can in the sentences about the same picture that was shown for the spontaneous speech sub-test.

Scoring: Score 34 points for a full description, 8 points for each complete sentence with 6 words or more, 1 point for each correct word incomplete or short sentences. Deduct 1/2 point for each spelling or paraphasic error. Score 1 point, to a maximum of 10 points for each isolated correct word.

(d). Writing to dictation: The person would be asked to write the sentence that the examiner dictates to him. The sentence may be divided if the patient cannot remember it and parts repeated once.

Scoring: Score 10 points for the complete sentence or 1 point for each correct word. Deduct 1/2 point for each spelling mistake or paraphasic error.

(e). Alphabets and Numbers: The alphabet and serial numbers from 0 to 20 would be asked to write. *Scoring*: Score 1/2 point for each letter or number, even it was out of order. The maximum score for alphabets would be 12.5 and the maximum score for numbers was 10.

(f). Writing of dictated letters and numbers: Six letters and six numbers are dictated.

Scoring: Score 1/2 point each for correctly written letters and one for each complete number.

(h). Copying a sentence: The person would be asked to copy the sentence which was given.

Scoring: Score 1 point for each correct word, 10 points for the complete sentence. Subtract 1/2 point for each incorrect letter.

(3). Apraxia

Rationale: These tasks would help assess whether the person with aphasia was associated with apraxia or not.

Description of the tasks: There were twenty commands given to assess a person's performance on apraxia tasks. The tasks include the actions of the upper limb, buccofacial, also body parts using few instruments.

Instruction: Tell the patient "I am going to ask you to do some things, try and do them as well as, you can". If the patient fails to perform the command well, imitate the action. If this also fails, then give the patient the real object.

Scoring: The patient is scored 3 for acceptable, 2 for approximate performance, 2 for imitation only I for approximate performance on imitation or if performed with the actual object.

(4). Constructional, Visuospatial, and calculation Tasks

Rationale: This subtest has four tasks that help in assessing the problem-solving skills, visuo-spatial function, two and three-dimensional constructions as well as some non-verbal analogies. The tasks are;

(a) Drawing
(b) Block design
(c) Calculation
(d) Raven's Coloured Progressive Matrices

(a). Drawing: The person would be asked to draw a circle, square, tree, cube, clock, house, and person, and also to bisect a line (to quantitative visuospatial neglect).

Scoring: Each diagram has a different score based on the complexity of the tasks. Scoring was similar as given in the original WAB-R. Also, it considers

completeness, perspective, and quality and penalizes perseveration, disconnected lines, inappropriate angles, and neglect in the diagram.

(b). Block Design: Wechsler's Intelligence Scale Bloch Design (Koh's Blocks) would be used to check for designing the blocks based on the picture which was given.

Instruction: The person would be asked to design the four blocks just like the picture which was given. If the person didn't understand the tasks, the examiner should demonstrate and show them how to replicate them.

Scoring: Score 3 for correct design within 60 seconds, Score 2 points for correct design with extra time, 1 point for putting the blocks together and try, 0 for no response or not made an attempt.

(c). Calculation: The calculation task contains one or two-digit numbers and 3 items for each of addition, subtraction, multiplication, and division. These tasks would be presented visually on cards as well as the examiner speaking the numbers and requested arithmetical operations.

Scoring: Score I point for each correct response and 0 for incorrect response.

(d). Raven's Coloured Progressive Matrices: This is used to assess visuospatial functions and nonverbal intelligence.

Instruction: There were three sets A, AB, and B with different patterns. The person would be asked to look at the pattern with a missed piece and provide them with six choices of different patterns to find out which one would be going with the missing part.

Scoring: Score I point for each correct response and 0 for incorrect response. If all the three sets were finished in less than 5 minutes then a bonus of 1 point should be given.

(5) Supplementary reading and writing

Rationale: The reading and writing irregular words and Non-words supplementary tasks were designed to assess various alexias and agraphia in persons with aphasia. It probe to

find out surface dyslexia, deep (phonological) dyslexia, and visual dyslexia. *Description of the tasks***:** It consists of four subtests;

(a) Writing irregular words to Dictation
(b) Writing non-words to Dictation
(c) Reading Irregular words
(d) Reading Non-words

(a). Writing Irregular words to dictation: The person would be instructed to write the list of 10 irregular words which was dictated by an examiner. If the person does not respond to five consecutive items and the test should be aborted.

Scoring: For each correct response, 1 score and incorrect response 0 scores should be given.

(b). Writing Non-words to dictation: The person would be instructed to write the list of 10 non-words which was dictated by an examiner. If the person does not respond to five consecutive items and the test should be discontinued.

Scoring: For each correct response, 1 score and incorrect response 0 scores should be given.

(c). Reading irregular words: The person would be instructed to read the list of 10 irregular words which was presented by an examiner. If the person does not respond to five consecutive items and the test should be aborted.

Scoring: For each correct response, 1 score and incorrect response 0 scores should be given.

(d). Reading Non-words: The person would be instructed to read the list of 10 non-words that was presented by an examiner. If the person does not respond to five consecutive items and the test should be discontinued.

Scoring: For each correct response, 1 score and incorrect response 0 scores should be given.

3.5.1.4 Content Validation of the developed and adapted WAB-Revised (English Version) to the Tamil language

After, the preparation of the test in the Tamil language, the test material was subjected for content validity by the five speech-language pathologists who were native speakers of Tamil, proficient in reading and writing Tamil, and who have at least two years of experience as a Speech-Language Pathologist. The rating of stimuli was carried out in two phases. The test stimuli were rated in the initial phase and in the second phase, the picture cards used in the test material were rated. the 5 point rating Likert scale (4-Absolutely Appropriate;3-Appropriate; 2-Slightly Appropriate; 1-Inappropriate; 0-Absolutely inappropriate). The picture cards were also rated with a similar 5 point rating based on respect to the size of the picture, color and appearance, arrangement, and iconicity.

3.5.1.5 Validation of the developed and adapted WAB-Revised (English Version) to the Tamil language on clinical population and neurotypical individuals

The Tamil Western Aphasia Battery-Revised test material was used to assess the language aspects in a clinical population involving individuals with aphasia and on neuro-typical individuals. The cultural and linguistic adaptations of the test was done and the method of test administration was maintained. Tamil version of WAB-R was administered on two groups (60 neuro-typical individuals and 77 individuals with aphasia) who were native speakers of Tamil and were also able to read and write Tamil.

To validate the developed test tool on neuro-typical individuals, both the WAB-R and Tamil WAB-R were administered to 30 neuro-typical individuals. These participants were between the age range of 30 and 70. All the participants had been exposed to English and Tamil since five years of age and had received formal instruction in English and Tamil for at least 10 years in school. None of the participants had any sensory, motor, cognitive, or language impairment, and they belonged to the middle socioeconomic strata. During testing, the WAB-R and the Tamil WAB-R were administered with a gap of one week between each test. The responses to each were recorded and the results yielded the validity of the test items.

To validate the developed test tool on individuals with aphasia, the administration process involved a semi-structured interview during the test procedures that solicited information regarding their (individuals with aphasia) post morbid status, language abilities (comprehension, expression, naming, reading, and writing skills) of the participants involved in the present study. The scores from all the sub-tests obtained for the participants on Tamil

WAB-R (administered by a Speech-Language Pathologist) were tabulated and considered for interpretation. Further, the scores were coded and then subjected to statistical analysis.

CHAPTER IV

RESULTS

Contents

The present study was a retrospective study that aimed to establish the clinical data on the Tamil Version of Western Aphasia Battery-Revised (WAB-R Tamil). The participants considered were, 60 neuro-typical individuals with Tamil as their mother tongue, and 77 individuals with different types of aphasia. To provide, normative and clinical data on WAB-R Tamil, the mean, median, and standard deviation were calculated in all the controls as well as in four categories of aphasia: (1) Brocas aphasia (2) Wernicke's aphasia (3) Global aphasia (4) Anomic aphasia. The present study also aimed to compare the performance between neurotypical individuals (NTA) and persons with aphasia (PWA) on the WAB-R Tamil version. This study also established age, gender, and aphasia type comparison on all the tasks of WAB-R Tamil. The validation of the Tamil version of WAB-R with the original version of WAB-R was conducted and it was administered on 30 Bilingual normal individuals who were native speakers of Tamil with the knowledge of English, Hindi, or any other language and were able to read and write Tamil.

4.1 Intra rater Test re-test Reliability Measures Using Cronbach's Alpha Co-Efficient

There were 10 participants from the control group (neuro-typical individuals- NTA) and 10 from the clinical group (persons with aphasia- PWA) who were subjected to the language assessment using the newly developed tool of Western Aphasia Battery-Revised in Tamil and the qualitative ratings of Performance in Spontaneous Speech and quantitative ratings for Auditory verbal comprehension, Repetition, Naming, AQ Scores, Reading, Writing, LQ Scores, Apraxia, Visuo-spatial skills & Calculations, CQ Scores, and Supplemental reading & writing scores were rated by the Research Officer. This assessment was repeated to the same participants within three weeks of interval. The scores obtained from the pre-assessment and three weeks post-interval assessments were subjected to intra judge reliability tests using Cronbach's Alpha Reliability tests and were performed separately for individuals with an Aphasic group and a neuro-typical group. Thus, the reliability

measures were carried out using Cronbach's alpha coefficient for the qualitative analysis of the WAB-R Tamil Scores. The results of Cronbach's Alpha coefficient for parameters related to qualitative analysis using 'Western Aphasia Battery-Revised in Tamil' for all the tasks in neuro-typical individuals as well as individuals with aphasia are represented in the following Table 4.1. Both the groups showed >0.7 scores on these reliability measures for all the tasks in WAB-R Tamil. This suggested that the data was reliable for the qualitative analysis. Hence, the performance on WAB-R Tamil by the neurotypical individuals and individuals with aphasia has good reliability and it ensures that the scores from the qualitative analysis of Western Aphasia Battery Revised in Tamil were considered for further statistical analysis.

Table 4.1: *Cronbach's Alpha coefficient for parameters related to qualitative analysis of Sub-tests scores of Group I (NTA) and Group II (PWA)*

Sub tests	NTA	PWA
Spontaneous speech	0.98	0.96
Auditory comprehension	0.98	0.97
Repetition	0.86	0.97
Naming	0.96	0.95
Reading	0.88	0.94
Writing	0.89	0.99
Apraxia	0.79	0.75
Constructional, Visuospatial and calculation	0.89	0.88
Supplemental reading and writing	0.79	0.99
Aphasia Quotient	0.87	0.98
Cortical Quotient	0.82	0.98
Language Quotient	0.86	0.99

The major findings and the objectives of the study are explained under three sections, S*ection A- Qualitative measures of WAB-R Tamil, Section-B- Quantitative measures of WAB-R Tamil, and Section-C-Validation of Subtests in WAB-R Tamil to WAB-R English using Qualitative and Quantitative measures.*

4.2 Section A- Qualitative measures of WAB-R Tamil

Section-A represents qualitative measures, Step I- Descriptive statistics (mean, standard deviation, and median) of neurotypical individuals and persons with aphasia on subtests of Western Aphasia Battery-Revised in Tamil. These qualitative measures were applied to normality checks before appearing for further comparison. Shapiro Wilks test was

administered to check whether the data follow the normal distribution. As the data did not follow the normal distribution further Non-Parametric tests were employed for the analysis. Step- II- The comparison of performance between individuals with aphasia and neuro-typicals was done using the Mann-Whitney U test for each age group. The same is represented in a flow chart in Figure 4.1.

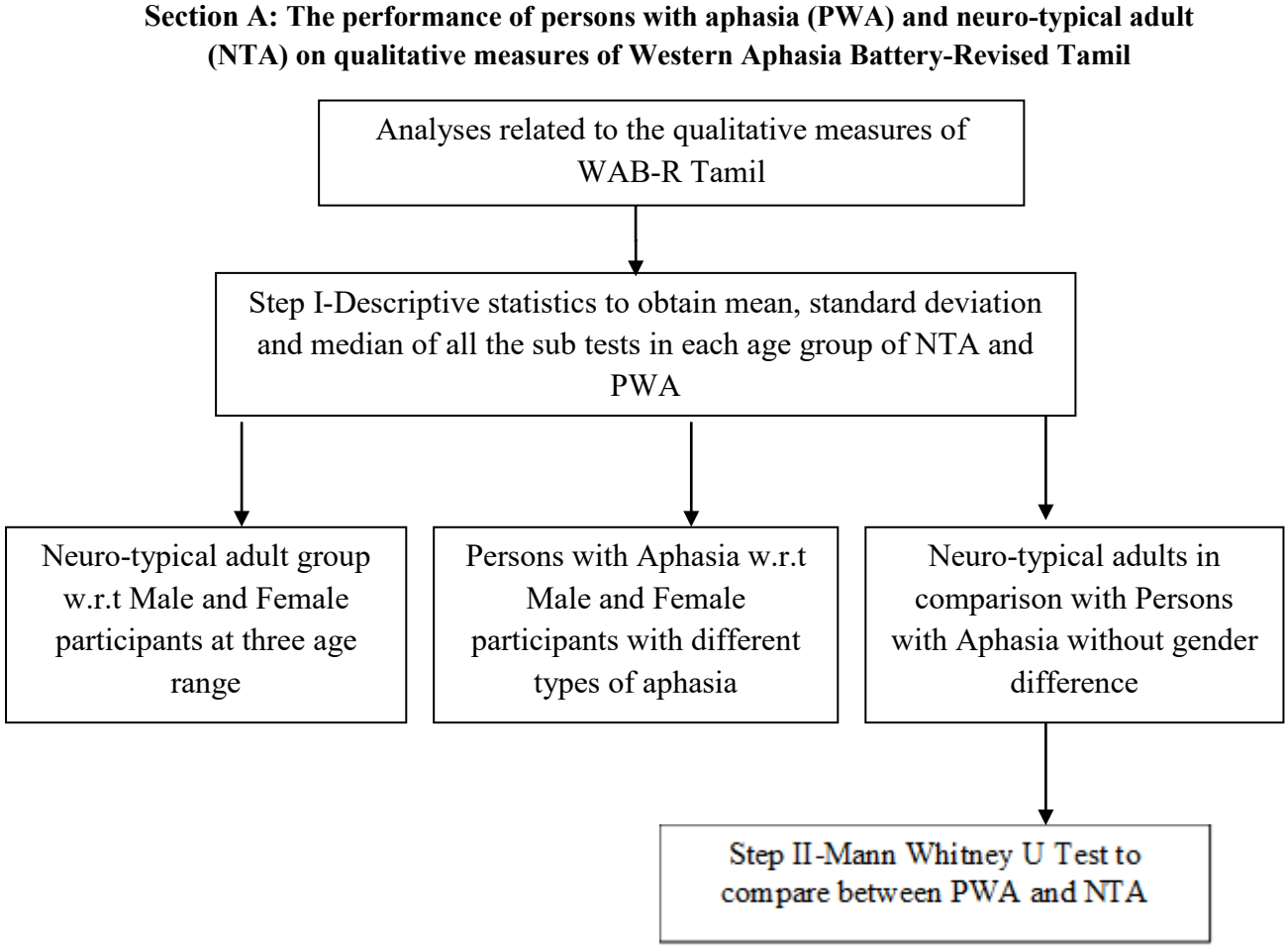


Figure 4.1: Statistical analysis employed for the qualitative measures of sub-tests of Western Aphasia Battery-Revised in Tamil for PWA and NTA

4.3 Section-B- Quantitative measures of WAB-R Tamil

The subsections of Section B are the quantitative measures with respect to subtests of Western Aphasia Battery-Revised in two languages (Tamil and English). Step I- The normality check was done using the Shapiro-Wilks test and Step II- The comparison was done

at the level of sub-tests between males and females within each age group using Mann Whitney U test. The effect of age on all the sub-tests of WAB-R Tamil was analyzed by the comparison among three age groups in males and females separately using the Kruskal Wallis test under Step-III. Later in Step- IV, the pair-wise comparisons were done between the two age groups using the Mann-Whitney U test to study the differences between the age groups with respect to gender. The same is represented in a flow chart in Figure 4.2.

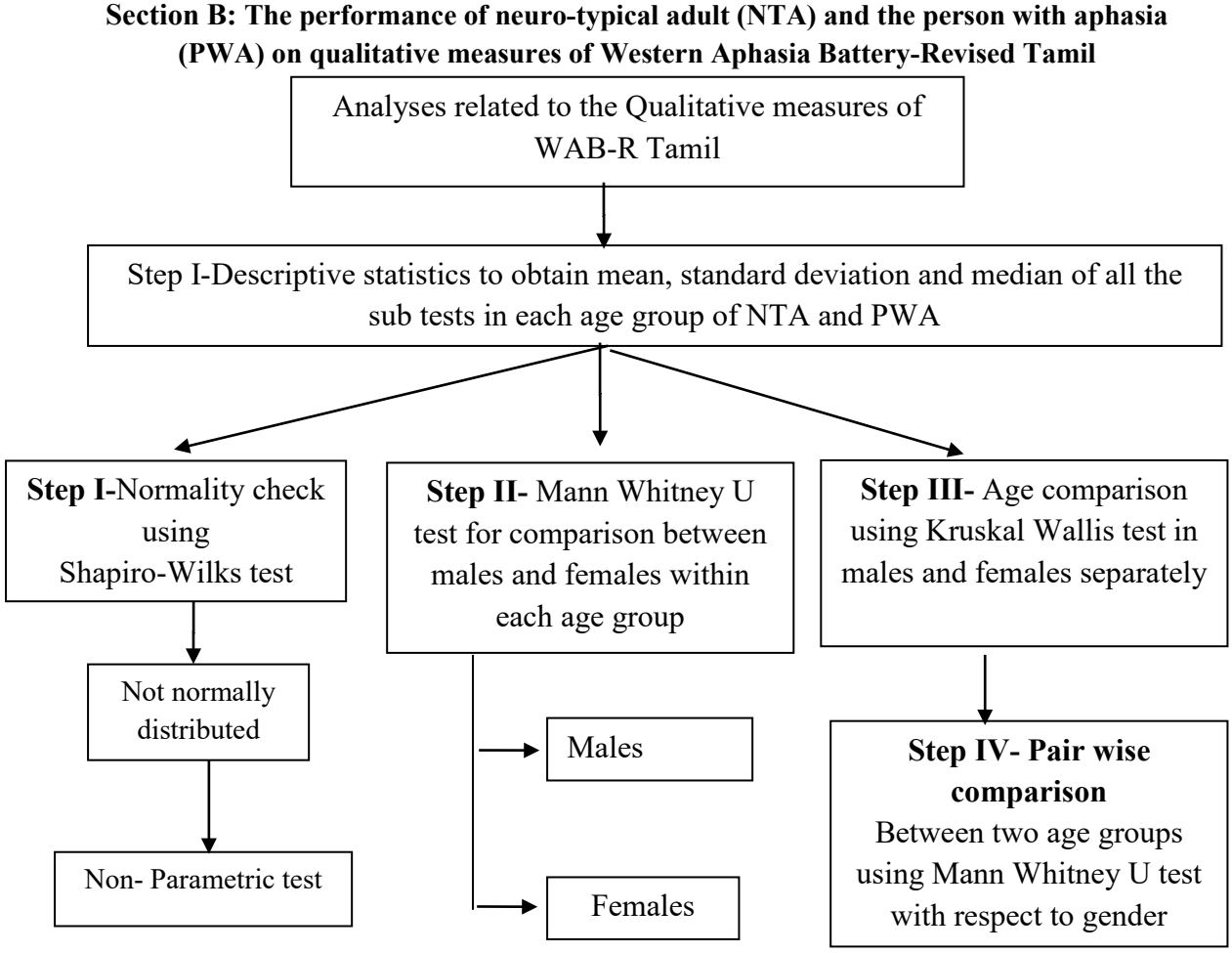


Figure 4.2. Statistical analysis employed for the within-group comparison of NTA and PWA on qualitative measures using Western Aphasia Battery-Revised in Tamil

4.4 Section-C- Validation of the Western Aphasia Battery-Revised in Tamil by the comparison and correlation between WAB-R Tamil and English

Section C represents qualitative measures, Step I- Descriptive statistics (mean, standard deviation, and median) of bilingual neurotypical individuals on all the sub-tests in WAB-R Tamil and English. In Step II- Mann Whitney U test was done to study the differences between the performances of bilingual neuro-typical individuals on Western Aphasia Battery-Revised Tamil and English among all the sub-tests. Finally in Step III- the correlation analysis was made using Spearman's coefficient to strengthen the overall validity of the newly adapted test tool Western Aphasia Battery-Revised in Tamil. The same is represented in a flow chart in Figure 4.3.

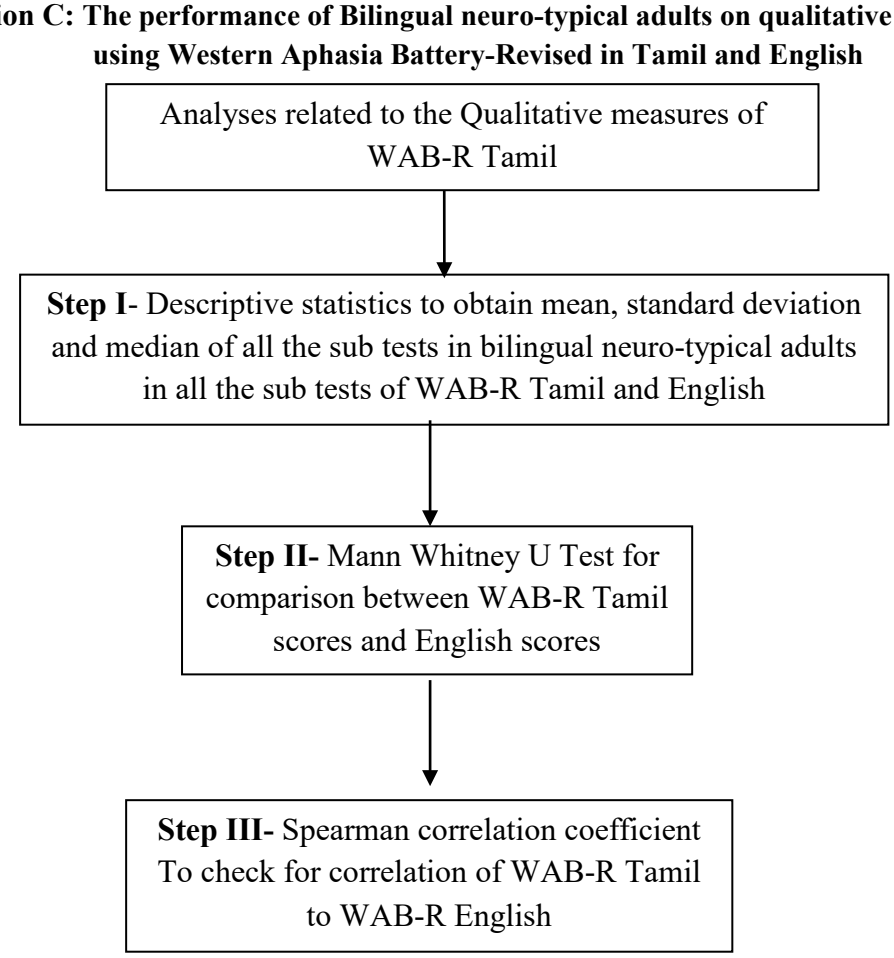


Figure 4.3. Statistical analysis employed for the comparison and correlation of WAB-R Tamil and English among all the sub tests

4.2. Section A- Qualitative measures of Western Aphasia Battery Revised in Tamil

4.2.1 Sub-section I: Mean and Standard Deviation of different parameters in neurotypicals with different age range with reference to male and female participants.

The results of descriptive statistics in terms of mean, median, a standard deviation of **Record Form-1 (WAB-R Tamil Version)** spontaneous speech, auditory verbal comprehension, repetition, and naming for three different age groups of neuro-typical individuals with reference to the gender male and females are shown in Table 4.2. Group-A age ranging 30-40 years, Group-B age ranging 41-60 years, and Group-C age ranging 61-70 years with reference to male neuro-typical individuals. Similarly with reference to female neuro-typicals with the age range of 30-40 years were in Group-a, 41-60 in Group-b, and 61-70 in Group-c.

The results of the descriptive statistics show that the Mean and Median scores of tasks (performance) in Record form-1 (WAB-R Tamil version) under 'spontaneous speech', 'auditory verbal comprehension', 'repetition' and 'naming' with reference to the male participants was slightly reduced for 'spontaneous speech-total' and 'auditory verbal comprehension-total' in Group-C compared to Group-A and Group-B. For 'Repetition-total', Group-A was lesser compared to Group-C followed by Group-B. With reference to 'naming-total', Group-B was lesser than Group-C followed by Group-A.

With reference to female participants, the Mean and Median scores of tasks in Record form-1 (WAB-R Tamil version) were reduced for 'spontaneous speech-total' and 'auditory verbal comprehension-total' in Group-c compared to Group-b and Group-a. For 'repetition-total', there was a relatively reduced performance by Group-b, Group-c, and Group-a and for 'naming-total', there was a relatively reduced performance by Group-b, Group-a, and Group-c. The median values showed the maximum to all the tasks in the Record form 1 for both males and females, respectively across three different age groups.

The results of descriptive statistics in terms of mean, median, a standard deviation of **Record Form-2 (WAB-R Tamil Version)** consisting of Reading and Writing tasks for three different age groups of neuro-typical individuals with reference to the gender Male and Females are shown in Table 4.3. The Mean and Median scores of 'Reading- total' is reduced in Group B, followed by Group C and Group A with reference to male participants and female participants. The Mean and Median scores of 'Writing-total' are reduced in Group-b,

followed by Group-a and Group-c for male participants, and for female participants, there is a reduced score in Group-a followed by Group-c and Group-b.

The results of descriptive statistics in terms of mean, median, a standard deviation of **Record Form-2 (WAB-R Tamil Version)** consisting of Apraxia, Constructional, Visuospatial and Calculation and Supplemental Writing and Reading for three different age groups of neuro-typical individuals with reference to the gender male and females are shown in Table 4.4. The Mean and Median scores of the 'Apraxia assessment' are the same with reference to gender and age range of neuro-typical individuals. Following the apraxia assessment, the scores corresponding to the 'Constructional, Visuospatial and Calculation-total' Group- C had relatively reduced scores compared to Group-A and Group-B for male participants. With reference to female participants, the 'constructional, visuospatial and calculation- total' score was reduced for Group-c, followed by Group-a and Group-b. Finally, with reference to 'Supplemental Writing and Reading assessment,' Group-B had a reduced score compared to Group- C and Group-A of male participants. With reference to female participants, Group-b has a reduced score compared to Group-a and Group-c.

To summarize the descriptive statistic at the level of 'Aphasia Quotient- Total' of male neurotypical individuals had relatively reduced Mean and Median for Group-C followed by Group-A and Group-B and for female neurotypical individuals the Mean and Median was reduced for Group-c followed by Group-b and Group-a. With reference to 'Cortical Quotient-Total' of male neurotypical individuals, Group- C was relatively reduced compared to Group-B and Group-A. For the same cortical quotients, the female neurotypical individuals had relatively reduced scores for Group-b followed by Group-c and Group-a. Finally, the 'Language Quotient Total' showed a reduced score for Group- B followed by Group-C and Group-A for male neurotypicals, and for female neurotypicals, the reduced score was for Group-c followed by Group-b and Group-a.

Table 4.2: Mean, Median, and Standard Deviation for the task in the Record Form-1-Spontaneous speech, auditory verbal comprehension, Repetition, Naming in neurotypicals of three different age groups

Record Form-1	**Group I- Neurotypicals- Male Participants**									**Group I- Neurotypicals –Female Participants**								
	Group-A (30-40)			Group-B (41-60)			Group-C (61-70)			Group-a (30-40)			Group –b (41-60)			Group – c (61-70)		
Parameters	Mean	S.D	Median	Mean	S.D	Median	Mean	S.D	Median	Mean	S.D	Median	Mean	SD	Median	Mean	SD	Median
Spontaneous Speech (SP)																		
Information Content	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00
Fluency	10.00	0.00	10.00	10.00	0.00	10.00	9.80	0.42	10.00	10.00	0.00	10.00	10.00	0.00	10.00	9.75	0.63	10.00
SP-TOTAL	**20.00**	**0.00**	**20.00**	**20.00**	**0.00**	**20.00**	**19.80**	**0.42**	**20.00**	**20.00**	**0.00**	**20.00**	**20.00**	**0.00**	**20.00**	**19.75**	**0.63**	**20.00**
Auditory Verbal Comprehension (AVC)																		
Yes-No questions	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00
Auditory Word Recognition	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00
Sequential Commands	78.60	1.95	80.00	78.80	2.30	80.00	78.00	1.63	78.00	80.00	0.00	80.00	78.80	2.57	80.00	77.20	2.93	78.00
AVC-TOTAL	**9.93**	**0.09**	**10.00**	**9.94**	**0.11**	**10.00**	**9.90**	**0.08**	**9.90**	**10.00**	**0.00**	**10.00**	**9.94**	**0.12**	**10.00**	**9.86**	**0.14**	**9.90**
Repetition (R)																		
R- TOTAL	**9.89**	**0.28**	**10.00**	**9.99**	**0.03**	**10.00**	**9.97**	**0.09**	**10.00**	**10.00**	**0.00**	**10.00**	**9.93**	**0.09**	**10.00**	**9.97**	**0.06**	**10.00**
Naming (N)																		
Object Naming	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00	60.00	0.00	60.00
Word Fluency	20.00	0.00	20.00	19.50	0.70	20.00	19.70	0.94	20.00	20.00	0.00	20.00	19.70	0.67	20.00	20.00	0.00	20.00
Sentence Completion	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00
Responsive Speech	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00
N-TOTAL	**10.00**	**0.00**	**10.00**	**9.95**	**0.07**	**10.00**	**9.97**	**0.09**	**10.00**	**10.00**	**0.00**	**10.00**	**9.97**	**0.06**	**10.00**	**10.00**	**0.00**	**10.00**

Table 4.3: Mean, Median, and Standard Deviation for the task in the Record Form-2- reading and writing tasks in neuro-typicals of three different age group

Record Form-2 Parameters	Group I- Neurotypicals- Male Participants									Group I- Neurotypicals –Female Participants								
	Group-A (30-40)			Group-B (41-60)			Group-C (61-70)			Group-a (30-40)			Group –b (41-60)			Group – c (61-70)		
	Mean	S.D	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Reading																		
Comprehension of Sentence	40.00	0.00	40.00	36.80	2.97	36.00	38.20	1.98	38.50	40.00	0.00	40.00	36.40	3.37	36.00	37.80	2.39	38.50
Reading Commands	20.00	0.00	20.00	20.00	0.00	20.00	20.00	0.00	20.00	20.00	0.00	20.00	20.00	0.00	20.00	20.00	0.00	20.00
Written word choice matching	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	20.00	0.00	20.00	20.00	0.00	20.00	20.00	0.00	20.00
Written word-picture choice matching	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00
Picture -written word choice matching	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00
Spoken word-written choice matching	4.00	0.00	4.00	4.00	0.00	4.00	4.00	0.00	4.00	4.00	0.00	4.00	4.00	0.00	4.00	4.00	0.00	4.00
Letter Discriminition	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00
Spelled word recognition	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00
Spelling	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00
READING TOTAL	**20.00**	**0.00**	**20.00**	**19.36**	**0.59**	**19.20**	**19.64**	**0.39**	**19.70**	**20.00**	**0.00**	**20.00**	**19.40**	**0.60**	**19.40**	**19.56**	**0.47**	**19.70**
Writing																		
Writing upon request	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00	6.00	0.00	6.00
Writing output	33.45	1.06	34.00	32.80	1.53	33.50	33.50	0.70	34.00	33.35	0.94	34.00	33.95	0.15	34.00	33.40	1.07	34.00
Writing to dictation	9.80	0.48	10.00	9.80	0.63	10.00	10.00	0.00	10.00	9.70	0.53	10.00	10.00	0.00	10.00	10.00	0.00	10.00
Writing dictated words	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00
Alphabet and Numbers	22.50	0.00	22.50	22.50	0.00	22.50	22.50	0.00	22.50	22.50	0.00	22.50	22.50	0.00	22.50	22.50	0.00	22.50
Dictated Letters and Numbers	7.50	0.00	7.50	7.50	0.00	7.50	7.50	0.00	7.50	7.50	0.00	7.50	7.50	0.00	7.50	7.50	0.00	7.50
Coping a sentence	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00
WRITING TOTAL	**19.85**	**0.24**	**20.00**	**19.72**	**0.39**	**19.90**	**19.90**	**0.14**	**20.00**	**19.81**	**0.24**	**19.95**	**19.99**	**0.03**	**20.00**	**19.88**	**0.21**	**20.00**

Table 4.4: Mean, Median, and Standard Deviation for the task in the Record Form-2 – Apraxia, constructional, visuospatial and calculation and supplemental writing and reading in neurotypicals of three different age groups

GROUP I- NEUROTYPICALS Record Form-2 Parameters	**MALE PARTICIPANTS**									**FEMALE PARTICIPANTS**								
	Group-A (30-40)			Group-B (41-60)			Group-C (61-70)			Group-a (30-40)			Group –b (41-60)			Group – c (61-70)		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Apraxia																		
Apraxia	**10.00**	**0.00**	**10.00**	**10.00**	**0.00**	**10.00**	**10.00**	**0.00**	**10.00**	**10.00**	**0.00**	**10.00**	**10.00**	**0.00**	**10.00**	**10.00**	**0.00**	10.00
Constructional, Visuospatial and Calculation (CVC)																		
Drawing	30.00	0.00	30.00	29.10	1.52	30.00	30.00	0.00	30.00	30.00	0.00	30.00	29.90	0.31	30.00	29.40	1.07	30.00
Block Design	7.50	2.55	9.00	7.80	2.09	9.00	5.70	2.21	6.00	7.80	2.09	9.00	7.80	1.54	9.00	4.50	2.12	6.00
Calculation	24.00	0.00	24.00	23.80	0.42	24.00	24.00	0.00	24.00	24.00	0.00	24.00	23.80	0.42	24.00	24.00	0.00	24.00
Raven's Coloured Progressive Matrices	35.80	2.89	37.00	36.60	0.69	37.00	35.50	1.90	36.50	36.00	1.70	37.00	36.90	0.31	37.00	36.30	1.25	37.00
CVC TOTAL	**9.73**	**0.51**	**10.00**	**9.73**	**0.35**	**10.00**	**9.52**	**0.39**	**9.65**	**9.78**	**0.31**	**10.00**	**9.84**	**0.19**	**9.95**	**9.42**	**0.36**	**9.40**
Supplemental Writing and Reading (SWR)																		
Writing Irregular Words to Dictation	9.50	0.52	9.50	9.00	0.66	9.00	9.60	0.51	10.00	9.20	0.78	9.00	9.50	0.52	9.50	9.70	0.48	10.00
Writing Non-Words to Dictation	10.00	0.00	10.00	9.60	0.69	10.00	9.80	0.42	10.00	10.00	0.00	10.00	9.40	0.69	9.50	9.90	0.31	10.00
Reading Irregular Words	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00
Reading Non-Words	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00
SWR TOTAL	**39.50**	**0.52**	**39.50**	**38.60**	**0.96**	**38.50**	**39.40**	**0.69**	**39.50**	**39.20**	**0.78**	**39.00**	**38.90**	**1.10**	**39.00**	**39.60**	**0.51**	**40.00**

Table 4.5: Mean, Median, and Standard Deviation of Aphasia Quotient, Cortical Quotient and Language Quotient for neurotypical individuals grouped under male and female participants

GROUP I- NEUROTYPICALS WAB-R Tamil Score Summary	**MALE PARTICIPANTS**									**FEMALE PARTICIPANTS**								
	Group-A (30-40)			**Group-B (41-60)**			**Group-C (61-70)**			**Group-a (30-40)**			**Group –b (41-60)**			**Group – c (61-70)**		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Aphasia Quotient	99.64	0.71	100.00	99.76	0.35	100.00	99.28	1.07	99.80	100.0	0.00	100.00	99.68	0.50	99.90	99.16	1.43	99.80
Cortical Quotient	99.40	0.64	99.50	99.09	0.78	99.35	98.83	1.04	99.15	99.68	0.41	99.87	99.31	0.74	99.50	98.58	1.21	99.05
Language Quotient	99.60	0.61	99.85	98.90	0.87	98.75	99.08	0.89	99.35	99.81	0.24	99.95	99.17	0.86	99.20	98.88	1.20	99.35

4.2.2 Sub-section II: Mean and Standard Deviation of different parameters for different type of aphasia with reference to male and female participants

The results of the descriptive statistics show that the Mean and Median scores of tasks (performance) in **Record form-1 (WAB-R Tamil version)** under 'Spontaneous Speech-Total', 'Auditory Verbal Comprehension- Total', 'Repetition- Total' and 'Naming- Total' with reference to the male and female participants with the diagnosis of aphasia was reduced when compared to neurotypical individuals. The Mean and Median scores of participants with different aphasia types like Persons with Broca Aphasia (PBA), Persons with Wernicke's Aphasia (PWA), Persons with Global Aphasia (PGA), and Persons with Anomic Aphasia (PAA) is represented in Table 4.6. From the table, it is observed that the PAA had better performance followed by PWA, PBA, and PGA for the 'Spontaneous Speech' assessment of the WAB-R Tamil version. Under 'Auditory Verbal Comprehension assessment', the better performance was by PAA, PBA, PWA, and PGA. The performance was very poor for 'Repetition Assessment' by PGA, PBA, PWA and better performance by PAA. Finally with reference to 'Naming Assessment', the performance was relatively better in PAA and very poor in PWA, PGA, and PBA. With reference to gender, the PAA showed no difference whereas the PBA, PWA, and PGA showed the difference in their Mean and Median value.

The results of descriptive statistics in terms of mean, median, a standard deviation of **Record Form-2 (WAB-R Tamil Version)** consisting of Reading and Writing tasks for male and female participants with the diagnosis of aphasia was reduced when compared to the neurotypical individuals. The Mean and Median scores of 'Reading- total' and Writing-total of different type of aphasia is represented in Table 4.7. With reference to the 'Reading-Total', the performance of PBA was better and for PAA, PWA, and PGA the scores are very poor in both male and female participants with a similar trend. And the scores for 'Writing-Total' were better for PAA compared to PBA, PWA, and PGA, where the male and female participants both have very poor Mean and Median scores with a similar trend.

The Mean, Median, and the Standard Deviation scores for the assessment of Apraxia, Constructional, Visuospatial and Calculation and Supplemental Writing and Reading of individuals with aphasia of different types by considering male and female participants are represented in Table 4.8. The Mean and Median scores of the 'Apraxia assessment- Total'

was very poorer for all the type of aphasia but participants in the sub-group of PAA was relatively better compared to PBA, PWA, and PGA. With reference to 'Constructional, Visuospatial and Calculation- total' there was better performance by PAA and very poor performance by PWA, PBA, and PGA. Finally for 'Supplemental Writing and Reading Assessment-Total' there was no response for PGA and better responses for PAA and poorer scores for PWA and PBA. To summarized the male and female participants had a similar trend of response.

The summary of the descriptive statistic at the 'Aphasia Quotient-Total, 'Cortical Quotient- Total' and 'Language Quotient- Total' of neurotypical individuals with three different age range grouped under male (Group- A, B, C) and female (Group- a, b, c) gender is given in Table 4.5. From the table, at the level of 'Aphasia Quotient- Total,' the male neurotypical individuals had relatively reduced Mean and Median for Group-C followed by Group-A and Group-B and for female neurotypical individuals the Mean and Median was reduced for Group-c followed by Group-b and Group-a. With reference to 'Cortical Quotient-Total' of male neurotypical individuals, Group- C was relatively reduced compared to Group-B and Group-A. For the same cortical quotients, the female neurotypical individuals had relatively reduced scores for Group-b followed by Group-c and Group-a. Finally, the 'Language Quotient Total' showed a reduced score for Group- B followed by Group-C and Group-A for male neurotypicals, and for female neurotypicals, the reduced score was for Group-c followed by Group-b and Group-a.

The summary of the descriptive statistic at the 'Aphasia Quotient-Total, 'Cortical Quotient- Total' and 'Language Quotient- Total' of individuals with aphasia grouped under a different type of aphasia under male and female gender is given in Table 4.9. From the table, with reference to PBA, the female participants had higher Mean and Median values for the 'Aphasia Quotient' and 'Cortical Quotient' and had a similar score for 'Langauge Quotient' with no difference in gender. For PWA and PAA, the performance of male participants was better than female participants at 'Aphasia Quotient', 'Cortical Quotient' and 'Language Quotient'. For PGA, the performance of female participants was better than male participants at 'Aphasia Quotient', 'Cortical Quotient', and 'Language Quotient'.

Table 4.6: Mean, Median, and Standard Deviation for Record Form-1 Spontaneous speech, Auditory Verbal Comprehension, Repetition, Naming of individuals with aphasia- Male and Female Participants

Group II- Persons with Aphasia Record Form-1 Parameters	**Persons with Broca's Aphasia (PBA)**			**Persons with Wernicke's Aphasia (PWA)**			**Persons with Global Aphasia (PGA)**			**Persons with Anomic Aphasia (PAA)**		
	Mean	S.D	Median	Mean	S.D	Median	Mean	S.D	Median	Mean	S.D	Median
MALE PARTICIPANTS												
Spontaneous Speech (SP)												
Information Content	1.21	1.01	1.00	5.33	1.21	5.50	0.25	0.46	0.00	6.33	2.16	6.50
Fluency	0.66	0.67	1.00	3.33	1.36	3.00	1.00	0.53	1.00	3.67	0.81	3.50
SP-TOTAL	**1.83**	**1.33**	**1.00**	**8.50**	**2.16**	**8.00**	**1.25**	**0.88**	**1.00**	**10.00**	**2.00**	**10.00**
Auditory Verbal Comprehension (AVC)												
Yes-No questions	49.38	10.46	50.00	12.17	4.16	12.00	2.00	1.60	2.00	57.50	4.32	59.50
Auditory Word Recognition	51.62	7.69	54.00	6.00	2.96	5.50	2.50	1.92	2.00	54.33	7.17	57.00
Sequential Commands	69.83	5.70	70.00	4.50	3.01	4.00	1.88	1.88	1.00	75.17	3.25	75.00
AVC- TOTAL	**8.52**	**1.00**	**8.80**	**1.13**	**0.47**	**1.10**	**0.32**	**0.20**	**0.35**	**9.48**	**0.44**	**9.58**
Repetition (R)												
R- TOTAL	**0.79**	**0.85**	**0.30**	**2.48**	**0.53**	**2.35**	**0.65**	**0.41**	**0.55**	**9.17**	**0.57**	**9.40**
Naming (N)												
Object Naming	0.97	0.73	1.00	15.00	3.68	15.00	2.25	1.38	2.00	28.50	8.33	29.50
Word Fluency	0.86	0.74	1.00	4.33	1.63	4.50	1.38	1.50	1.00	11.50	2.16	11.00
Sentence Completion	1.14	0.95	1.00	3.50	1.37	3.50	1.13	1.35	1.00	4.33	0.81	4.50
Responsive Speech	1.03	0.90	1.00	1.17	0.40	1.00	2.00	2.97	1.50	2.83	1.16	2.50
N-Total	**0.40**	**0.18**	**0.40**	**2.40**	**0.37**	**2.45**	**0.68**	**0.56**	**0.65**	**4.72**	**0.83**	**4.65**
FEMALE PARTICIPANTS												
Spontaneous Speech (SP)												
Information Content	1.93	0.73	2.00	5.33	1.52	5.00	0.43	0.78	0.00	5.25	1.70	5.50
Fluency	0.64	0.63	1.00	3.00	2.00	3.00	1.14	1.06	1.00	4.00	2.16	3.50
SP-TOTAL	**2.57**	**1.15**	**3.00**	**8.33**	**0.57**	**8.00**	**1.57**	**1.27**	**1.00**	**9.25**	**0.95**	**9.50**
Auditory Verbal Comprehension (AVC)												
Yes-No questions	47.14	8.66	46.00	12.33	4.50	12.00	3.29	1.11	3.00	56.50	5.06	58.50
Auditory Word Recognition	45.43	9.00	45.00	8.00	6.00	8.00	3.00	1.41	3.00	50.25	5.56	52.50
Sequential Commands	58.50	11.40	60.00	6.33	4.16	5.00	4.71	3.30	5.00	72.50	5.19	71.00
AVC- TOTAL	**7.55**	**1.37**	**7.63**	**1.33**	**0.61**	**1.50**	**0.54**	**0.24**	**0.55**	**8.96**	**0.24**	**9.08**
Repetition (R)												
R- TOTAL	**2.09**	**1.49**	**1.50**	**1.90**	**0.43**	**2.10**	**0.70**	**0.42**	**0.70**	**6.25**	**3.91**	**7.95**
Naming (N)												
Object Naming	2.29	1.20	2.00	11.33	3.05	12.00	1.71	0.95	1.00	24.75	12.20	25.00
Word Fluency	3.21	2.04	3.00	6.67	1.52	7.00	2.00	1.00	2.00	12.00	4.54	11.50
Sentence Completion	2.00	1.51	2.00	3.67	1.52	4.00	2.00	1.15	2.00	5.00	1.41	5.50
Responsive Speech	1.71	1.97	1.00	2.00	0.00	2.00	3.71	3.14	2.00	3.50	1.00	4.00
N-Total	**0.92**	**0.35**	**0.90**	**2.37**	**0.58**	**2.60**	**0.94**	**0.45**	**0.70**	**4.53**	**1.86**	**4.60**

Table 4.7: Mean, Median, and Standard Deviation for Record Form-2-Reading and Writing of persons with aphasia- Male and Female Participants

Group II- Persons with Aphasia Record Form-2 Parameters	**Persons with Broca's Aphasia (PBA)**			**Persons with Wernicke's Aphasia (PWA)**			**Persons with Global Aphasia (PGA)**			**Persons with Anomic Aphasia (PAA)**		
	Mean	S.D	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
MALE PARTICIPANTS												
Reading (R)												
Comprehension of Sentence	33.45	5.84	35.00	1.67	2.58	0.00	0.00	0.00	0.00	34.17	3.76	35.00
Reading Commands	18.97	1.18	19.00	1.00	1.09	1.00	0.25	0.70	0.00	19.83	0.40	20.00
Written word choice matching	5.72	0.64	6.00	1.00	0.89	1.00	0.00	0.00	0.00	4.50	1.76	5.00
Written word-picture choice matching	4.83	1.25	5.00	0.50	0.83	0.00	0.00	0.00	0.00	4.67	1.03	4.00
Picture -written word choice matching	4.48	1.40	5.00	0.33	0.51	0.00	0.13	0.35	0.00	5.50	0.83	6.00
Spoken word-written choice matching	3.69	0.54	4.00	0.33	0.51	0.00	0.00	0.00	0.00	3.67	1.36	3.50
Letter Discriminition	5.55	0.82	6.00	1.33	0.51	1.00	0.00	0.00	0.00	3.83	1.16	4.00
Spelled word recognition	0.48	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.67	0.81	6.00
Spelling	0.34	0.48	0.00	0.17	0.40	0.00	0.00	0.00	0.00	5.33	1.03	6.00
R- TOTAL	**15.50**	**1.29**	**15.40**	**1.27**	**1.15**	**0.90**	**0.08**	**0.21**	**0.00**	**5.33**	**1.03**	**6.00**
Writing (W)												
Writing upon request	1.00	1.46	0.00	1.33	0.51	1.00	0.13	0.35	0.00	4.33	1.21	4.50
Writing output	3.59	4.92	0.00	0.83	0.98	0.50	0.00	0.00	0.00	15.00	3.22	14.50
Writing to dictation	.97	1.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	0.54	3.50
Writing dictated words	1.03	1.52	0.00	0.67	0.81	0.50	0.00	0.00	0.00	3.83	0.75	4.00
Alphabet and Numbers	3.47	4.90	0.00	0.83	0.75	1.00	0.13	0.35	0.00	14.42	2.43	14.00
Dictated Letters and Numbers	0.98	1.35	0.00	1.17	0.98	1.50	0.00	0.00	0.00	3.92	1.71	3.75
Coping a sentence	1.31	1.79	0.00	1.17	0.40	1.00	0.00	0.00	0.00	5.00	1.54	5.00
W-TOTAL	**2.47**	**3.26**	**0.00**	**1.20**	**0.42**	**1.30**	**0.05**	**0.14**	**0.00**	**10.00**	**1.43**	**10.05**
FEMALE PARTICIPANTS												
Reading (R)												
Comprehension of Sentence	36.79	3.16	35.00	1.67	2.88	0.00	0.00	0.00	0.00	33.75	2.50	35.00
Reading Commands	19.43	0.64	19.50	1.00	1.00	1.00	0.71	0.95	0.00	19.50	1.00	20.00
Written word choice matching	5.64	0.49	6.00	1.00	1.00	1.00	0.14	0.37	0.00	5.50	1.00	6.00
Written word-picture choice matching	4.57	1.08	5.00	0.67	0.57	1.00	0.00	0.00	0.00	5.50	0.57	5.50
Picture -written word choice matching	4.64	1.00	5.00	0.33	0.57	0.00	0.00	0.00	0.00	4.50	1.00	4.00
Spoken word-written choice matching	3.71	0.46	4.00	0.67	0.57	1.00	0.00	0.00	0.00	3.00	0.81	3.00
Letter Discriminition	5.43	0.93	6.00	1.00	1.00	1.00	0.00	0.00	0.00	5.00	0.81	5.00
Spelled word recognition	0.57	0.51	1.00	0.00	0.00	0.00	0.00	0.00	0.00	5.75	0.50	6.00
Spelling	0.29	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00	6.00
R- TOTAL	**16.21**	**1.09**	**16.00**	**1.27**	**1.13**	**1.60**	**0.17**	**0.21**	**0.00**	**17.70**	**0.52**	**17.60**
Writing (W)												
Writing upon request	1.14	1.65	0.00	1.33	0.57	1.00	0.29	0.48	0.00	3.75	0.95	3.50
Writing output	5.14	7.37	0.00	1.33	0.57	1.00	0.00	0.00	0.00	12.50	3.10	11.50
Writing to dictation	0.93	1.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	1.41	4.50
Writing dictated words	1.07	1.59	0.00	0.67	1.15	0.00	0.00	0.00	0.00	4.25	1.50	4.00
Alphabet and Numbers	1.29	1.94	0.00	1.00	0.00	1.00	0.29	0.48	0.00	13.00	0.91	13.00
Dictated Letters and Numbers	0.89	1.43	0.00	1.67	0.57	2.00	0.00	0.00	0.00	2.75	0.95	3.00
Coping a sentence	0.93	1.68	0.00	0.67	0.57	1.00	0.00	0.00	0.00	5.50	1.29	5.50
W-TOTAL	**2.28**	**3.34**	**0.00**	**1.33**	**0.30**	**1.40**	**0.11**	**0.19**	**0.00**	**9.15**	**1.63**	**8.70**

Table 4.8: Mean, Median, and Standard Deviation for Record Form-2 Apraxia, Constructional, Visuospatial and Calculation, Supplemental reading and writing of persons with aphasia- Male and Female Participants

Group II- Persons with Aphasia Record Form-2 Parameters	**Persons with Broca's Aphasia (PBA)**			**Persons with Wernicke's Aphasia (PWA)**			**Persons with Global Aphasia (PGA)**			**Persons with Anomic Aphasia (PAA)**		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
MALE PARTICIPANTS												
Apraxia												
Apraxia	**2.40**	**3.10**	**0.00**	**1.08**	**0.58**	**1.00**	**0.06**	**0.17**	**0.00**	**6.58**	**1.28**	**6.50**
Constructional, Visuospatial and Calculation (CVC)												
Drawing	5.03	7.09	0.00	0.33	0.51	0.00	0.25	0.46	0.00	15.83	7.27	14.00
Block Design	1.76	2.47	0.00	0.33	0.51	0.00	0.00	0.00	0.00	5.00	2.44	4.50
Calculation	7.55	7.00	8.00	1.17	1.32	1.00	0.00	0.00	0.00	15.17	4.66	14.00
Raven's Coloured Progressive Matrices	6.69	6.64	6.00	1.17	1.32	1.00	0.00	0.00	0.00	19.17	8.97	16.50
CVC TOTAL	**2.10**	**2.12**	**1.70**	**0.30**	**0.30**	**0.30**	**0.03**	**0.04**	**0.00**	**5.52**	**2.24**	**4.65**
Supplemental Writing and Reading (SWR)												
Writing Irregular Words to Dictation	0.76	0.98	1.00	1.00	0.89	1.00	0.00	0.00	0.00	4.83	1.16	5.00
Writing Non-Words to Dictation	0.59	0.73	0.00	0.67	1.21	0.00	0.00	0.00	0.00	4.67	1.63	4.50
Reading Irregular Words	0.34	0.72	0.00	0.33	0.51	0.00	0.00	0.00	0.00	6.33	1.36	6.50
Reading Non-Words	0.21	0.41	0.00	0.33	0.51	0.00	0.00	0.00	0.00	6.33	2.06	6.50
SWR TOTAL	**1.90**	**1.67**	**2.00**	**2.33**	**2.94**	**1.00**	**0.00**	**0.00**	**0.00**	**22.17**	**5.34**	**22.00**
FEMALE PARTICIPANTS												
Apraxia												
Apraxia	**1.75**	**2.57**	**0.00**	**0.67**	**0.28**	**0.50**	**0.14**	**0.24**	**0.00**	**5.63**	**1.25**	**5.75**
Constructional, Visuospatial and Calculation												
Drawing	3.43	5.04	0.00	1.00	0.00	1.00	0.29	0.48	0.00	13.75	2.21	13.00
Block Design	1.29	1.93	0.00	0.67	1.15	0.00	0.29	0.48	0.00	5.25	1.50	6.00
Calculation	7.00	5.53	7.00	1.33	0.57	1.00	0.00	0.00	0.00	12.00	4.96	10.50
Raven's Coloured Progressive Matrices	6.36	6.39	5.00	1.00	0.00	1.00	0.00	0.00	0.00	12.75	2.87	11.50
CVC TOTAL	**1.81**	**1.66**	**1.40**	**0.40**	**0.10**	**0.40**	**0.06**	**0.09**	**0.00**	**4.38**	**0.82**	**4.35**
Supplemental Writing and Reading												
Writing Irregular Words to Dictation	1.07	0.82	1.00	1.00	0.00	1.00	0.14	0.37	0.00	2.75	0.95	2.50
Writing Non-Words to Dictation	0.79	1.05	0.00	0.33	0.57	0.00	0.14	0.37	0.00	3.00	0.81	3.00
Reading Irregular Words	0.07	0.26	0.00	0.33	0.57	0.00	0.00	0.00	0.00	5.00	0.81	5.00
Reading Non-Words	0.21	0.57	0.00	0.67	0.57	1.00	0.00	0.00	0.00	5.50	0.57	5.50
SWR TOTAL	**2.14**	**1.74**	**2.00**	**2.33**	**1.52**	**2.00**	**0.29**	**0.48**	**0.00**	**16.25**	**1.70**	**16.50**

Table 4.9: Mean, Median, and Standard Deviation of Aphasia Quotient, Cortical Quotient and Language Quotient for persons with aphasia - male and female participants

WAB-R Tamil Score Summary	Group II- Persons with Aphasia											
	Persons with Broca's Aphasia (PBA)			Persons with Wernicke's Aphasia (PWA)			Persons with Global Aphasia (PGA)			Persons with Anomic Aphasia (PAA)		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
MALE PARTICIPANTS												
Aphasia Quotient	23.06	4.07	23.30	29.03	5.20	27.45	5.78	3.00	5.65	66.71	3.92	65.80
Cortical Quotient	37.99	3.85	38.70	18.11	4.06	16.85	3.33	1.76	3.10	70.01	2.83	70.10
Language Quotient	33.50	6.53	31.60	18.26	3.92	16.60	3.36	1.76	3.10	68.40	4.03	67.85
FEMALE PARTICIPANTS												
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Aphasia Quotient	26.26	6.96	25.80	27.86	4.12	28.40	7.51	3.56	7.00	57.97	5.67	57.45
Cortical Quotient	39.18	6.51	37.75	17.86	3.91	19.50	4.58	1.86	3.90	64.80	3.81	64.80
Language Quotient	33.49	8.69	29.95	17.63	3.38	18.90	4.64	1.85	4.20	61.37	3.99	61.07

4.2.3 Sub-section III: The comparison between the performance of neuro-typical adults and persons with aphasia on Western Aphasia Battery-Revised Tamil.

The results of descriptive statistics in terms of mean, median, and standard deviation of **Record Form-1 (WAB-R Tamil Version)** spontaneous speech, auditory verbal comprehension, repetition and naming and **Record Form-2 (WAB-R Tamil Version)** consisting of Reading and Writing tasks, Apraxia assessment, Constructional, Visuospatial and Calculation and Supplemental Writing and Reading of neuro-typical individuals in comparison with individuals with aphasia without the gender differences at three different age range is shown in Table 4.10. The neurotypical individuals had lower performance when compared to the individuals with aphasia at three different age range. Following this, the Mann-Whitney U test was administered to examine the difference in parameters of Record Form-1 and Record Form-2 of WAB-R Tamil Version between the neurotypical individuals and individuals with aphasia at three different age ranges. The results of the Mann Whitney U test in Table 4.11, show a significant difference between the groups for all the parameters of Record Form-1 and Record Form-2 of the WAB-R Tamil version.

Table 4.10: Mean and Standard Deviation of Record Form 1 & 2 parameters (TOTAL) for Group I and Group II participants in three different age range

Record Form-1 & 2 Parameters	Group I- neurotypicals		Group II- Persons with Aphasia		Group I- neurotypicals		Group II- Persons with Aphasia		Group I- neurotypicals		Group II- Persons with Aphasia	
	Group-A (30-40)				Group-B (41-60)				Group-C (61-70)			
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Spontaneous speech	20.00	0.00	4.00	2.93	20.00	0.00	4.18	3.82	19.78	0.58	2.18	3.16
Auditory Word comprehension	9.97	0.07	5.78	3.78	9.94	0.11	5.86	3.76	9.88	0.11	6.35	3.76
Repetition	9.95	0.20	1.98	2.65	9.96	0.07	2.60	2.93	9.97	0.80	1.58	2.36
Naming	10.00	0.00	1.45	1.46	9.96	0.68	1.43	1.41	9.99	0.69	1.20	1.68
Reading	20.00	0.00	11.04	7.51	19.36	0.58	11.09	7.59	19.60	0.43	11.55	7.18
Writing	19.83	0.24	2.73	4.16	19.86	0.30	3.28	3.69	19.60	0.43	2.12	3.60
Apraxia	10.00	0.00	1.83	2.91	10.00	0.00	2.58	2.84	10.00	0.00	1.85	2.85
Constructional, Visuospatial, and calculation	9.76	0.41	1.25	1.91	9.79	0.28	2.37	2.67	9.47	0.37	1.53	1.53
Supplementary Reading and Writing	39.35	0.67	2.78	5.41	38.75	1.02	4.91	7.81	39.50	0.60	3.62	5.70
Aphasia Quotient	99.82	0.52	26.43	14.85	99.72	0.42	28.14	18.07	99.22	1.23	23.87	16.86
Cortical Quotient	99.54	0.54	32.77	18.6	99.20	0.74	34.25	20.46	98.70	1.11	31.93	20.04
Language Quotient	99.54	0.46	28.97	17.58	99.03	0.85	32.01	20.02	98.98	1.03	28.47	18.88

Table 4.11: Results of Mann-Whitney Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil in three different age range (NTI verses PWA)

Record Form-1 & 2 Parameters	Group-A (30-40)		Group-B (41-60)		Group-C (61-70)	
	/Z/ Value	*p-value*	/Z/ Value	*p-value*	/Z/ Value	*p-value*
Spontaneous speech	5.708	0.00**	6.260	0.00**	5.914	0.00**
Auditory Word comprehension	5.366	0.00**	6.001	0.00**	5.485	0.00**
Repetition	5.336	0.00**	6.129	0.00**	5.914	0.00**
Naming	5.701	0.00**	6.122	0.00**	5.991	0.00**
Reading	5.695	0.00**	6.026	0.00**	5.781	0.00**
Writing	5.398	0.00**	6.141	0.00**	5.985	0.00**
Apraxia	5.755	0.00**	5.314	0.00**	5.314	0.00**
Constructional, Visuospatial, and calculation	5.439	0.00**	6.258	0.00**	6.186	0.00**
Supplementary Reading and Writing	5.385	0.00**	5.834	0.00**	5.789	0.00**
Aphasia Quotient	5.470	0.00**	6.093	0.00**	5.845	0.00**
Cortical Quotient	5.314	0.00**	6.057	0.00**	5.763	0.00**
Language Quotient	5.287	0.00**	6.083	0.00**	5.768	0.00**

***p* value<0.001

4.3 Section-B- Quantitative measures of WAB-R Tamil

The quantitative measures were made for the tasks like 'Picture Description', 'Spontaneous Speech total', Sequential Command', 'Repetition', 'Word Fluency', 'Comprehension of sentences', 'Reading Total', 'Writing Output', 'Writing to Dictation', 'Writing Total', 'Drawing', 'Block Design', 'Calculation', 'Raven's Progressive Matrices', 'Constructional, visuospatial and calculation', 'Writing Irregular Words', 'Writing non-words to dictation', 'Supplementary reading and writing Total', 'Aphasia Quotient', 'Cortical Quotient', 'Language Quotient' under Record Form 1 and 2 of WAB-R Tamil was subjected for the test of normality using Shapiro Wilks test of normality. The results of the normality test did not show a normal distribution of the data and hence the non-parametric test was employed for further analysis as follows.

4.3.1 Sub-section I: Differences between the gender male and female within Group I (Neurotypical individuals)

Mann-Whitney U test was administered to examine the difference in parameters of Record Form-1 and Record Form-2 of WAB-R Tamil Version between the gender male and female within Group I (Neurotypical individuals) separately for three different age range. The results of Mann Whitney U test in Table 4.12, shows no significant difference between the gender in Group I for the subgroup of participants in the age range of 61-70 years, and a significant difference between the gender male and female was seen only for one parameter 'sequential command' for the subgroup of participants in the age range 30-40 years and significant difference in two parameters 'written output' and 'Writing Total' for the subgroup of participants in the age range 41-60 years.

Table 4.12: Results of Mann-Whitney Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil in three different age range of neurotypical individuals (Male versus Female)

Record Form-1 & 2 Tasks	Group I- Neurotypical Individuals					
	Group-A (30-40)		Group-B (41-60)		Group-C (61-70)	
	Z Value	*P-value*	*Z Value*	*P-value*	*Z Value*	*P-value*
Picture description Task	0.000	1.000	0.000	1.000	0.000	1.000
Spontanrous Speech Task	0.000	1.000	0.000	1.000	0.000	1.000
Sequential command	-2.163	0.031*	0.000	1.000	-0.308	0.758
Repetition	-1.451	0.147	-1.645	0.100	-0.486	0.627
Word Fluency	0.000	1.000	-0.844	0.399	-1.000	0.317
Comprehension of sentences	0.000	1.000	-0.394	0.694	-0.311	0.756

Table 4.12 continuation…						
Reading Total	0.000	1.000	-0.197	0.844	-0.311	0.756
Writing Output	-0.357	0.721	-2.097	0.036*	-0.178	0.858
Writing to dictation	-0.497	0.619	-1.000	0.317	0.000	1.000
Writing Total	-1.024	0.306	-2.097	0.036*	-0.178	0.858
Drawing	0.000	1.000	-1.244	0.214	-1.824	0.068
Block Design	-0.140	0.888	-0.271	0.786	-1.052	0.293
Calculation	0.000	1.000	0.000	1.000	0.000	1.000
Raven's Progressive Matrices	-0.398	0.691	-1.139	0.255	-1.026	0.305
Constructional, visuospatial, and calculation	-0.222	0.824	-0.373	0.709	-0.698	0.485
Writing irregular words	-0.835	0.403	-1.699	0.089	-0.457	0.648
Writing non-words to dictation	0.000	1.000	-0.781	0.435	-0.610	0.542
Supplementary reading and writing Total	-0.835	0.403	-0.671	0.502	-0.602	0.547
Aphasia Quotient	-2.163	0.031*	-0.331	0.740	-0.115	0.909
Cortical Quotient	-0.743	0.458	-0.836	0.403	-0.530	0.596
Language Quotient	-0.406	0.685	-0.802	0.423	-0.114	0.909

**p value<0.001

4.3.2 Sub-section II: Differences between the age ranges for male and female participants within Group I (Neurotypical individuals)

Kruskal-Wallis test was administered to examine the difference in parameters of Record Form-1 and Record Form-2 of WAB-R Tamil Version by studying the difference between the age range within Group I (Neurotypical individuals) separately for male participants and female participants. The results of the Kruskal-Wallis test in Table 4.13, show a significant difference between the age range for the task 'comprehension of sentences', 'Reading Total', 'Drawing', 'Supplementary Reading and Writing Total' of male participants. With reference to female participants, the significant difference between the age range was for the task 'Sequential Command', 'Auditory verbal comprehension, Comprehension of sentences', 'comprehension of sentences', 'Reading total', 'Block Design', 'Constructional, Visuospatial and Calculation Total', 'Writing non-word to dictation', 'Aphasia Quotient' and 'Cortical Quotient'.

Table 4.13: Results of Kruskal-Wallis Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil for male and female participants (neuro-typical individuals) (Difference between age ranges)

Task	Group I- Neurotypical Individuals			
	Male		Female	
	Chi-Square	***P-value***	***Chi square***	***P value***
Picture Description	4.143	0.126	4.138	0.126
Spontaneous Speech total	4.143	0.126	4.138	0.126
Sequential Commands	2.639	0.267	10.183	0.006*
Auditory verbal comprehension Total	2.578	0.276	10.183	0.006*
Repetition	0.678	0.713	4.945	0.084
Word fluency	5.453	0.065	4.138	0.126
Comprehension of sentences	9.458	0.009*	10.165	0.006*
Reading total	9.458	0.009*	10.036	0.007*
Writing output	1.363	0.506	2.668	0.263
Writing to dictation	2.008	0.366	6.423	0.040
Writing Total	0.998	0.607	4.165	0.125
Drawing	6.423	0.040*	4.111	0.128
Block design	5.238	0.073	12.606	0.002*
Calculation	4.143	0.126	4.143	0.126
Raven's progressive Matrices	2.085	0.353	1.820	0.402
Constructional, Visuospatial, and Calculation Total	3.386	0.184	8.711	0.013*
Writing Irregular Words dictation	4.877	0.087	2.578	0.276
Writing Non words to Dictation	3.329	0.189	8.561	0.014*
Supplementary Reading and Writing Total	5.966	0.051*	2.555	0.279
Aphasia Quotient	2.283	0.319	9.541	0.008*
Cortical Quotient	2.046	0.359	8.080	0.018*
Language Quotient	4.310	0.116	5.539	0.063

*p value<0.05

4.3.3 Sub-section III: Pairwise comparison with reference to the age range for male and female participants within Group I (Neurotypical individuals)

The pairwise differences between Pair 1- Group A (30-40 years) and Group B (41-60 years) with only male participants for all the tasks of WAB-R Tamil were studied using the Mann-Whitney U test in Table 4.14. The statistically significant difference was not seen between Group A and Group B on all the tasks except, 'Word fluency', 'Comprehension of sentences' and overall 'Reading Total'. And, for Pair-2 - Group B and Group C with male participants for all the tasks of WAB-R Tamil indicated that there was no statistically significant difference for all the tasks, except 'comprehension of sentences tasks' and overall 'reading total'. Whereas in, Pair- 3- Group C and Group D, none of the tasks had a

statistically significant difference except 'Block Design', Writing irregular words' and 'Supplementary reading and writing Total'.

Table 4.14: Results of Mann-Whitney U Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil for pairwise comparison for male participants

Record Form-1 & 2 Tasks	Group I- Neurotypical Individuals (Males)					
	Pair 1:A-B		Pair 2:B-C		Pair3: C-D	
	Z Value	***P-value***	***Z Value***	***P-value***	***Z Value***	***P-value***
Picture description Task	0.000	1.000	-1.453	0.146	-1.453	0.146
Spontanrous Speech Total	0.000	1.000	-1.453	0.146	-1.453	0.146
Sequential command	-0.444	0.657	-1.021	0.307	-1.593	0.111
Repetition	-0.730	0.466	-0.608	0.543	-0.073	0.942
Word Fluency	-2.169	0.030*	-1.000	0.317	-1.295	0.195
Comprehension of sentences	-2.804	0.005*	-2.799	0.005*	-0.985	0.324
Reading Total	-2.804	0.005*	-2.799	0.005*	-0.985	0.324
Writing Output	-1.024	0.306	-0.311	0.756	-0.915	0.360
Writing to dictation	-0.486	0.627	-1.451	0.147	-1.000	0.317
Writing Total	-0.768	0.442	-0.044	0.965	-0.915	0.360
Drawing	-1.824	0.068	0.000	1.000	-1.824	0.068
Block Design	-0.140	0.888	-1.744	0.081	-2.078	0.038*
Calculation	-1.453	0.146	0.000	1.000	-1.453	0.146
Raven's Progressive Matrices	-0.199	0.842	-1.109	0.267	-1.283	0.200
Constructional, visuospatial and calculation	-0.266	0.790	-1.752	0.080	-1.292	0.196
Writing irregular words	-1.699	0.089	-0.438	0.661	-2.013	0.044*
Writing non-words to dictation	-1.826	0.068	-1.453	0.146	-0.600	0.549
Supplementary reading and writing Total	-2.207	0.027*	-0.213	0.831	-1.912	0.056*
Aphasia Quotient	-0.043	0.966	-1.134	0.257	-1.409	0.159
Cortical Quotient	-0.954	0.340	-1.334	0.182	-0.606	0.545
Language Quotient	-1.742	0.082	-1.802	0.072	-0.568	0.570

*p value<0.05

The pairwise differences between Pair 1- Group-a (30-40 years) and Group-b (41-60 years) with only female participants for all the tasks of WAB-R Tamil were studied using the Mann-Whitney U test in Table 4.15. There was no statistically significant difference ($p<0.05$) seen between Group-a and Group-b on most of the tasks, except 'Repetition', 'Comprehension of sentences', 'Reading Total', "Writing Total', 'Writing non-words to dictation', 'AQ'. Pair 2- Group-b and Group-c indicated no statistically significant differences on all the tasks, except 'Sequential commands', 'Comprehension of sentences',

'Reading Total', 'Block design tasks' and 'total score of Constructional, Visuospatial and Calculation' "AQ', 'CQ'. The results of Pair 3- Group-c and Group-d show a significant difference for 'block design', 'Constructional, Visuospatial and Calculation', Writing non-words to dictation'.

Table 4.15: Results of Mann-Whitney U Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil for pairwise comparison for female participants

Record Form-1 & 2 Tasks	Group I- Neurotypical Individuals (Females)					
	Pair 1:a-b		Pair 2:b-c		Pair 3:c-d	
	Z Value	***P-value***	***Z Value***	***P-value***	***Z Value***	***P-value***
Picture description Task	0.000	1.000	-1.451	0.147	-1.451	0.147
Spontanrous Speech Total	0.000	1.000	-1.451	0.147	-1.451	0.147
Sequential command	-1.824	0.068	-3.106	0.002*	-1.618	0.106
Repetition	-2.169	0.030*	-1.451	0.147	-1.032	0.302
Word Fluency	-1.451	0.147	0.000	1.000	-1.451	0.147
Comprehension of sentences	-2.798	0.005*	-3.108	0.002*	-0.736	0.462
Reading Total	-2.798	0.005*	-3.108	0.002*	-0.426	0.670
Writing Output	-1.645	0.100	-0.312	0.755	-1.244	0.214
Writing to dictation	-1.824	0.068	-1.824	0.068	0.000	1.000
Writing Total	-2.053	0.040*	-0.812	0.417	-1.244	0.214
Drawing	-1.000	0.317	-1.824	0.068	-1.190	0.234
Block Design	-0.271	0.786	-2.929	0.003*	-3.122	0.002*
Calculation	-1.453	0.146	0.000	1.000	-1.453	0.146
Raven's Progressive Matrices	-1.244	0.213	-0.233	0.816	-1.191	0.234
Constructional, visuospatial and calculation	-0041	0.967	-2.055	0.040*	-2.945	0.003*
Writing irregular words	-0.835	0.403	-1.529	0.126	-0.890	0.374
Writing non-words to dictation	-2.500	0.012*	-1.000	0.317	-1.933	0.053*
Supplementary reading and writing Total	-0.559	0.576	-1.174	0.240	-1.479	0.139
Aphasia Quotient	-2.484	0.013*	-3.106	0.002*	-0.704	0.481
Cortical Quotient	-1.044	0.297	-2.810	0.005*	-1.707	0.088
Language Quotient	-1.759	0.079	-2.242	0.025	-0.419	0.675

*p value<0.05

4.3.4 Sub-section IV: Differences between the gender male and female within Group II (Persons with aphasia)

Parameters in Record Forms 1 and 2 of WAB-R Tamil were subjected to the test of normality using the Shapiro Wilks test of normality. The results of the normality test did not show a normal distribution of the data and hence the non-parametric test was employed for further analysis as follows.

Mann-Whitney U test was administered to examine the difference in parameters of Record Form-1 and Record Form-2 of WAB-R Tamil Version between the gender male and female within Group II (Persons with aphasia) separately for four different types of aphasia (Persons with Broca's Aphasia, Persons with Wernicke's Aphasia, Persons with Global Aphasia and Persons with Anomic Aphasia). The results of Mann Whitney U test in Table 4.16 with reference to the Persons with Broca's Aphasia shows a significant difference between the gender for the tasks like a 'conversational question', 'spontaneous speech total', 'auditory word recognition', 'sequential commands', 'auditory verbal comprehension', 'repetition', 'object naming', 'word fluency', 'sentence completion', and 'naming', all other tasks and parameters under Record Form 1 and 2 did not show any significant differences between the gender in the sub-group consisting only persons with Broca's Aphasia.

With reference to the sub-group consisting of Persons with Wernicke's Aphasia, there was no significant difference between the gender for none of the parameters of Record Form 1 and 2 of WAB-R Tamil except 'Responsive Speech'. The results corresponding to the sub-group consisting of Persons with Global Aphasia showed significant differences only for the parameter 'Sequential Command'. Finally, in the sub-group consisting of Persons with Anomic Aphasia the significant difference was for 'Repetition', 'Writing Irregular Words to Dictation', and 'Aphasia Quotient'.

Table 4.16: Results of Mann-Whitney Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil in four different types of aphasia (Male versus Female)

Record Form-1 & 2 Tasks	Group II- Persons with Aphasia							
	Persons with Broca's Aphasia		Persons with Wernicke's Aphasia		Persons with Global Aphasia		Persons with Anomic Aphasia	
	Z Value	*P-value*	*Z Value*	*P-value*	*Z Value*	*P-value*	*Z Value*	*P-value*
Conversational Questions	-2.422	0.015*	0.000	1.000	-0.299	0.765	-0.863	0.388
Picture description	0.000	1.000	-0.268	0.788	-0.066	0.948	-0.111	0.911
Spontaneous speech total	-1.951	0.051*	-0.131	0.896	-0.505	0.614	-0.545	0.586
Yes/No questions	-1.067	0.286	.0000	1.000	-1.539	0.124	-0.554	0.580
Auditory word recognition	-2.113	0.035*	-0.521	0.603	-0.834	0.404	-1.180	0.238
Sequential commands	-3.276	0.001*	-0.927	0.354	-1.891	0.059*	-1.083	0.279

Table 4.16 continuation…

Auditory Verbal Comprehension	-2.178	0.029*	-0.516	0.606	-1.574	0.116	-1.732	0.083
Repetition	-3.101	0.002*	-1.823	0.068	-0.407	0.684	-2.374	0.018*
Object Naming	-3.541	0.000**	-1.055	0.291	-0.742	0.458	-0.535	0.593
Word Fluency	-4.213	0.000*	-1.692	0.091	-1.076	0.282	-0.108	0.914
Sentence Completion	-1.941	0.052*	-0.134	0.893	-1.425	0.154	-1.111	0.267
Responsive speech	-1.172	0.241	-2.236	0.025*	-1.065	0.287	-1.006	0.314
Naming	-4.375	0.000**	-0.130	0.896	-0.932	0.352	-0.213	0.831
Comprehension of sentences	-1.745	0.081	0.000	1.000	0.000	1.000	-0.122	0.903
Reading Commands	-1.070	0.284	-0.137	0.891	-1.195	0.232	-0.456	0.648
Written word choice matching	-0.957	0.339	0.000	1.000	-1.069	0.285	-0.964	0.335
Written word picture choice matching	-0.875	0.382	-0.577	0.564	0.000	1.000	-1.369	0.171
Picture to written word choice matching	-0.255	0.799	0.000	1.000	-0.935	0.350	-1.532	0.126
Spoken to written word choice matching	0.000	1.000	-0.894	0.371	0.000	1.000	-0.783	0.434
Letter discrimination	-0.496	0.620	-0.577	0.564	0.000	1.000	-1.560	0.119
Spelled word recognition	0-.539	0.590	0.000	1.000	0.000	1.000	-0.152	0.879
Spelling	-0.383	0.702	-0.707	0.480	0.000	1.000	-1.225	0.221
Reading Total	-1.650	0.099	0.000	1.000	-1.046	0.296	-0.215	0.830
Writing on request	-0.105	0.917	0.000	1.000	-0.750	0.453	-0.783	0.434
Written output	-0.508	0.611	-0.816	0.414	0.000	1.000	-1.407	0.159
Writing to dictation	-0.352	0.724	0.000	1.000	0.000	1.000	-1.006	0.314
Writing dictation word	0.000	1.000	-0.143	0.886	0.000	1.000	-0.335	0.737
Alphabet and Numbers	-0.998	0.318	-0.463	0.643	-0.750	0.453	-0.974	0.330
Dictated Letters and Numbers	-0.279	0.780	-0.714	0.475	0.000	1.000	-0.965	0.334
Copying Sentence	-0.584	0.559	-1.414	0.157	0.000	1.000	-0.548	0.584
Writing Total	-0.367	0.714	-0.396	0.692	-0.750	0.453	-0.640	0.522
Apraxia	-0.617	0.537	-1.099	0.272	-0.750	0.453	-0.971	0.331
Drawing	-0.558	0.577	-1.789	0.074	-0.151	0.880	-0.215	0.830
Block Design	-0.477	0.634	-0.309	0.758	-1.569	0.117	-0.354	0.724
Calculation	-0.239	0.811	-0.268	0.788	0.000	1.000	-1.180	0.238
Ravens progressive Matrices	-0.040	0.968	0.000	1.000	0.000	1.000	-1.721	0.085
Constructional, Visuospatial and Calculation Total	-0.224	0.823	-0.264	0.792	-0.447	0.655	-0.962	0.336
Writing Irregular Words dictation	-1.458	0.145	0.000	1.000	-1.069	0.285	-2.165	0.030*
Writing Non words to Dictation	-0.347	0.729	-0.154	0.877	-1.069	0.285	-1.655	0.098
Reading Irregular words	-1.359	0.174	0.000	1.000	0.000	1.000	-1.634	0.102
Reading Non words	-0.384	0.701	-0.894	0.371	0.000	1.000	-0.652	0.515
Supplementary Reading and Writing Total	-0.451	0.652	-0.528	0.598	-1.569	0.117	-1.716	0.086
Aphasia Quotient	-1.400	0.162	-0.130	0.897	-0.810	0.418	-2.132	0.033*
Cortical Quotient	-0.181	0.856	-0.258	0.796	-1.510	0.131	-2.032	0.042*
Language Quotient	-0.324	0.746	-0.258	0.796	-1.510	0.131	-2.245	0.025*

*p value<0.05 **p value<0.001

4.3.5 Sub-section V: Difference between types of aphasia within each gender of Group II (Persons with Aphasia)

Kruskal-Wallis test was administered to examine the difference in parameters of Record Form-1 and Record Form-2 of WAB-R Tamil Version by studying the difference between the type of aphasia within Group II (Persons with Aphasia) separately for male participants and female participants. The results of Kruskal-Wallis test in Table 4.17, shows a significant difference between the type of aphasia for all the task of Record Form 1 and 2 of WAB-R Tamil for the male participants. With reference to female participants, the results showed a significant difference between the type of aphasia for all the tasks of Record Form 1 and 2 except for the 'Responsive Speech' from the 'Naming task' of WAB-R Tamil.

Table 4.17: Results of Kruskal-Wallis Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil for male and female participants of Persons with Aphasia (Types of Aphasia)

Tasks	Group II- Persons with Aphasia			
	Male		Female	
	Chi-Square	P-value	Chi-Square	P-value
Conversational Questions	30.932	0.000**	20.423	0.000**
Picture description	29.175	0.000**	13.100	0.004**
Spontaneous speech total	28.938	0.000**	17.302	0.001**
Yes/No questions	32.666	0.000**	21.163	0.000**
Auditory word recognition	30.492	0.000**	19.155	0.000**
Sequential commands	32.101	0.000**	20.695	0.000**
Auditory Verbal Comprehension	33.311	0.000**	20.379	0.000**
Repetition	25.149	0.000**	10.941	0.012*
Object Naming	32.253	0.000**	16.552	0.001**
Word Fluency	27.334	0.000**	15.066	0.002**
Sentence Completion	23.216	0.000**	9.695	0.021*
Responsive speech	11.530	0.009*	6.556	0.087
Naming	28.364	0.000**	15.421	0.001**
Comprehension of sentences	30.939	0.000**	21.529	0.000**
Reading Commands	33.125	0.000**	19.959	0.000**
Written word choice matching	36.480	0.000**	20.957	0.000**
Written word picture choice matching	30.962	0.000**	20.861	0.000**
Picture to written word choice matching	32.290	0.000**	19.892	0.000**
Spoken to written word choice matching	33.818	0.000**	22.090	0.000**
Letter discrimination	38.197	0.000**	20.992	0.000**
Spelled word recognition	26.622	0.000**	17.706	0.001**
Spelling	24.362	0.000**	17.357	0.001**
Reading Total	34.313	0.000**	21.020	0.000**
Writing on request	20.161	0.000**	10.384	0.016*
Written output	21.298	0.000**	10.509	0.015*
Writing to dictation	23.393	0.000**	14.257	0.003**
Writing dictation word	18.738	0.000**	13.013	0.005**
Alphabet and Numbers	19.147	0.000**	13.080	0.004**
Dictated Letters and Numbers	18.203	0.000**	12.760	0.005**
Copying Sentence	20.363	0.000**	14.149	0.003**
Writing Total	21.808	0.000**	12.410	0.006**

Table 1.17 continuation..				
Apraxia	15.753	0.001*	10.470	0.015*
Drawing	13.617	0.003*	12.178	0.007**
Block Design	16.274	0.001*	10.723	0.013*
Calculation	17.797	0.000**	13.416	0.004**
Ravens Progressive Matrices	20.878	0.000**	15.167	0.002**
Constructional, Visuospatial, and Calculation Total	17.873	0.000**	14.077	0.003**
Writing Irregular Words dictation	22.945	0.000**	14.306	0.003**
Writing Non Words to Dictation	22.392	0.000**	12.157	0.007**
Reading Irregular words	24.906	0.000**	20.276	0.000**
Reading Non words	26.023	0.000**	18.566	0.000**
Supplementary Reading and Writing Total	23.977	0.000**	15.848	0.001**
Aphasia Quotient	33.432	0.000**	20.578	0.000**
Cortical Quotient	37.682	0.000**	23.133	0.000**
Language Quotient	37.345	0.000**	23.121	0.000**

*p value<0.05 **p value<0.001

4.3.6 Sub-section V: Pairwise comparison with reference to different types of aphasia male and female participants within Group II (Persons with Aphasia)

The pairwise differences were studied by forming SIX pairs. They are, Pair 1- PBA (Persons with Broca's Aphasia) and PWA (Persons with Wernicke's Aphasia), Pair 2- PBA (Persons with Broca's Aphasia) and PGA (Persons with Global Aphasia), Pair 3- PBA (Persons with Broca's Aphasia) and PAA (Persons with Anomic Aphasia), Pair 4- PWA (Persons with Wernicke's Aphasia) and PGA (Persons with Global Aphasia), Pair 5- PWA (Persons with Wernicke's Aphasia) and PAA (Persons with Anomic Aphasia), Pair 6- PGA (Persons with Global Aphasia) and PAA (Persons with Anomic Aphasia) with only male participants and similar pairs for only female participants were also constituted. The pairwise differences were studied using the Mann-Whitney U test for all the tasks of WAB-R Tamil as shown in Table 4.18 and Table 4.19 for male participants. For female participants, the results are shown in Table 4.20 and Table 4.21.

Table 4.18.: Results of Mann-Whitney Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil in pairwise comparison (1,2.3) of four different types of aphasia in males

Pairwise comparison	***PBA-PWA***		***PBA-PGA***		***PBA-PAA***	
	Pair 1		**Pair 2**		**Pair 3**	
	Z Value	***P Value***	***Z-value***	***P Value***	***Z-value***	***P Value***
Conversational Questions	-3.867	0.000**	-2.570	0.010*	-3.843	0.000**
Picture description	-3.886	0.000**	-1.435	0.151	-4.021	0.000**
Spontaneous speech total	-3.937	0.000**	-1.049	0.294	-3.937	0.000**
Yes/No questions	-3.822	0.000**	-4.294	0.000**	-2.098	0.036*
Auditory word recognition	-3.825	0.000**	-4.298	0.000**	-0.969	0.333
Sequential commands	-3.823	0.000**	-4.295	0.000**	-2.111	0.035*
Auditory Verbal Comprehension	-3.809	0.000**	-4.282	0.000**	-2.454	0.014*
Repetition	-3.294	0.001*	-0.691	0.490	-3.846	0.000**
Object Naming	-3.978	0.000**	-2.637	0.008*	-3.977	0.000**

Table 4.18 continuation…						
Word Fluency	-3.837	0.000**	-0.628	0.530	-3.968	0.000**
Sentence Completion	-3.327	0.001**	-0.389	0.697	-3.857	0.000**
Responsive speech	-0.628	0.530	-0.586	0.558	-3.354	0.001*
Naming	-3.867	0.000**	-1.235	0.217	-3.866	0.000**
Comprehension of sentences	-3.903	0.000**	-4.390	0.000**	-0.023	0.982
Reading Commands	-3.929	0.000**	-4.408	0.000**	-1.912	0.056*
Written word choice matching	-4.509	0.000**	-4.949	0.000**	-1.885	0.059*
Written word picture choice matching	-3.872	0.000**	-4.402	0.000**	-0.507	0.612
Picture to written word choice matching	-3.922	0.000**	-4.400	0.000**	-1.643	0.100
Spoken to written word choice matching	-4.326	0.000**	-4.782	0.000**	-0.602	0.547
Letter discrimination	-4.309	0.000**	-4.767	0.000**	-3.452	0.001*
Spelled word recognition	-2.166	0.030*	-2.459	0.014*	-4.118	0.000**
Spelling	-0.843	0.399	-1.918	0.055*	-4.216	0.000**
Reading Total	-3.814	0.000**	-4.300	0.000**	-2.829	0.005*
Writing on request	-1.514	0.130	-1.510	0.131	-3.612	0.000**
Written output	-0.297	0.767	-2.010	0.044*	-3.889	0.000**
Writing to dictation	-1.764	0.078	-2.019	0.044*	-3.716	0.000**
Writing dictation word	-0.074	0.941	-2.012	0.044*	-3.427	0.001*
Alphabet and Numbers	-0.096	0.924	-1.709	0.087	-3.768	0.000**
Dictated Letters and Numbers	-0.598	0.550	-2.130	0.033*	-3.283	0.001*
Copying Sentence	-1.017	0.309	-2.015	0.044*	-3.503	0.000**
Writing Total	-0.930	0.352	-1.709	0.087	-3.977	0.000**
Apraxia	-0.698	0.485	-1.710	0.087	-2.865	0.004*
Drawing	-0.939	0.348	-1.312	0.189	-2.745	0.006*
Block Design	-0.947	0.344	-2.145	0.032*	-2.727	0.006*
Calculation	-1.608	0.108	-2.859	0.004*	-2.274	0.023*
Ravens Progressive Matrices	-1.675	0.094	-2.857	0.004*	-3.070	0.002*
Constructional, Visuospatial, and Calculation Total	-1.430	0.153	-2.540	0.011*	-2.835	0.005*
Writing Irregular Words dictation	-0.853	0.393	-2.533	0.011*	-3.911	0.000**
Writing Non Words to Dictation	-0.271	0.786	-2.274	0.023*	-4.045	0.000**
Reading Irregular words	-0.344	0.731	-1.515	0.130	-4.400	0.000**
Reading Non-words	-0.662	0.508	-1.386	0.166	-4.514	0.000**
Supplementary Reading and Writing Total	-0.022	0.982	-3.128	0.002*	-3.870	0.000**
Aphasia Quotient	-2.496	0.013*	-4.281	0.000**	-3.809	0.000**
Cortical Quotient	-3.808	0.000**	-4.280	0.000**	-3.808	0.000**
Language Quotient	-3.721	0.000**	-4.280	0.000**	-3.808	0.000**

*p value<0.05 **p value<0.001

With reference to male participants, for Pair 1, there was a significant difference between the groups for all the parameters of Record Form 1 and 2 except few, they were ‘responsive speech’, ‘Spelling’, ‘Writing on request’, ‘Written output’, ‘Writing to dictation’, ‘Writing dictation word’, ‘Alphabet and Numbers’, ‘Dictated Letters and Numbers’, ‘Copying Sentence’, ‘Writing Total’, ‘Apraxia’, ‘Drawing’, ‘Block Design’, ‘Calculation’, ‘Ravens Progressive Matrices’, ‘Constructional, Visuospatial, and Calculation Total’, ‘Writing Irregular Words dictation’, ‘Writing Non Words to Dictation’, ‘Reading Irregular words’, ‘Reading Non-words’, ‘Supplementary Reading and Writing Total’.

For Pair 2, a significant difference was seen for all the parameters except 'Picture description', 'Spontaneous Speech', 'Repetition', 'Word fluency', 'Sentence Completion', 'Responsive Speech', 'Naming', 'Writing on request', Alphabet and number', 'Comprehension of Sentences', 'Writing total', 'Apraxia', 'Drawing', 'Reading Irregular Word' and 'Reading Non-words'.

For Pair 3, the statistical difference was seen for all the tasks except 'Auditory Word Recognition', 'Written Word Picture Choice Matching', 'Comprehension of sentences', 'Picture to written word choice matching', 'Picture Word Written Choice Matching' and 'Spoken to written word choice matching' of WAB-R Tamil.

Table 4.19: Results of Mann-Whitney Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil in pair comparison (4.5.6) of four different types of aphasia in males

Pairwise comparison	***PWA-PGA***		***PWA-PAA***		***PGA-PAA***	
	Pair 4		**Pair 5**		**Pair 6**	
	Z Value	***P Value***	***Z-value***	***P Value***	***Z-value***	***P Value***
Conversational Questions	-3.236	0.001*	-0.973	0.331	-3.229	0.001*
Picture description	-3.113	0.002*	-0.672	0.502	-3.244	0.001*
Spontaneous speech total	-3.176	0.001*	-1.229	0.219	-3.176	0.001*
Yes/No questions	-3.109	0.002*	-2.903	0.004*	-3.122	0.002*
Auditory word recognition	-2.350	0.019*	-2.898	0.004*	-3.129	0.002*
Sequential commands	-1.895	0.058*	-2.898	0.004*	-3.119	0.002*
Auditory Verbal Comprehension	-3.047	0.002*	-2.887	0.004*	-3.112	0.002*
Repetition	-3.109	0.002*	-2.913	0.004*	-3.116	0.002*
Object Naming	-3.126	0.002*	-2.585	0.010*	-3.119	0.002*
Word Fluency	-2.543	0.011*	-2.898	0.004*	-3.122	0.002*
Sentence Completion	-2.557	0.011*	-1.092	0.275	-2.891	0.004*
Responsive speech	-0.137	0.891	-2.798	0.005*	-1.825	0.068
Naming	-3.109	0.002*	-2.887	0.004*	-3.105	0.002*
Comprehension of sentences	-1.700	0.089	-2.966	0.003*	-3.455	0.001*
Reading Commands	-1.816	0.069	-3.017	0.003*	-3.395	0.001*
Written word choice matching	-2.596	0.009*	-2.771	0.006*	-3.450	0.001*
Written word picture choice matching	-1.695	0.090	-2.994	0.003*	-3.483	0.000**
Picture to written word choice matching	-0.906	0.365	-2.994	0.003*	-3.351	0.001*
Spoken to written word choice matching	-1.700	0.089	-2.950	0.003*	-3.441	0.001*
Letter discrimination	-3.483	0.000**	-2.802	0.005*	-3.441	0.001*
Spelled word recognition	0.000	1.000	-3.207	0.001*	-3.528	0.000**
Spelling	-1.155	0.248	-3.052	0.002*	-3.483	0.000**
Reading Total	-2.968	0.003*	-2.882	0.004*	-3.309	0.001*
Writing on request	-3.116	0.002*	-2.950	0.003*	-3.317	0.001*
Written output	-2.160	0.031*	-2.913	0.004*	-3.436	0.001*
Writing to dictation	0.000	1.000	-3.127	0.002*	-3.469	0.001*
Writing dictation word	-2.160	0.031*	-2.934	0.003*	-3.455	0.001*
Alphabet and Numbers	-2.062	0.039*	-2.913	0.004*	-3.313	0.001*
Dictated Letters and Numbers	-2.605	0.009*	-2.694	0.007*	-3.431	0.001*
Copying Sentence	-3.528	0.000**	-3.000	0.003*	-3.441	0.001*
Writing Total	-3.313	0.001*	-2.887	0.004*	-3.309	0.001*
Apraxia	-3.191	0.001*	-2.898	0.004*	-3.313	0.001*
Drawing	-0.329	0.742	-2.945	0.003*	-3.233	0.001*
Block Design	-1.700	0.089	-2.966	0.003*	-3.455	0.001*

Table 4.19 continuation..						
Calculation	-2.160	0.031*	-2.913	0.004*	-3.436	0.001*
Ravens Progressive Matrices	-2.160	0.031*	-2.908	0.004*	-3.431	0.001*
Constructional, Visuospatial, and Calculation Total	-1.871	0.061	-2.892	0.004*	-3.229	0.001*
Writing Irregular Words dictation	-2.596	0.009*	-2.908	0.004*	-3.441	0.001*
Writing Non Words to Dictation	-1.695	0.090	-2.791	0.005*	-3.436	0.001*
Reading Irregular words	-1.700	0.089	-2.950	0.003*	-3.441	0.001*
Reading Non-words	-1.700	0.089	-2.945	0.003*	-3.436	0.001*
Supplementary Reading and Writing Total	-2.592	0.010*	-2.892	0.004*	-3.431	0.001*
Aphasia Quotient	-3.098	0.002*	-2.882	0.004*	-3.098	0.002*
Cortical Quotient	-3.102	0.002*	-2.882	0.004*	-3.102	0.002*
Language Quotient	-3.102	0.002*	-2.882	0.004*	-3.102	0.002*

*p value<0.05 **p value<0.001

For Pair 4, the statistical differences were seen for all the tasks except, 'Responsive speech', 'Comprehension of sentences', 'Reading Commands', 'Written word picture choice matching', 'Picture to written word choice matching', 'Spoken to written word choice matching', 'Spelled word recognition', 'Spelling', 'Writing to dictation', 'Block Design', 'Calculation', 'Constructional, Visuospatial, and Calculation Total', 'Writing Non Words to Dictation', 'Reading Irregular words' and 'Reading Non-words'.

For Pair 5, the significant differences were seen for all the tasks except, 'Conversational Questions', 'Picture description', and 'sentence completion'.

Finally, for Pair 6, the statistically significant differences were seen for all the tasks of WAB-R Tamil except 'Responsive Speech'.

Table 4.20: Results of Mann-Whitney Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil in pair comparison (1,2,3) of four different types of aphasia in females

Pairwise comparison	***PBA-PWA***		***PBA-PGA***		***PBA-PAA***	
	Pair 1		**Pair 2**		**Pair 3**	
	Z Value	***P Value***	***Z-value***	***P Value***	***Z-value***	***P Value***
Conversational Questions	-2.767	0.006	-3.078	0.002*	-2.932	0.003*
Picture description	-2.249	0.024*	-1.060	0.289	-3.070	0.002*
Spontaneous speech total	-2.731	0.006*	-1.662	0.097	-3.053	0.002*
Yes/No questions	-2.651	0.008*	-3.663	0.000**	-2.024	0.043*
Auditory word recognition	-2.654	0.008*	-3.664	0.000**	-0.748	0.454
Sequential commands	-2.647	0.008*	-3.658	0.000**	-2.180	0.029*
Auditory Verbal Comprehension	-2.647	0.008*	-3.658	0.000**	-1.704	0.088
Repetition	-0.694	0.488	-2.953	0.003*	-1.488	0.137
Object Naming	-2.703	0.007*	-1.056	0.291	-3.027	0.002*
Word Fluency	-2.162	0.031*	-1.341	0.180	-2.887	0.004*
Sentence Completion	-1.697	0.090	-0.502	0.616	-2.556	0.011*
Responsive speech	-1.404	0.160	-1.388	0.165	-2.372	0.018*
Naming	-2.654	0.008*	0.000	1.000	-2.981	0.003*
Comprehension of sentences	-2.809	0.005*	-3.844	0.000**	-1.670	0.095
Reading Commands	-2.807	0.005*	-3.783	0.000**	-0.477	0.633
Written word choice matching	-2.907	0.004*	-3.883	0.000**	-0.064	0.949
Written word picture choice matching	-2.701	0.007*	-3.765	0.000**	-1.556	0.120

Table 4.20 continuation..						
Picture to written word choice matching	-2.706	0.007*	-3.769	0.000**	-0.390	0.697
Spoken to written word choice matching	-2.987	0.003*	-3.965	0.000**	-1.856	0.063
Letter discrimination	-2.873	0.004*	-3.890	0.000**	-1.181	0.237
Spelled word recognition	-1.746	0.081	-2.481	0.013*	-3.182	0.001*
Spelling	-1.027	0.304	-1.534	0.125	-3.306	0.001*
Reading Total	-2.654	0.008*	-3.678	0.000**	-2.187	0.029*
Writing on request	-0.889	0.374	-0.757	0.449	-2.402	0.016*
Written output	-0.819	0.413	-1.747	0.081	-1.590	0.112
Writing to dictation	-1.017	0.309	-1.524	0.127	-2.633	0.008*
Writing dictation word	-0.296	0.767	-1.749	0.080	-2.619	0.009*
Alphabet and Numbers	-0.821	0.411	-0.756	0.450	-3.179	0.001*
Dictated Letters and Numbers	-1.434	0.151	-1.747	0.081	-2.163	0.031*
Copying Sentence	-0.355	0.723	-1.751	0.080	-2.902	0.004*
Writing Total	-0.819	0.413	-0.756	0.450	-2.838	0.005*
Apraxia	-0.819	0.413	-0.756	0.450	-2.444	0.015*
Drawing	-0.821	0.411	-0.756	0.450	-2.959	0.003*
Block Design	-0.446	0.656	-0.759	0.448	-2.715	0.007*
Calculation	-1.149	0.250	-2.832	0.005*	-1.350	0.177
Ravens Progressive Matrices	-1.146	0.252	-2.824	0.005*	-2.194	0.028*
Constructional, Visuospatial, and Calculation Total	-1.142	0.253	-2.411	0.016*	-2.406	0.016*
Writing Irregular Words dictation	-0.204	0.839	-2.458	0.014*	-2.559	0.011*
Writing Non Words to Dictation	-0.568	0.570	-1.427	0.153	-2.746	0.006*
Reading Irregular words	-1.240	0.215	-0.707	0.480	-3.766	0.000**
Reading Non-words	-1.700	0.089	-1.025	0.306	-3.547	0.000**
Supplementary Reading and Writing Total	-0.256	0.798	-2.516	0.012*	-2.995	0.003*
Aphasia Quotient	-0.504	0.614	-3.656	0.000**	-2.974	0.003*
Cortical Quotient	-2.649	0.008*	-3.658	0.000**	-2.977	0.003*
Language Quotient	-2.646	0.008*	-3.656	0.000**	-2.974	0.003*

With reference to female participants, for Pair 1, there was a significant difference between the groups for all the parameters of Record Form 1 and 2 except ‘Repetition’, ‘Sentence Completion’, ‘Responsive speech’, ‘Spelled word recognition’, ‘Spelling’, Reading Total, ‘Writing on request’, ‘Written output’, ‘Writing to dictation’, ‘Writing dictation word’, ‘Alphabet and Numbers’, ‘Dictated Letters and Numbers’, ‘Copying Sentence’, ‘Writing Total’, ‘Apraxia’, ‘Drawing’, ‘Block Design’, ‘Calculation’, ‘Ravens Progressive Matrices’, ‘Constructional, Visuospatial, and Calculation Total’, ‘Writing Irregular Words dictation’, ‘Writing Non Words to Dictation’, ‘Reading Irregular words’, ‘Reading Non-words’, ‘Supplementary Reading and Writing Total’ and ‘Aphasia Quotient’.

For Pair 2, the significant difference was not seen for all the parameters except ‘Picture Description’, ‘Spontaneous Speech Total’, ‘Object Naming’, ‘Word Fluency’, ‘Sentence Completion’, ‘Responsive speech’, ‘Naming’, ‘Spelling’, ‘Writing on request’, ‘Written output’, ‘Writing to dictation’, ‘Writing dictation word’, ‘Alphabet and Numbers’, ‘Dictated Letters and Numbers’, ‘Copying Sentence’, ‘Writing Total’, ‘Apraxia’, ‘Drawing’,

'Block Design', 'Writing Non Words to Dictation', 'Reading Irregular words', and 'Reading Non-words'.

For Pair 3, the statistical difference was seen for all the tasks except 'Auditory word recognition', Auditory Verbal Comprehension', 'Repetition', and 'Calculation', 'Reading Commands', 'Written word choice matching', 'Written word picture choice matching', 'Picture to written word choice matching', 'Spoken to written word choice matching', 'Letter discrimination', 'Written output' and 'Calculation'.

Table 4.21: Results of Mann-Whitney Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil in pair comparison (4,5,6) of four different types of aphasia in females

Pairwise comparison	*PWA-PGA*		*PWA-PAA*		*PGA-PAA*	
	Pair 4		**Pair 5**		**Pair 6**	
	Z Value	***P Value***	***Z-value***	***P Value***	***Z-value***	***P Value***
Conversational Questions	-2.553	0.011*	0.000	1.000	-2.775	0.006*
Picture description	-1.538	0.124	-0.535	0.593	-2.305	0.021*
Spontaneous speech total	-2.438	0.015*	-1.310	0.190	-2.683	0.007*
Yes/No questions	-2.415	0.016*	-2.121	0.034*	-2.664	0.008*
Auditory word recognition	-1.273	0.203	-2.121	0.034*	-2.658	0.008*
Sequential commands	-0.575	0.565	-2.141	0.032*	-2.658	0.008*
Auditory Verbal Comprehension	-1.943	0.052	-2.141	0.032*	-2.658	0.008*
Repetition	-2.293	0.022*	-1.061	0.289	-1.705	0.088
Object Naming	-2.477	0.013*	-1.414	0.157	-2.714	0.007*
Word Fluency	-2.453	0.014	-1.605	0.108	-2.695	0.007*
Sentence Completion	-1.519	0.129	-1.260	0.208	-2.429	0.015*
Responsive speech	0.000	1.000	-1.837	0.066	-0.289	0.772
Naming	-2.408	0.016*	-1.414	0.157	-2.658	0.008*
Comprehension of sentences	-1.528	0.127	-2.223	0.026*	-3.102	0.002*
Reading Commands	-0.495	0.621	-2.201	0.028*	-2.741	0.006*
Written word choice matching	-1.690	0.091	-2.201	0.028*	-2.917	0.004*
Written word picture choice matching	-2.291	0.022*	-2.181	0.029*	-3.083	0.002*
Picture to written word choice matching	-1.528	0.127	-2.223	0.026*	-3.102	0.002*
Spoken to written word choice matching	-2.291	0.022*	-2.160	0.031*	-3.074	0.002*
Letter discrimination	-2.277	0.023*	-2.141	0.032*	-3.074	0.002*
Spelled word recognition	0.000	1.000	-2.291	0.022*	-3.102	0.002*
Spelling	0.000	1.000	-2.449	0.014*	-3.162	0.002*
Reading Total	-1.356	0.175	-2.121	0.034*	-2.734	0.006*
Writing on request	-2.142	0.032*	-2.160	0.031*	-2.789	0.005*
Written output	-2.958	0.003*	-2.141	0.032*	-3.064	0.002*
Writing to dictation	0.000	1.000	-2.223	0.026*	-3.074	0.002*
Writing dictation word	-1.528	0.127	-2.160	0.031*	-3.074	0.002*
Alphabet and Numbers	-1.964	0.050*	-2.201	0.028*	-2.782	0.005*
Dictated Letters and Numbers	-2.958	0.003*	-1.440	0.150	-3.074	0.002*
Copying Sentence	-2.291	0.022*	-2.141	0.032*	-3.064	0.002*
Writing Total	-2.562	0.010*	-2.121	0.034*	-2.782	0.005*
Apraxia	-2.142	0.032*	-2.141	0.032*	-2.782	0.005*
Drawing	-1.964	0.050*	-2.223	0.026*	-2.789	0.005*
Block Design	-0.423	0.673	-2.223	0.026*	-2.810	0.005*
Calculation	-2.958	0.003*	-2.141	0.032*	-3.064	0.002*
Ravens Progressive Matrices	-3.000	0.003*	-2.223	0.026*	-3.074	0.002*
Constructional, Visuospatial, and Calculation Total	-2.562	0.010*	-2.121	0.034*	-2.782	0.005*

Table 4.21 continuation.						
Writing Irregular Words dictation	-2.405	0.016*	-2.223	0.026*	-2.893	0.004*
Writing Non Words to Dictation	-0.655	0.513	-2.160	0.031*	-2.893	0.004*
Reading Irregular words	-1.528	0.127	-2.160	0.031*	-3.074	0.002*
Reading Non-words	-2.291	0.022*	-2.181	0.029*	-3.083	0.002*
Supplementary Reading and Writing Total	-2.342	0.019*	-2.121	0.034*	-2.782	0.005*
Aphasia Quotient	-2.393	0.017*	-2.121	0.034*	-2.646	0.008*
Cortical Quotient	-2.393	0.017*	-2.121	0.034*	-2.646	0.008*
Language Quotient	-2.393	0.017*	-2.121	0.034*	-2.646	0.008*

For Pair 4, the statistical differences were seen for all the tasks except, 'Auditory word recognition', 'Sequential commands', 'Auditory Verbal Comprehension', 'Sentence Completion', 'Responsive speech', 'Comprehension of sentences', 'Reading Commands', 'Written word choice matching', 'Spelled word recognition', 'Spelling', 'Reading Total', 'Writing to dictation', 'Writing dictation word', 'Block Design', 'Writing Non Words to Dictation', and 'Reading Irregular words' of WAB-R Tamil.

For Pair 5, the significant differences were seen for all the tasks except, the tasks of 'Conversational Questions', 'Picture description', 'Spontaneous speech total', 'Repetition', 'Object Naming', 'Word Fluency', 'Sentence Completion', 'Responsive speech', 'Naming', and 'Dictated Letters and Numbers'.

Finally, for Pair 6, the statistically significant differences were seen for all the tasks of WAB-R Tamil and prove that there was a gender difference in persons with anomic aphasia.

4.4 Section-C- Validation of the Western Aphasia Battery-Revised in Tamil with reference to the WAB-R English on neuro-typical individuals

4.4.1 Sub-section I: The performance of bilingual neuro-typical individuals on all the sub-tests of Western Aphasia Battery-Revised Tamil and English.

The validation process was carried out for the newly adapted WAB-R Tamil, where the Mean and Standard Deviation of all the parameters derived from the administration of the Tamil version was compared with the Mean and Standard Deviation of all the parameters derived from the WAB-R English as shown in the Table 4.22. The Mean is relatively high on the WAB-R English version for the parameter 'Spontaneous speech', 'Writing', 'Constructional, Visuospatial and calculation', 'Cortical Quotient', and 'Language Quotient'. The parameter which was relatively high on WAB-R Tamil version was 'Auditory

Comprehension', 'Repetition', 'Supplemental Reading and Writing', 'Aphasia Quotient' and 'Langauge Quotient'. The parameter which showed equal mean was the 'Naming', 'Reading', and 'Apraxia'.

Table 4.22: Mean and Standard Deviation for the task in the Record Form-1 and 2 of WAB-R Tamil and English for bilingual neuro-typical individuals

Record Form-1 & 2 Paramters	WAB-R Tamil		WAB-R English	
	Mean	S.D	Mean	S.D
Spontaneous speech	19.90	0.30	19.95	0.15
Auditory comprehension	9.90	0.15	9.87	0.19
Repetition	9.81	0.38	9.80	0.40
Naming	9.70	0.64	9.70	0.64
Reading	19.70	0.64	19.70	0.64
Writing	19.67	0.37	19.72	0.33
Apraxia	9.60	0.80	9.60	0.80
Constructional, Visuospatial and calculation	9.78	0.39	9.87	0.21
Supplemental Reading and Writing	39.30	0.78	39.20	0.74
Aphasia Quotient	99.87	0.21	99.70	0.45
Cortical Quotient	99.23	0.73	99.25	0.69
Language Quotient	99.69	0.47	99.56	0.64

4.4.2 Sub-section II: The Comparison between the performance of bilingual neuro-typical adults on Western Aphasia Battery-Revised Tamil and Western Aphasia Battery-Revised English.

An attempt was also made to find the differences between the performances of the neuro-typical individuals in Tamil WAB-R and original English WAB-R using the Mann Whitney U test. The results of the Mann-Whitney U test showed no significant difference ($p<0.01$) between the scores of WAB-R English and WAB-R Tamil as shown in Table 4.23.

Table 4.23: Results of Mann-Whitney Test for the parameters of Record Form 1 & 2 of WAB-Revised Tamil versus English of bilingual neuro-typical individuals

Record Form-1 & 2 Paramters	*Z Value*	*P-value*
Spontaneous speech	0.000	1.00
Auditory comprehension	0.075	0.93
Repetition	0.037	0.96
Naming	0.037	0.96
Reading	0.037	0.96
Writing	-0.188	0.84
Apraxia	0.188	0.84

Table 4.23 continuation..		
Constructional, Visuospatial and calculation	-0.075	0.93
Supplemental reading and writing	0.453	0.65
Aphasia Quotient	0.302	0.76
Language Quotient	0.151	0.88
Cortical Quotient	0.000	1.00

4.4.3 Sub-section III: The Correlation between the sub-tests of Western Aphasia Battery-Revised Tamil and Western Aphasia Battery-Revised English.

The results for correlation analysis were to provide whether the test is consistent, positively correlated. The Spearman's correlation test was conducted as there were no significant differences among the performances on WAB-R English and WAB-R Tamil. The results showed higher correlation values which infer that all the subtests of WAB-R English and WAB-R Tamil have a strong positive correlation with each other inferring that the participants' performance was consistent in the two versions of WAB-R as shown in Table 4.24. However, due to the difficulty level of subtest items, there is a moderate positive correlation in reading and writing scores between WAB-R Tamil and WAB-R English with the Spearman's values of 0.61 and 0.69. The correlation coefficient values above 0.90 indicating that there is a presence of a strong positive correlation between scores of WAB-R English and WAB-R Tamil where the parameters like ' Spontaneous Speech', 'Repetition', 'Naming', 'Aphasia Quotient' and 'Language Quotient'. The results of the present study indicate that the WAB-R Tamil adapted from WAB-R English demonstrate preliminary validity and thus, the test material can be used in the diagnosis of aphasia with the information on severity and aphasia type.

Table 4.24: Correlation of WAB-R Tamil and WAB-R English of Bilingual Neurotypical Individuals

Sub tests	**Spearman's correlation (rho)**
Spontaneous speech	1
Auditory comprehension	0.76
Repetition	0.99
Naming	0.99
Reading	0.69
Writing	0.61
Apraxia	0.83

Table 4.24 continuation..	
Constructional, Visuospatial and calculation	0.81
Aphasia Quotient	0.99
Language Quotient	0.92
Cortical Quotient	0.87

CHAPTER V

DISCUSSION

The project aimed to develop by adapting the WAB-R (English version) in the Tamil language and standardize the Western Aphasia Battery- Revised (WAB-R) in the Tamil language by considering neuro-typical individuals and persons with aphasia. The objectives were (a). To develop by adapting the WAB-R (English version) into the Tamil language as WAB-R in Tamil. (b). To assess language aspects by administering the newly adapted WAB-R in Tamil by considering normal controls and patients with a history of Cerebrovascular Accident (CVA) or brain injury and thus implement the standardization process. (c). To differentiate between the normal control and patients with a history of CVA or diagnosed as Aphasia with reference to the scores obtained on the administration of WAB-R in Tamil and thus implement the validation process. The administration of WAB-R Tamil on neuro-typical individuals with reference to the gender Male and Female under three different age ranges 30-40 years, 41-60 years, and 61-70 years are discussed in detail. The persons with aphasia were sub-grouped under the heading of Persons with Broca's Aphasia, Person's with Wernicke's Aphasia, Person's with Global aphasia, and Person's with Anomic Aphasia are also discussed in detail. The first part of the discussion will be about the results of WAB-R Tamil in neuro-typical individuals, persons with aphasia, and later comparison between the two groups.

5.1 Neurotypicals

The neurotypical individuals (male and female participants) had an 'Aphasia Quotient' greater than 93.8 (Criteria used to diagnose aphasia according to WAB-R English) on WAB-R Tamil suggesting that the participants are neuro-typical. Hence the norms of WAB-R English can be adapted to the WAB-R Tamil version for neuro-typical. However, on detailed observation with reference to neuro-typical individuals, the performance of participants in the age range of 61-70 years was relatively reduced (Total scores) when compared to other two age range on most of the parameters 'spontaneous speech-total', 'auditory verbal comprehension-total', 'Constructional, Visuospatial and Calculation', 'Aphasia Quotient' and 'Cortical Quotient' of WAB-R Tamil. For 'naming', 'writing', 'reading', 'Supplemental Writing and Reading', 'Language Quotient' the participants in the

age range of 41-60 had relatively reduced performance compared to other age range. These results are in accordance with various normative studies reporting mild decline with increasing age, also the greatest decline was seen in the age group of 61-70 years on the administration of Western Aphasia Battery and Western Aphasia Battery-Revised (Kertesz 1974; 2006), Western Aphasia Battery in Kannada (Chengappa & Kumar, 2008), Western Aphasia Battery in Malayalam (Jenny, 1992), Western Aphasia Battery in Telugu (Pallavi, 2010), Western Aphasia Battery in Korean (Kim & Na, 2010), Western Aphasia Battery-Revised in Bangla (Keshree et al. 2013), Western Aphasia Battery in Hindi (Indian Aphasia Battery) (Kaur et al., 2017). The overall AQ showed a slight reduction of mean scores with the age increases and this finding is in concordance with the previous findings (Chengappa & Kumar, 2008; Keshree et al. 2013; Kim & Na, 2010). The additional reasons for poorer performance in an elderly aged individual could be due to their reduction in cognitive functions and motor functioning, which progress with age, and the faulty productions can also be due to the reduced psychomotor speed rather than cognitive-linguistic reduction with increasing age (Rodríguez-Aranda, 2003). However, their language remains intact (Damasio, 1981; Harada et al, 2013).

The performance of male and female participants of neurotypical individuals was also studied, the results showed a significant difference for one parameter 'sequential command' for the participants in the age range 30-40 years, in that females performs better than males (Mean Scores: Males-78.60; Females-80.00) and significant difference in two parameters 'written output' and 'Writing Total' for the subgroup of participants in the age range 41-60 years. Here also, the females scored higher in writing output and writing total than males. It has been stated that females usually perform better than males in fine motor skill (Hall & Kimura, 1995; Halpern, 1997). According to Rubia et al. (2013) the males and females have been found to differ in utilizing cortical and subcortical regions to carry out motor control . The brain lateralization provides a key to account for gender differences in language processing. Yang et al (2019) studied lateralization analysis provided with the results of males exhibited left-lateralized activation in Exner's area during handwriting, while females exhibited bilateral. Writing skill is based on maturity and stable in adults, thus the developmental and maturational factors that have been found to influence the presence of gender differences significantly (Hirnstein et al., 2013; Scheiber et al., 2015).

5.2 Persons with aphasia

The Mean and Median scores of participants with different aphasia types like Persons with Broca Aphasia (PBA), Persons with Wernicke's Aphasia (PWA), Persons with Global Aphasia (PGA), and Persons with Anomic Aphasia (PAA) was significantly reduced when compared to neurotypical individuals. With reference to Record Form 1, the persons with anomic aphasia (male and female) performed better when compared to persons with Wernicke's aphasia, persons with Broca's aphasia, and Persons with Global Aphasia on 'spontaneous speech', auditory-verbal comprehension' and 'naming' and participant from all the type of aphasia performed very poorly on 'repetition'. This result is in support of the results of Kertesz (2006) and other adaptation studies of WAB in different Indian languages.

Persons with anomic aphasia have lesser speech production difficulty compared to other types of aphasia such as persons with Broca's aphasia, and Persons with Global Aphasia (Susan & Harold, 1985) with reference to spontaneous speech tasks. The non-canonical, passive, topicalized and complex sentence production was significantly difficult for patients with agrammatic non-fluent Broca's aphasia compare to fluent aphasics on the Persian WAB (Mehri et al., 2016). The lesion in the inferior posterior portion (Broca's area) of the frontal lobe causes reduced verbal fluency, whereas anomia is a fluent type of aphasia, which has reduced difficulties in the fluency of speech and it results after damage throughout the perisylvian region in the left hemisphere. According to Kertesz (2020), the fluency deficits on the WAB have been associated with resection of the precentral gyrus and the adjacent inferior frontal cortex. Reduced information content of spoken output was associated with resection of the ventral precentral gyrus and posterior inferior frontal gyrus (pars opercularis).

Specific to 'Auditory verbal comprehension' and 'Repetition', the persons with Global aphasia had the least score followed by persons with Wernicke's aphasia and the next poorest performance was by the Brocas aphasia in both males and females. Here also, the persons with anomic aphasia had good scores and it ensures that the anomic aphasics have better auditory verbal comprehension and repetition skills compare to other types of aphasia. The research findings in Malayalam language (Jenny, 1992), Telugu language (Pallavi, 2010), Kannada language (Chengappa & Kumar, 2008) are in support with the present findings showing a hierarchy of better performance in neurotypical individuals, persons with

Anomic Aphasia, Persons with Conduction Aphasia, Persons with Wernicke's Aphasia, Persons with Broca's and Persons with Global aphasics. The nature of comprehension errors in Broca's, Conduction and Wernicke's aphasics as reported by Heilman and Scholes (1976) is that the persons with Wernicke's aphasia were made a significantly greater number of lexical errors than of the other types of aphasia and there was no significant difference found between the lexical errors made by Broca's, Conduction and control groups. Also, they have found that were no significant differences between persons with Broca's and Conduction aphasia on syntactic errors. Tanner (2003) in their research reported that any person with impairment in Wernicke's area, provided with difficulties in processing and decoding the phonological, grammatical, sensory-perceptual, and semantic aspects of language. Also, they found that persons who present with damage in the temporal areas of the brain show auditory processing difficulties which leads to poor performance in auditory comprehension. Evidence reported that damage to the parietal cortex, angular cortex, temporal middle cortex, striatum, and temporal superior cortex was associated with poor recovery of comprehension skills. . Moser et al. (2009) explained that the inferior parietal lobe functions for the processing of speech syllables and they also reported that the maintenance of speech monitoring is based on the auditory speech code.

With reference to 'Repetition tasks', the present study is in concordance with previous studies done by Wernicke, (1874) and Geschwind, (1965) and they have identified that difficulties in repetition exist in persons with aphasia, who have any structural damage to arcuate fasciculus. The disruption in the flow of information due to disconnection between anterior and posterior speech areas, where the transformation of auditory speech signals into motor speech production takes place. The persons with aphasia performed better in words, with the phrase and sentence repetition in the ascending line of order. According to Wilson et al (2015) repetition deficits were associated with lesions of the posterior superior temporal gyrus.

With reference to 'Naming task', all four types of aphasia have got the lowest scores and exhibiting word retrieval problems. From, the different types of aphasias, Wernicke's and Anomic were shared almost similar higher mean and median scores compare to Persons with Broca's and Global aphasia. The persons with Global aphasia had provided with the least score, overall of all the tasks of Record Form 1 in both males and females. The errors like paraphasias, circumlocutions, and retrieval problems revealed while performing the naming

tasks and the same is reported by Goodglass and Wingfield (1993), Benson, (1979) study on individuals with brain damage and reported that the impaired picture naming might be the result of damage to brain regions. There are several studies in the line corresponding to these results with behavioral assessment and document the results that the persons with aphasia have poorer performance in 'naming tasks' (Chengappa & Kumar, 2008; Jenny, 1992; Pallavi, 2010). It is also reported that the retrieval of even the simpler semantic verbs was difficult for persons with aphasia (Breedin et al., 1998). The deficits in conceptual and phonological lexicon influence the verb and lexical retrieval in persons with aphasia (Kim & Thompson, 2000).

In Broca's aphasia, there is a major impairment in spontaneous speech, perseverations, and agrammatism than naming difficulties. As observed in the assessment, during the object naming tasks, the reaction time was faster and the performance of persons with Wernicke's aphasia and persons with anomic aphasia is better in both males and females compared to other sub-tasks in naming. The reason for the quick response is the visual recognition of objects is predominantly related to the right temporo-occipital cortex, and the left inferior temporal cortex is related to the object name. It is believed that most lesions in the angular cortex, supramarginal cortex, posterior corona radiata, superior longitudinal fasciculus, internal capsule, temporal superior cortex, and temporal middle cortex were associated with poor recovery of naming (Sul et al., 2019).

In Responsive speech tasks, both male and female participants from all types of aphasia performed poorer compared to other sub-tasks in naming. And the performance range is maintained by scoring less than or equal to score three. Also, it has been found that there are no significant differences among all the types of aphasia of female participants on responsive speech tasks.

Luria, (1966, 1970) stated that depending on the area of damage, the naming deficits would be present. And in the late years, the reason for poorer performance in 'naming tasks' by few types of aphasia was investigated by Baldo et al., (2001). The verbal fluency is more dependent on the left frontal cortex so that the persons with aphasia who have left frontal lobe lesions would be more affected than right frontal lobe lesions. Therefore with reference to the objective evaluation, the functional imaging studies of naming tasks done by Abrahams et al (2003); Davis & Harrington (2006); Grabowski et al (2003); Hirsch et al (2001); Howard et

a1(1992); Kemeny et al (2005); Martin et al (2005); Price et al (2005); Saccuman et al (2006) have found the activation of left perisylvian and extrasylvian cortex during naming. If the individual with aphasia has a lesion in the left perisylvian and extrasylvian cortex may experience naming difficulties. seen in a person with aphasia. According to Wilson et al (2015), the naming deficits are associated with lesions of the ventral temporal cortex, with mid temporal and posterior temporal damage more predictive of naming deficits than anterior temporal damage.

The descriptive results of the tasks in Record form-2 (WAB-R Tamil version) such as Reading, Writing, Apraxia, Constructional, Visuospatial and calculation and Supplementary reading and writing provides that the mean and median values of persons with anomic aphasia and Broca's aphasia were performed better in Reading, Writing, Apraxia, Constructional, Visuospatial and calculation compare to other two types of aphasia. The global aphasia showed the least scores and it was followed by Wernicke's aphasia. And the scores of Supplementary reading and writing were almost similar in all the types of aphasia but comparatively, the persons with anomic aphasia have greater values than Broca's, Wernicke's, and Global in both male and female participants. The findings of poorer performance by different types of aphasia in non-verbal tasks such as reading, writing, constructional, visuospatial, and calculation and also the Supplementary reading and writing were revealed in the Bangla version of Western Aphasia Battery-Revised (Keshree et al. 2013). Individuals with focal brain damage experience the inability to retrieve phonological or orthographic word form from intact knowledge. The deterioration (though not significant) is seen in the auditory discrimination and repetition task across age, and this can be explained by the reduction in auditory selective attention abilities with an increase in age (Barr & Giambra, 1990). Also, the tasks like sequential commands in the auditory comprehension subtest and the repetition task relied on auditory processing abilities, and thus, the lesser deterioration might be seen with an increase in age. Albert, (1976); Burgio and Basso, (1997); Caplan and Walters, (1999); DeDe, Caplan, Kemtes, and Waters, (2004) reported that the impairment in verbal short term memory in conjunction with the aging process may result in comprehension difficulties. Korda and Douglass, (1997) executed the study on persons with stroke and resulted in disturbances in processing both verbal and nonverbal tasks.

According to Brady et al (2016) AQ is an often used, comprehensive outcome measure used in the assessment of aphasia. In the present study, it has been found that the

overall mean and median values of AQ showed that the Anomic aphasia was performed to the higher level followed by Wernicke's, then Broca's aphasia at last by Global aphasia. Kertesz (2020) stated that adding reading and writing subtests with the spoken language performance provides a Language Quotient (LQ) and Cortical Quotient (CQ), a weighted average of both the language and nonlanguage subtest scores such as praxis and calculation, and nonverbal cognition, such as Raven's matrices and Block design. In CQ and LQ, the results were varied from AQ, the scores of Anomic aphasia were highest but next, it was followed by Broca's aphasia and then Wernicke's, at last Global. The decreased performance of persons with Wernicke's aphasia in nonverbal intelligence tasks due to comprehension deficit and difficulty in recognizing the sensorimotor organization of language which restricts the understanding and performance of nonverbal tasks such as Raven's test, block design, and calculation. The results were in agreement with previous findings as the persons with Wernicke's aphasia had trouble performing the test of visuospatial logic (Kertesz & McCabe, 1974). Similarly, it was found that sensory aphasia performed poorer on Raven's test, while global aphasia had the lowest performance on non-verbal intelligence tasks (Blazková-Ctrnáctá et al., 2004).

Here also, the poor performance was seen by persons with Global aphasia in both male and female participants. The poorer AQ scores obtained by Global or severe Broca's aphasia demonstrate changes in the type of expressive errors which would be recognized on repetition and naming tasks according to Crary and Kertesz (1988). Also, similar findings were revealed by Kertesz (1974; 2006), Western Aphasia Battery in Kannada (Chengappa & Kumar, 2008), Western Aphasia Battery in Malayalam (Jenny, 1992), Western Aphasia Battery in Telugu (Pallavi, 2010), Western Aphasia Battery in Korean (Kim & Na, 2010), Western Aphasia Battery-Revised in Bangla (Keshree et al. 2013). Studies have reported that persons with aphasia showed the change in their communication abilities over time, thus the degree of change in language performances was measured by AQ (Susan & Harold, 1985; Lomas & Kertesz, 1978).

5.3 Western Aphasia Battery- Revised in Tamil: Difference at gender and age range- NTI and IWA

With reference to neuro-typical individuals, there was no significant difference between the gender male and female in most of the tasks of the newly adapted Tamil version of Western Aphasia Battery-Revised. Similar findings were reported by various authors in

different languages (Kim & Na, 2010) in Korean, (Keshree et al. 2013) in Bangla and Dravidian languages, like the Malayalam (Jenny, 1992), Telugu (Pallavi, 2010), Kannada (Chengappa & Kumar, 2008). Also, the contrary findings identified for the subgroup of participants in the age range of 31-40 years, that there was a significant difference seen for only one parameter 'sequential command' and significant difference in two parameters 'written output' and 'Writing Total' for the subgroup of participants in the age range 41-60 years.

With reference to neuro-typical individuals, the difference across the age range was analyzed in males and females using the Kruskal-Wallis test. The results revealed that there was a significant difference among the three age groups was relatively for more parameters of WAB-R Tamil in females compared to males. With reference to male participants, the difference was more with reading and few writing tasks. On observation, there was a difference between the age range for the task 'comprehension of sentences', 'Reading Total', 'Drawing', 'Supplementary Reading and Writing Total' of male participants. Here, the younger age group (31 to 40 years) performed better followed by (61-70 years) then (41-60 years in Reading Total', 'Drawing'. But in 'Supplementary Reading and Writing, it was varied to 41-60 years then 61-70 years. The increase in age always affects the accuracy and time taken to execute the task, because the processing of information reduces as the age increases. (Rodrigues et al., 2008; Rönnlund, Nybertg, Backman, & Nilsson, 2005; Salthouse, 1996). The performance of lexical retrieval in tasks may be relative to the effect of age (Mansur, Radanovic, Rüegg, Mendonça, & Scaff, 2002; Obler, Au, & Albert, 1995; Taylor & Burke, 2002) and on inhibitory functions (Bryan & Luszcz, 2000). With reference to female participants, the difference between the age range was for the task 'Sequential Command', 'Auditory verbal comprehension total, Comprehension of sentences', 'Reading total', 'Block Design', 'Constructional, Visuospatial and Calculation Total', 'Writing non-word to dictation', 'Aphasia Quotient' and 'Cortical Quotient'. The younger age group (31 to 40 years) were performed higher then followed by (41-60 years) then (61-70 years older groups in all the tasks, except sentence comprehension. In the comprehension of sentences tasks, it was varied to 61-70 years as second better performance group followed by 41-60 years.

The older adults provided with less gray matter volume, particularly the prefrontal cortex is more susceptible to gray matter atrophy which contributes to significant poor performance in older age groups in comparison to young adults, (Good et al., 2001; Jernigan

et al. 2001; Raz et al., 1997, 2004; Resnick et al., 2003). These results were in concordance with the previous findings of Raz et al (2004) who studied the variations in gray matter volume of the participant's age range from 18-77 years. And the results found that the greatest differences across age groups were observed in gray matter volume at the dorsolateral prefrontal and orbitofrontal cortices. Salat et al. (2004) reported that the differences in cortical thickness in prefrontal regions are found between young and older adults. Few other studies (Good et al. 2001; Resnick et al., 2003) noted that the parietal cortex shows more differences in gray matter volume depends on age than either temporal or occipital regions. The effect of age in prefrontal and parietal cortices may be associated with deficits in execution or motor performance tasks in older adults. Because it has been evidenced that motor control is highly rely on these brain regions in older adults (Resnick et al. 2003).

The other tasks had no statistically significant difference between different age ranges, also some of the tasks had complete positive responses. Thus, the results indicated that there were statistically significant differences between age range ($p>0.05$) only in few tasks of the WAB-R Tamil version. These results are in concordance with various studies in other languages, like the Kertesz, (1974, 2007); Indian Aphasia Battery (Kaur et al.2017), Korean (Kim & Na, 2010), Western Aphasia Battery-Revised in Bangla (Keshree et al. 2013), Susan & Harold (1985), Malayalam (Jenny, 1992), Telugu (Pallavi, 2010), Kannada (Chengappa & Kumar, 2008) and Korean (Kim & Na, 2010) WAB.

The pairwise comparison in the age ranges of neuro-typical showed a difference in 'Word fluency', 'Comprehension of sentences', overall 'Reading Total', 'Block Design', Writing irregular words' and 'Supplementary reading and writing Total' among male participants. The younger age group (31 to 40 years) performed better than older groups (41-60 years; 61-70 years) due to the reduced cortical thickness, neural degeneration, and gray matter atrophy associated with aging (Good et al., 2001; Raz et al., 2004)

In the pairwise comparison with reference to female participants, there was a difference seen for the tasks like 'Repetition', 'Comprehension of sentences', 'Reading Total', "Writing Total', 'Writing non-words to dictation', 'AQ', 'Sequential commands', 'Reading Total', 'Block design tasks' and 'total score of Constructional, Visuospatial and

Calculation' “AQ’, ‘CQ’, and Writing non-words to dictation’.Here, also the younger age group (31 to 40 years) performed better than older groups (41-60 years; 61-70 years).

To study the difference between the gender male and female participants of persons with aphasia, the analysis was done at sub-types of aphasia/sub-group level, Persons with Broca’s Aphasia shows a significant difference between the gender for the tasks like a ‘conversational question’, ‘spontaneous speech total’, ‘auditory word recognition, ‘sequential commands’, ‘auditory verbal comprehension, ‘repetition’, ‘object naming’, ‘word fluency’, ‘sentence completion’, and ‘naming’. With reference to the sub-group consisting of Persons with Wernicke’s Aphasia, there was a difference between the gender for ‘Responsive Speech’ and Persons with Global Aphasia difference was for ‘Sequential Command’. Finally, in the sub-group consisting of Persons with Anomic Aphasia the difference was for ‘Repetition’, ‘Writing Irregular Words to Dictation’, and ‘Aphasia Quotient’. Overall, the gender difference was seen in more parameters of WAB-R Tamil for the person with Broca's aphasia and Person with Anomic Aphasia. Bhatnagar, et al. (2002) also reported similar gender differences that there was no significant difference found in the Hindi speaking right-handed individuals with aphasia (Broca’s, Wernicke’s, Anomic, Global, Conduction, and Transcortical) types but the scores were more in males than females. Similar findings were reported by various authors in Dravidian languages, like the Kannada (Chengappa & Kumar, 2007), Malayalam (Jenny, 1992), Telugu (Pallavi, 2010).

In persons with Broca's aphasia females were performing better compared to males. These results were in agreement with the previous results as women had less severe forms of aphasia and greater performance on tasks than men, Basso et al. (1982). Chen and Li (2009) also found that women had less severe aphasia impairment when compared with men. Finally, Yao et al. (2015) found that men evidenced greater aphasia morbidity than women after stroke. Also, found gender differences in most of the tasks in WAB-R such as information content, fluency, repetition, sentence completion, responsive speech, yes/no comprehension, auditory word recognition, and sequential commands. Few findings noted that group differences in the types of aphasia with more men classified as having Broca’s and Wernicke’s aphasia than women (Basso et al. 1982, Chen and Li 2009, Yao et al. 2015). Broca’s aphasia was mostly observed in men (Yao et al. 2015). The reason for the poor performance of men in most of the execution tasks would be lesions causing aphasia in men

were more posteriorly located areas whereas the lesions were located more anteriorly in women. A similar finding was evidenced by Roquer et al. (2003).

In persons with anomic aphasia, males had good performance compare to females. The findings were in concordance with the recent finding noted that aphasia following stroke has been reported to affect women to a larger degree than men (Berglund et al. 2017).

The difference was studied between the type of aphasia for all the tasks of Record Form 1 and 2 of WAB-R Tamil for the male and female participants separately. With reference to both male and female participants, the results showed a significant difference between the type of aphasia for all the tasks of Record Form 1 and 2 except for the 'Responsive Speech' (female participants) of WAB-R Tamil. The reason could be the socio-cultural background, where the males are more extravert than females in the Indian scenario. Another reason could be the site of the lesion. Luria, (1966, 1970) stated that depending on the area of damage, the naming deficits would be present. Roquer et al. (2003) stated that males are more susceptible to have posterior brain lesions whereas females damage anteriorly. Wilson et al (2015) reported that the naming deficits mostly occur with middle or posterior temporal damage. And the responsive speech of naming deficits in females may be less due to the anterior lesion site.

The pairwise comparison for the sub-types of aphasia was studied, with reference to male and female participants, there was more difference for the parameters of WAB-R Tamil when the Persons with Anomic Aphasia was paired with Person with Global Aphasia, Person with Wernicke's Aphasia and Person with Brocas' Aphasia was the first observation, followed by this was when the Persons with Global Aphasia was paired with Persons with Wernicke's Aphasia and Persons with Broca's Aphasia. Finally, the Persons with Wernicke's Aphasia was paired with Person with Broca's Aphasia. The foremost reason for this is the extent of pathology in these various aphasia types, the small lesion size is Anomia and the most extended and widespread lesion is in Global aphasia.

Yourganov et al. 2015 noted that there were no brain areas are strongly predictive of anomic aphasia and no spatial pattern of brain damage specific for anomic aphasia in a neuroimaging study. It can be easily distinguished from most other aphasia types because all other aphasia types have stronger associations with particular brain areas. Also, they found that Broca's aphasia is strongly associated with damage to pars opercularis of the inferior

frontal gyrus, Broca's area. Damage to brain regions supplied by the superior division of the middle cerebral artery (MCA), such as the left posterior inferior frontal cortex and insula, result in Broca's aphasia symptomatology (e.g., non-fluent speech production, relatively spared auditory comprehension, and, in some cases, agrammatic sentence processing). Global aphasia is associated with extensive cortical damage. Middle and inferior frontal gyri, temporal regions (temporal pole; Heschl's and superior temporal gyri), insula and rolandic operculum, pre-and postcentral gyri, and putamen all had a high predictive suggestion for global aphasia. Finally, Wernicke's aphasia can be predicted from damage to angular, Heschl's, and superior temporal gyri, as well as temporal pole and putamen. And the deficits associated with Wernicke's aphasia (e.g., fluent jargon and poor auditory comprehension) are often related to damage of neural regions supplied by the inferior division of the left MCA.

The results of the Tamil version of Western Aphasia Battery-Revised administered to the persons with aphasia provided that the mean scores across most of the subtests differed statistically from the neuro-typical individuals. Bhatnager et al. (2002) has found the mean age of Indian patients with aphasia was significantly lower compare to neuro-typical individuals. These results were in agreement with the original version of WAB & WAB-R in English, Kertesz (1974; 2006), the Japanese version of WAB (Aphasia Test Construction Committee, 1986); Hebrew and Korean version of the WAB reported by Kasher et al. (1999), Zaidel et al. (2000) and Kim and Na (2004), the Persian version of WAB by Nilipour et al. (2014). Similar findings have been reported by various authors in Dravidian languages, like Malayalam (Jenny, 1992), Telugu (Pallavi, 2010), Kannada (Chengappa & Kumar, 2008), Quick aphasia Battery, (Wilson et al. 2018).

With reference to the validation, there was no significant difference between the performances of bilingual normal adults on the WAB-R English and WAB-R Tamil. This pre-test allowed us to observe the behavior, language of the individuals during interactions, collection of impressions of overall communication, and to quantify communication ability by calculating the aphasia quotient and the language quotient in both the test materials. These results were in agreement with the previous findings of the test of aphasia in Malayalam (Jenny, 1992) and the Bangla version of WAB by Keshree et al. (2013). Based on their findings, if the newly adapted version is well associated with the original version of WAB and had no significant difference, it can be considered as a linguistically unaltered better tool to evaluate the persons with aphasia.

CHAPTER VI

SUMMARY AND CONCLUSION

The project aimed to develop by adapting the WAB-R (English version) in the Tamil language and standardize the Western Aphasia Battery- Revised (WAB-R) in the Tamil language thus establish the clinical data on the Tamil Version of Western Aphasia Battery-Revised (WAB-R Tamil) by considering neuro-typical individuals (60 in total) and persons with aphasia (77 in total). The objectives were (a). To develop by adapting the WAB-R (English version) into the Tamil language as WAB-R in Tamil. (b). To assess language aspects by administering the newly adapted WAB-R in Tamil by considering normal controls and patients with a history of Cerebrovascular Accident (CVA) or brain injury and thus implement the standardization process. (c). To differentiate between the normal control and patients with a history of CVA or diagnosed as Aphasia with reference to the scores obtained on the administration of WAB-R in Tamil and thus implement the validation process. The types of aphasia considered were Person with Broca's Aphasia, Person with Wernicke's Aphasia, Person with Global Aphasia, and Person with Anomic Aphasia. The validation of the Tamil version of WAB-R with the original version of WAB-R was conducted by administering the test material on 30 Bilingual neuro-typical individuals who were native speakers of Tamil and were able to read and write Tamil and was aware of English, Hindi, or any other language.

The intra-rater test re-test Reliability was done by considering the scores of ten persons with aphasia on all subtests of WAB-R Tamil using Cronbach's Alpha Coefficient. The results of Cronbach's Alpha coefficient for all the sub-tests showed >0.7 scores on these reliability measures for all the tasks in WAB-R Tamil. The results suggested that the test was reliable for the clinical assessment. To provide, normative and clinical data on WAB-R Tamil, the mean, median, and standard deviation were calculated for neurotypical individuals and persons with aphasia with reference to age, gender, and type of aphasia using descriptive statistics.

With reference to neurotypical individuals, the results of the descriptive statistics show that the Mean and Median scores of tasks (performance) in Record form-1 (WAB-R Tamil version) under 'spontaneous speech', 'auditory verbal comprehension, 'repetition' and

‘naming’ with reference to the male participants was slightly reduced for ‘spontaneous speech-total’ and ‘auditory verbal comprehension-total’ in Group-C (61-70 years) compared to Group-A (30-40 years) and Group-B (41-60 years). For ‘Repetition-total’, Group-A was lesser compared to Group-C followed by Group-B. With reference to ‘naming-total’, Group-B was lesser than Group-C followed by Group-A.

With reference to female participants, the Mean and Median scores of tasks in Record form-1 (WAB-R Tamil version) were reduced for ‘spontaneous speech-total’ and ‘auditory verbal comprehension-total’ in Group-c (61-70 years) compared to Group-b (41-60 years) and Group-a (30-40 years). For ‘repetition-total’, there was a relatively reduced performance by Group-b, Group-c, and Group-a and for ‘naming-total’, there was a relatively reduced performance by Group-b, Group-a, and Group-c. The median values showed the maximum to all the tasks in the Record form 1 for both males and females, respectively across three different age groups.

The Mean and Median scores of ‘Reading- total’ is reduced in Group B, followed by Group C and Group A with reference to male participants and female participants. The Mean and Median scores of ‘Writing-total’ are reduced in Group-b, followed by Group-a and Group-c for male participants, and for female participants, there is a reduced score in Group-a followed by Group-c and Group-b. The Mean and Median scores of the ‘Apraxia assessment’ are the same with reference to gender and age range of neuro-typical individuals. Following the apraxia assessment, the scores corresponding to the ‘Constructional, Visuospatial and Calculation- total’ Group- C had relatively reduced scores compared to Group-A and Group-B for male participants. With reference to female participants, the ‘constructional, visuospatial and calculation- total’ score was reduced for Group-c, followed by Group-a and Group-b. Finally, with reference to ‘Supplemental Writing and Reading assessment,’ Group-B had a reduced score compared to Group- C and Group-A of male participants. With reference to female participants, Group-b has a reduced score compared to Group-a and Group-c.

To summarize the descriptive statistic at the level of ‘Aphasia Quotient- Total’ of male neurotypical individuals had relatively reduced Mean and Median for Group-C followed by Group-A and Group-B and for female neurotypical individuals the Mean and Median was reduced for Group-c followed by Group-b and Group-a. With reference to ‘Cortical Quotient-

Total' of male neurotypical individuals, Group- C was relatively reduced compared to Group-B and Group-A. For the same cortical quotients, the female neurotypical individuals had relatively reduced scores for Group-b followed by Group-c and Group-a. Finally, the 'Language Quotient Total' showed a reduced score for Group- B followed by Group-C and Group-A for male neurotypicals, and for female neurotypicals, the reduced score was for Group-c followed by Group-b and Group-a. The overall AQ showed a slight reduction of mean scores with the age increases and this finding is in concordance with the previous findings (Chengappa & Kumar, 2008; Keshree et al. 2013; Kim & Na, 2010). The additional reasons for poorer performance in an elderly aged individual could be due to their reduction in cognitive functions and motor functioning, which progress with age, and the faulty productions can also be due to the reduced psychomotor speed rather than cognitive-linguistic reduction with increasing age (Rodríguez-Aranda, 2003). However, their language remains intact (Damasio, 1981; Harada et al, 2013).

There was no significant difference between the gender in Group I for the subgroup of participants in the age range of 61-70 years, and a significant difference between the gender male and female was seen only for one parameter 'sequential command' for the subgroup of participants in the age range 30-40 years and significant difference in two parameters 'written output' and 'Writing Total' for the subgroup of participants in the age range 41-60 years. Similar findings were reported by various authors in different languages (Kim & Na, 2010) in Korean, (Keshree et al. 2013) in Bangla and Dravidian languages, like the Malayalam (Jenny, 1992), Telugu (Pallavi, 2010), Kannada (Chengappa & Kumar, 2008). Yang et al (2019) studied lateralization analysis provided with the results of males exhibited left-lateralized activation in Exner's area during handwriting, while females exhibited bilaterally. Writing skill is based on maturity and stable in adults, thus the developmental and maturational factors that have been found to influence the presence of gender differences significantly (Hirnstein et al., 2013; Scheiber et al., 2015).

The results of the Kruskal-Wallis test show a significant difference between the age range for the task 'comprehension of sentences', 'Reading Total', 'Drawing', 'Supplementary Reading and Writing Total' of male participants. With reference to female participants, the significant difference between the age range was for the task 'Sequential Command', 'Auditory verbal comprehension, Comprehension of sentences', 'comprehension of sentences', 'Reading total', 'Block Design', 'Constructional, Visuospatial and Calculation

Total', 'Writing non-word to dictation', 'Aphasia Quotient' and 'Cortical Quotient'. The reason for significant less performance in older age groups was identified that older adults exhibit less gray matter volume in comparison to young adults, the prefrontal cortex is particularly susceptible to gray matter atrophy (Good et al., 2001; Jernigan et al. 2001; Raz et al., 1997, 2004; Resnick et al., 2003).

With reference to male participants, the statistically significant difference was not seen between Group A and Group B on all the tasks except, 'Word fluency', 'Comprehension of sentences' and overall 'Reading Total'. And, for Pair-2 - Group B and Group C with male participants for all the tasks of WAB-R Tamil indicated that there was no statistically significant difference for all the tasks, except 'comprehension of sentences tasks' and overall 'reading total'. Whereas in, Pair- 3- Group C and Group D, none of the tasks had a statistically significant difference except 'Block Design', Writing irregular words' and 'Supplementary reading and writing Total'.

With reference to female participants, there was no statistically significant difference ($p<0.05$) seen between Group-a and Group-b on most of the tasks, except 'Repetition', 'Comprehension of sentences', 'Reading Total', "Writing Total', 'Writing non-words to dictation', 'AQ'. Pair 2- Group-b and Group-c indicated no statistically significant differences on all the tasks, except 'Sequential commands', 'Comprehension of sentences', 'Reading Total', 'Block design tasks' and 'total score of Constructional, Visuospatial and Calculation' "AQ', 'CQ'. The results of Pair 3- Group-c and Group-d show a significant difference for 'block design', 'Constructional, Visuospatial and Calculation', Writing non-words to dictation'.

With reference to a person with aphasia, the results of the descriptive statistics show that the Mean and Median scores of tasks (performance) in Record form-1 (WAB-R Tamil version) under 'Spontaneous Speech- Total', 'Auditory Verbal Comprehension- Total', 'Repetition- Total' and 'Naming- Total' with reference to the male and female participants with the diagnosis of aphasia was reduced when compared to neurotypical individuals. It is observed that the PAA had better performance followed by PWA, PBA, and PGA for the 'Spontaneous Speech' assessment of the WAB-R Tamil version. Under 'Auditory Verbal Comprehension assessment', the better performance was by PAA, PBA, PWA, and PGA. The performance was very poor for 'Repetition Assessment' by PGA, PBA, PWA and better performance by PAA. Finally, with reference to 'Naming Assessment', the performance was

relatively better in PAA and very poor in PWA, PGA, and PBA. With reference to gender, the PAA showed no difference whereas the PBA, PWA, and PGA showed the difference in their Mean and Median value. According to Kertesz (2020), the fluency deficits on the WAB have been associated with resection of the precentral gyrus and the adjacent inferior frontal cortex. Reduced information content of spoken output was associated with resection of the ventral precentral gyrus and posterior inferior frontal gyrus (pars opercularis). Moser et al. (2009) explained that the inferior parietal lobe functions for the processing of speech syllables and they also reported that the maintenance of speech monitoring is based on the auditory speech code. According to Wilson et al (2015) repetition deficits were associated with lesions of the posterior superior temporal gyrus. It is also reported that the retrieval of even the simpler semantic verbs was difficult for persons with aphasia (Breedin et al., 1998). The deficits in conceptual and phonological lexicon influence the verb and lexical retrieval in persons with aphasia (Kim & Thompson, 2000). The reaction time was faster and the performance of persons with Wernicke's aphasia and persons with anomic aphasia is better in both males and females compared to other sub-tasks in naming. The reason for the quick response is the visual recognition of objects is predominantly related to the right temporo-occipital cortex, and the left inferior temporal cortex is related to the object name. It is believed that most lesions in the angular cortex, supramarginal cortex, posterior corona radiata, superior longitudinal fasciculus, internal capsule, temporal superior cortex, and temporal middle cortex were associated with poor recovery of naming (Sul et al., 2019).

With reference to the 'Reading-Total', the performance of PBA was better and for PAA, PWA, and PGA the scores are very poor in both male and female participants with a similar trend. And the scores for 'Writing-Total' were better for PAA compared to PBA, PWA, and PGA, where the male and female participants both have very poor Mean and Median scores with a similar trend. The Mean and Median scores of the 'Apraxia assessment-Total' was very poorer for all the type of aphasia but participants in the sub-group of PAA was relatively better compared to PBA, PWA, and PGA. With reference to 'Constructional, Visuospatial and Calculation- total' there was better performance by PAA and very poor performance by PWA, PBA, and PGA. Finally for 'Supplemental Writing and Reading Assessment-Total' there was no response for PGA and better responses for PAA and poorer scores for PWA and PBA. To summarized the male and female participants had a similar trend of response. The reason for the poorer performance of persons with Wernicke aphasia

in non-verbal intelligence tasks due to comprehension deficit and difficulty in recognizing the sensorimotor organization of language which restricts the understanding and performance of non-verbal tasks such as Raven's test, block design, and calculation. The results were in agreement with previous findings as the persons with Wernicke's aphasia had trouble performing the test of visuospatial logic (Kertesz & McCabe, 1974). Similarly, it was found that sensory aphasia performed poorer on Raven's test, while global aphasia had the lowest performance on non-verbal intelligence tasks (Blazková-Ctrnáctá et al., 2004).

The summary of the descriptive statistic at the 'Aphasia Quotient-Total, 'Cortical Quotient- Total' and 'Language Quotient- Total' of individuals with aphasia grouped under a different type of aphasia under male and female gender. With reference to PBA, the female participants had higher Mean and Median values for the 'Aphasia Quotient' and 'Cortical Quotient' and had a similar score for 'Langauge Quotient' with no difference in gender. For PWA and PAA, the performance of male participants was better than female participants at 'Aphasia Quotient', 'Cortical Quotient' and 'Language Quotient'. For PGA, the performance of female participants was better than male participants at 'Aphasia Quotient', 'Cortical Quotient', and 'Language Quotient'. The poorer AQ scores obtained by Global or severe Broca's aphasia demonstrate changes in the type of expressive errors which would be noted on naming and repetition tasks according to Crary and Kertesz (1988).

The results of Mann Whitney U test with reference to the Persons with Broca's Aphasia shows a significant difference between the gender for the tasks like a 'conversational question', 'spontaneous speech total', 'auditory word recognition, 'sequential commands', 'auditory verbal comprehension, 'repetition', 'object naming', 'word fluency', 'sentence completion', and 'naming', all other tasks and parameters under Record Form 1 and 2 did not show any significant differences between the gender in the sub-group consisting only persons with Broca's Aphasia.

With reference to the sub-group consisting of Persons with Wernicke's Aphasia, there was no significant difference between the gender for none of the parameters of Record Form 1 and 2 of WAB-R Tamil except 'Responsive Speech'. The results corresponding to the sub-group consisting of Persons with Global Aphasia showed significant differences only for the parameter 'Sequential Command'. Finally, in the sub-group consisting of Persons with

Anomic Aphasia the significant difference was for ‘Repetition’, ‘Writing Irregular Words to Dictation’, and ‘Aphasia Quotient’.

The results of Kruskal-Wallis test shows a significant difference between the type of aphasia for all the task of Record Form 1 and 2 of WAB-R Tamil for the male participants. With reference to female participants, the results showed a significant difference between the type of aphasia for all the tasks of Record Form 1 and 2 except for the ‘Responsive Speech’ from the ‘Naming task’ of WAB-R Tamil. Broca’s aphasia was mostly observed in men (Yao et al. 2015). The reason for the poor performance of men in most of the execution tasks would be lesions causing aphasia in men were more posteriorly located areas whereas the lesions were located more anteriorly in women. A similar finding was evidenced by Roquer et al. (2003). In persons with anomic aphasia, males had good performance compare to females. The findings were in concordance with the recent finding noted that aphasia following stroke has been reported to affect women to a larger degree than men (Berglund et al. 2017).

The pairwise differences were studied by forming SIX pairs. When anomic aphasia was paired with other types of aphasia there was a significant difference compared to other pair of aphasia type. The younger age group (31 to 40 years) performed better than older groups (41-60 years; 61-70 years) due to the reduced cortical thickness, neural degeneration, and gray matter atrophy associated with aging (Good et al., 2001; Raz et al., 2004). The foremost reason for this is the extent of pathology in these various aphasia types, the small lesion size is Anomia and the most extended and widespread lesion is in Global aphasia.

With reference to the difference between neurotypical individuals and persons with aphasia, **t**he neurotypical individuals had lower performance when compared to the individuals with aphasia at three different age range. Following this, the Mann-Whitney U test was administered to examine the difference in parameters of Record Form-1 and Record Form-2 of WAB-R Tamil Version between the neurotypical individuals and individuals with aphasia at three different ages ranges. The results of the Mann Whitney U test show a significant difference between the groups for all the parameters of Record Form-1 and Record Form-2 of the WAB-R Tamil version.

The validation process was carried out for the newly adapted WAB-R Tamil, the Mean is relatively high on the WAB-R English version for the parameter ‘Spontaneous

speech', 'Writing', 'Constructional, Visuospatial and calculation', 'Cortical Quotient', and 'Language Quotient'. The parameter which was relatively high on WAB-R Tamil version was 'Auditory Comprehension', 'Repetition', 'Supplemental Reading and Writing', 'Aphasia Quotient' and 'Langauge Quotient'. The parameter which showed equal mean was the 'Naming', 'Reading', and 'Apraxia'. These results were in agreement with the previous findings of the test of aphasia in Malayalam (Jenny, 1992) and the Bangla version of WAB by Keshree et al. (2013). Based on their findings, if the newly adapted version is well associated with the original version of WAB and had no significant difference, it can be considered as a linguistically unaltered better tool to evaluate the persons with aphasia.

An attempt was also made to find the differences between the performances of the neuro-typical individuals in Tamil WAB-R and original English WAB-R using the Mann Whitney U test. The results showed no significant difference ($p<0.01$) between the scores of WAB-R English and WAB-R Tamil.

The results for correlation analysis were to provide whether the test is consistent, positively correlated. The Spearman's correlation test was conducted the results showed higher correlation values which infer that all the subtests of WAB-R English and WAB-R Tamil have a strong positive correlation with each other inferring that the participants' performance was consistent in the two versions of WAB-R. There is a strong positive correlation between scores of WAB-R English and WAB-R Tamil where the parameters like 'Spontaneous Speech', 'Repetition', 'Naming', 'Aphasia Quotient' and 'Language Quotient'. The results of the present study indicate that the WAB-R Tamil adapted from WAB-R English demonstrate preliminary validity and thus, the test material can be used in the diagnosis of aphasia with the information on severity and aphasia type.

Limitations

Lesser number of persons with aphasia in each age group and only four types of aphasia were included in the study and other types were difficult to find as a clinical diagnosis in various hospitals in Tamil Nadu. Consequently, as a future direction, it is proposed for further analyses of the effect of age in each type of aphasia in the Tamil population using WAB-R in a larger clinical population.

Implications of the study

The original characteristics of the test (Original Western Aphasia Battery in English) were maintained during the process of adaptation to the Tamil version of the Western Aphasia Battery. Thus, the test of aphasia in Tamil adapted from WAB-R has good reliability and validity. This test tool will be helpful in assessment, management as well as to give information about the type and severity of impairment with reference to the diagnostic classification criteria of WAB-R English in the persisting language functioning in the Tamil population. Therefore the adaptation of Western Aphasia Battery – Revised English to Tamil language demonstrated two major implications, first in terms of research contributing to the existing knowledge about the use of WAB-R English, and second is in terms of clinical implications in using for diagnosis of different type of aphasia with Tamil as their native language. This study employed the use of WAB R English under Record Form 1 and Record Form 2 in assessing Aphasia Quotient, Language Quotient, and Cortical Quotient.

Utilization of the study

The results from the current study will help in understanding and comparing clinical and normal performance on the various variables in detail while analyzing language, reading, writing, apraxia, and constructional, visuospatial, and calculation ability of neurotypical individuals and persons with aphasia and thus facilitates in the classification of aphasia among native Tamil language speaking population.

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	Year	Month	Day
Date of Test			
Date of Birth			
Chronological Age			

APPENDIX-D

Western Aphasia Battery- Revised (Tamil)

Record Form – Part 1I

(Supplemental)

Name:	ID Number:
Examiners Name:	
Notes:	

General recording and Scoring Directions

1. Unless otherwise indicated, score 1 point for a correct response and 0 points for an incorrect response.
2. Write NR if the patient does not respond and score as 0.
3. Unless otherwise indicated, the maximum point value for each item is in parentheses in the lower, right-hand corner of the score column.
4. If the patient's response is different from the target, write it verbatim in the space provided.

Reading

A. Comprehension of Sentences	**Materials:** Stimulus book				
	Directions: Turn to the Trial item on page 7 in the Stimulus Book. Point to the incomplete sentence and the word choices and say, **Read this sentence and point to the missing word. Choose the best word from these**. Repeat the directions if the patient does not seem to understand, if the patient does not give the correct response, point to the correct response (for this item only) and say**, this is the missing word. The tree has...Leaves. Let's try some more.** Present the test items.				
	Scoring: Circle and score the patient's response. Correct responses are in bold type.				
வினாக்கள்	பதில்			மதிப்பெண்கள்	
				Correct	Incorrect
1. மழையின் பதம்.....	a.ஊதா	b. **ஈரம்**	e. NR		
	c. வானிலை	d. கடல்			
2.காவலரின் கையில்...	a.**துப்பாக்கி**	b.குடை	e. NR		
	c. திண்பண்டம்	d. மளிகை பொருட்கள்			
3.திரு.ராமன் வாகனங்களை பழுதுபார்க்கிறார். அவர் ஒரு	a.தையல்காரர்	b. இயந்திரம்	e. NR		
	c. **மெக்கானிக்/** இயந்திர வல்லுநர்	d. பேருந்து			
4.ஆசிரியர்கள் ஒவ்வொரு இலையுதிர் காலத்திலும் பள்ளிக்கு திரும்புகிறார்கள். அவர்களால் கற்பிக்கப்படுபவர்கள்.....	a.இலைகள்	b. மாணவர்கள்	e. NR		
	c. இளவேனிற் காலம்	d. புத்தகங்கள்			
5.மண்வாரியும் ரம்பமும் பொதுவான கருவிகள். அவற்றை செய்ய உபயோகிக்கின்ற பொருள்.....	a. இலை	b. தங்கம்	e. NR		
	c. **உலோகம்/** மெட்டல்	d. பஞ்சு			
6. உழவர்கள் பெரும்பாலும் கோதுமை, சோளம் மற்றும் பிற தானியங்களை விளைவிக்கிறார்கள். அவர்களால்.....கூட உற்பத்தி செய்யப்படுகிறது.	a.நிலக்கரி	b. பாரவண்டிகள்	e. NR		
	c. பூமி	d. **காய்கறிகள்**			
7. ஆற்றல் மிக அதிகளவில் பயன்படுத்தப்படுகிறது. எண்ணை பற்றாக் குறையினால், பல நாடுகள் மாற்று எரிபொருளுக்கு அதாவது... க்கு மாறுகின்றன.	a.கொதிக்கும் நீர்	b. வங்கிகள்	e. NR		
	c. சூரியஆற்றல்	d. பொருளாதாரம்			
8.தஞ்சை பெரியகோயில்ஆயிரம்ஆண்டுகளுக்குமுன்பாகசோழபேரரசால்கட்டப்பட்டது. அதுராஜாராஜாசோழனின் ..... உச்சம்என்றுசொன்னால்மிகையாகாது.	**a.** கட்டிடக்கலையின்	b. சமையலின்	e. NR		
	c. நாட்டியத்தின்	d. பாடலின்			
			Comprehension of Sentences Score ***(Max 40)***		

B. Reading Commands	**Materials**: Stimulus Book (புத்தகம்), Pen (பேனா)	
	Direction: Turn to page 17 in the Stimulus book. Say, I want you to read this aloud and then do what it says. Present each Item in the order it appears in the Stimulus Book.	
	Repetition: Repeat the directions if the patient completes only one part of a two or three-part command or does not respond.	
	Scoring: Score each item twice; once for reading and once for the performance of the commands. Score the maximum points (in parentheses) if the patient accurately reads the item aloud (deduct paraphasias) and or correctly performs the command. Score only the part(s) of the command read accurately without paraphasias and or only the part(s) of the command performed accurately.	
வினாக்கள்	வாசிப்புக்கான மதிப்பெண்	செயல்பாட்டுக்கான மதிப்பெண்
1 1. கைகளை தூக்கவும்.	(1)	(1)
1 2.வணக்கம் சொல்லுங்கள்.	(1)	(1)
1 3.கண்களை மூடவும்.	(1)	(1)
1 1 4.காலினால் பெருக்கல் குறி இடவும்.	(2)	(2)
1 1 5.நாற்காலியை காண்பிக்கவும் பின்பு கதவினை காண்பிக்கவும்.	(2)	(2)
1 1 1 6.பேனாவைஎடுத்து, மூன்றுமுறை தட்டவும், பின்பு திரும்ப வைத்துவிடவும்.	(3)	(3)
	Reading Commands Score ***(Max 20)***	
Note: Determining Which Task to Administer Next *Directions:* Add the patient's scores from Reading tasks A and B. If the Combined Score is greater than or equal to (>/=) 50, discontinue the Reading tasks. If the Combined score is less than (<) 50, continue administration of Reading tasks C-1.		
_____/40	**A. Comprehension of Sentences Score**	
_____/20	**B. Reading Commands Score**	
_____/60	**Combined Score**	

C. Written Word-Object Choice Matching	**Materials**: Stimulus Book,	
	Direction: Place the objects in a random order in front of the patient. Turn to page 23 in the stimulus Book. Say, **Point to the object that goes with this word**. Present the rest of the Items.	
வினாக்கள்	**மதிப்பெண்**	
1. கிண்ணம்	1	0
2. சீப்பு	1	0
3. பேனா	1	0
4. பூ	1	0
5. தீப்பெட்டி	1	0
6. விசிறி	1	0
Written Word-Object Choice Matching Score *(Max 6)*		
D. Written Word-Picture Choice Matching	**Materials**: Stimulus Book,	
	Direction: Turn to pages 29 and 30 in the Stimulus Book. Direct the patient's attention to the two-page format by pointing to the word flower and saying. **Point to the picture that goes with this word.** Present the test of the items.	
வினாக்கள்	**மதிப்பெண்**	
1. பூ	1	0
2. தீப்பெட்டி	1	0
3. கிண்ணம்	1	0
4. விசிறி	1	0
5. சீப்பு	1	0
6. பேனா	1	0
Written Word-Picture Choice Matching *(Max 6)*		
E. Picture-Written Word Choice Matching	**Materials**: Stimulus Book,	
	Directions: Turn to pages 41 and 42 in the Stimulus Book and turn it so that both pages (the picture and words) face the patient. Point to the picture of the cup and say, **Point to the word that goes with this picture.** Present the rest of the items.	
வினாக்கள்	**மதிப்பெண்**	
1. கிண்ணம்	1	0
2. பேனா	1	0
3. விசிறி	1	0
4. தீப்பெட்டி	1	0

5. பூ	1	0
6. சீப்பு	1	0
Picture-Written Word Choice Matching *(Max 6)*		

F. Spoken Word-Written Word Choice Matching	**Materials**: Stimulus Book, **Direction:** Tum to page 53 In the Stimulus Book. Say, **Show me the word** மலர். Present the rest of the Items. **Scoring:** Circle the patient's response. Correct responses are in hold type.

வினாக்கள்	பதில்						மதிப்பெண்	
1.மலர்	a.கோபுரம்	b.**மலர்**	c.மரம்	d. சக்தி	e. பூங்கா	f. ஒன்றுமில்லை	1	0
2.மேஜை	a.கயிறு	b.பூஜை	c.மேஜை	d. நாற்காலி	e. துணி	f. ஒன்றுமில்லை	1	0
3.பணப்பை	a.பணம்	b.குப்பை	c.தோல்பை	d. பணப்பை	e. காசு	f. ஒன்றுமில்லை	1	0
4.ஜன்னல்	a.மின்னல்	b.ஜன்னல்	c.கண்ணாடி	d. கதவு	e. குளிர்காலம்	f. ஒன்றுமில்லை	1	0
Spoken Word-Written Word Choice Matching Score *(Max 6)*								

G. Letter Discrimination	**Materials:** None **Directions**: Transfer the Auditory Word Recognition-Letters score (sum of Items 19-21) from Record Form Part 1 (page 5) in the space below.

Letter Discrimination Score *(Max 6)*	

H. Spelled Word Recognition	**Materials**: None **Direction:** Say, Tell me what word I spell. If the patient does not understand the task, give an example not listed on the test (e.g.,ஆ-ம் is the word ஆம்). Present the test items.

வினாக்கள்	மதிப்பெண்	
1.ஆ-ம்	1	0

2எ-ரு-து	1	0
3.ப-ட்-ட-ம்	1	0
4.ப-ழ-ப்-பு	1	0
5.சு-த்-தி-ய-ல்	1	0
6.தொ-லை-பே-சி	1	0
Spelled Word Recognition Score *(Max 6)*		

I. Spelling	**Materials**: None
	Directions: Present each of the following words orally and ask the patient to spell each word. Say, **Spell the word up**. If the patient does not understand the task, give an example not listed on the test (eg.,பூனைis spelledபூ-னை). Present the test items.

வினாக்கள்	மதிப்பெண்	
1.வீடு	1	0
2.பன்றி	1	0
3.மக்கள்	1	0
4.பங்களா	1	0
5.அரண்மனை	1	0
6.அரசாங்கம்	1	0
Spelling Score *(Max 6)*		

Writing

	Materials: Stimulus Book, unlined paper, pen
	General Directions: Place a sheet of unlined paper and a pen on the table in front of the patient. Say, now I want you to write some different things. Use additional sheets of paper as necessary. After the patient finishes using a sheet of paper, label it with the patient's name and the date of testing.
A. Writing Upon Request	**Directions:** Say, Write your name and address. The patient may print or write in cursive.
	Scoring: Score I point for each recognizable word or number (Maximum = 6 points). Deduct 1/2 point for each spelling mistake or paraphasic error.
Writing Upon Request Score *(Max 6)*	
B. Writing Output	**Additional Materials:** Stimulus Book, stopwatch or watch with second hand
	Directions: Turn to page 57 in the Stimulus Book (Picnic Scene). Say, Write about what is happening in this picture or write a story about what is going on in this picture. If the patient begins to list words or write incomplete sentences, say, Write

	In sentences. Move the picture toward the patient's intact visual field if necessary. Encourage the patient to pay attention to all aspects of the picture.
	Time Limit: Allow up to three minutes for a response.
	Scoring: Score 31 points for a full description; 8 points for each complete sentence with 6 words or more; 1 point for each correct word in incomplete or short sentences; and 1 point for each isolated word up to a maximum of 10 points. Deduct 1/2 point for each spelling or paraphasic error. Do not score punctuation.
	Writing Upon Request Score *(Max 34)*
C. Writing to Dictation	**Directions:** Say, Write the following sentence: “கசடதபறவல்லினம், ஙஞணநமனமெல்லினம், யரலவழளஇடையினம." The sentence may be broken up and parts repeated once if the patient cannot remember it.
	Scoring: Score 10 points for the complete sentence or 1 point for each correct word. Deduct ½ point for each spelling or paraphasic error.
	Writing Upon Request Score *(Max 10)*

Note: Determining Which Task to Administer Next

Directions: Add the patient’s scores from Writing Tasks A-C. If the Combined Score is greater than or equal to (>/=) 40, discontinue the Writing tasks.

If the Combined score is less than (<) 40, continue administration of Writing tasks D-G.

_____**/6**	**A. Writing Upon Request Score**
_____**/20**	**B. Writing Output Score**
_____**/60**	**C. Writing to Dictation Score**
_____**/50**	**Combined Score**

D. Writing Dictated Words	**Materials:** (if needed for cueing) (கிண்ணம்,கைக்கடிகாரம்,மூக்கு,சுத்தியல், தொலைபேசி, விசிறி)
	Directions: Say, Write the following words. Dictate each word. if the patient does not respond or appears to not understand, show the actual object and gesture to the patient to write the object name. If the patient writes an unrecognizable word or does not respond. Spell the word verbally and gesture to the patient to write the object name.

	Scoring: Circle the appropriate score for each part of the task the patient performs correctly. If the patient is unable to write the correct response after cueing, circle 0.			
வினாக்கள்	**மதிப்பெண்**			
	சொல்லப்பட்ட சொல்	**பொருள்**	**வாய்மொழி எழுத்துக்கூட்டல்**	**தவறு**
1.கிண்ணம்	1	1	.5	0
2.கைக்கடிகாரம்	2	2	1	0
3.மூக்கு	1	1	.5	0
4.சுத்தியல்	2	2	1	0
5.தொலைபேசி	2	2	1	0
6.விசிறி	2	2	1	0
Writing Dictated Words Score *(Max 10)*				

E. Alphabet and Numbers	**Alphabet** ***Directions:*** Say, Write the letters of the alphabet.	
	Scoring: Score 1/2 point for each letter written (maximum= 12.5 points), even if it is out of order.	
	Numbers ***Directions:*** Say, Write the numbers 0 through 20.	
	Scoring: Score 1/2 point for each number written (maximum =10 points), even if it is out of order.	
Alphabet and Numbers Score *(Max 22.5)*		

F. Dictated Letters and Numbers	**Letters** ***Directions***: Say, **Write these letters**. Dictate the letters.	
	Scoring: Score 1 point for each correct response and 0 points for each incorrect response.	
வினாக்கள்	**மதிப்பெண்**	
ட	1	0
ம	1	0
ச	1	0
ப	1	0
வ	1	0
	Numbers ***Directions***: Say, **Write these numbers**. Dictate the letters.	
வினாக்கள்	**மதிப்பெண்**	
5	1	0

61	1	0
32	1	0
700	1	0
1867	1	0
Dictated Letters and Numbers Score *(Max 7.5)*		
G. Copying a Sentence	**Directions:** Turn to page 58 of the Stimulus Book. Say, Copy this sentence. Move the Stimulus Book toward the patient's intact visual field if necessary.	
	Scoring: Score 1 point for each correct word (up to 10 points for the complete sentence). Subtract 1/2 point for each incorrect letter.	
Copying a Sentence Score *(Max 10)*		

Apraxia

Materials:பூ, தீப்பெட்டி, சீப்பு,பல்துலக்கி / ப்ருஷ், கரண்டி, சுத்தியல், சாவி, காகிதம், தொலைப்பேசி
Directions: Say, I'm going to ask you to do some things. Try to do them as well as you can. If the patient does not perform the action adequately or indicates that he or she cannot do it, demonstrate the action for him or her to imitate. If the patient does not imitate the action adequately, provide the object (where applicable). Allow for variations in normal performance.
Scoring: Circle the score that reflects the patient's performance of each task.
Score Criteria
3 = A good performance upon command (e.g., patient whistles by pursing his or her lips and blowing to make a whistling sound; patient sniffs a flower by wrinkling his or her nose and inhaling through the nose).
2 = An approximate performance upon command (e.g., patient 'whistles' by pursing his or her lips and blowing without making a whistling sound; patient "sniffs- a flower without Inhaling); Or A good performance upon imitation (e.g., patient imitates a whistle by pursing lips and blowing to make a whistling sound; patient imitates sniffing a flower by wrinkling his or her nose and inhaling through the nose); Or Patient uses a body part as an object (e.g., fingers used as a comb through the hair).
1= An approximate performance on imitation (e.g., patient Imitates a whistle by pursing his or her lips and blowing without making a whistling sound; patient imitates sniffing a flower by grimacing or inhaling through the mouth); or An adequate performance with the object (e.g., patient sniffs with the flower).
0 = An Incorrect or no response after imitation or with the object (e.g., patient imitates pursing lips, but does not blow; patient rubs the flower on his or her nose, but does not inhale).

வினாக்கள்	பதில் வகைகள்					
	கட்டளையின்கீழ் செயலை செய்தல் <u>மதிப்பெண்கள்</u> நன்றாகசெய்தல் = 3 தோராயமாகசெய்தல்= 2		செயலைபார்த்து செய்தல் <u>மதிப்பெண்கள்</u> நன்றாகசெய்தல் = 3 தோராயமாகசெய்தல்= 2		பொருளுடன்செயலைசெய்தல் (தேவைப்பட்டால்) 1 மதிப்பெண்	தவறு
கைகளுக்கானசெயல்கள்						
1.கையைமூடவும்	3	2	2	1	1	0
2.வணக்கம் வைக்கவும்	3	2	2	1	1	0
3.டாட்டா காண்பிக்கவும்	3	2	2	1	1	0
4.தலையை சொரியவும்	3	2	2	1	1	0
5.விரலைக் கடிக்கவும்	3	2	2	1	1	0
முகத்துகுரியசெயல்கள்						
6.நாக்கை வெளியே நீட்டுங்கள்	3	2	2	1	1	0
7.கண்களை மூடுங்கள்	3	2	2	1	1	0
8.விசில் ஊதவும்.	3	2	2	1	1	0
9.மலரை முகர்வதுபோல செய்யுங்கள்	3	2	2	1	1	0
10.தீப்பெட்டியை ஊதுவது போல செய்யுங்கள்	3	2	2	1	1	0
பொருளுடன்செய்யும்**செயல்கள்**						
11.சீப்பு பயன்படுத்துவது போல செய்யுங்கள்	3	2	2	1	1	0
12.பல்துலக்கி பயன்படுத்துவது போல செய்யுங்கள்	3	2	2	1	1	0
13. கரண்டியைவைத்துசாப்பிடுவது போல்செய்யுங்கள்	3	2	2	1	1	0
14.சுத்தியலை பயன்படுத்துவது போல செய்யுங்கள்	3	2	2	1	1	0
15. சாவியை பயன்படுத்துவது போல செய்யுங்கள்	3	2	2	1	1	0
சிக்கலானசெயல்கள்						
16.காரினை எடுத்து ஓட்டுவது போல செய்யுங்கள்	3	2	2	1	1	0
17.கதவினை தட்டுவது போல செய்து அதை திறங்கள்.	3	2	2	1	1	0
18. ஒரு தாளினை மடிப்பது போல செய்யுங்கள்.	3	2	2	1	1	0

19. போன் செய்வது போல செய்யுங்கள்.	3	2	2	1	1	0
20. நாதஸ்வரம்வாசிப்பது போல செய்யுங்கள்	3	2	2	1		0
					Apraxia *(Max-60)*	

Constructional, Visuospatial, and Calculation

A. Drawing		
Materials:தூண்டல்புத்தகம், வெள்ளைகாகிதம், பேனா, கடிகாரம்		
Directions: Place a piece of paper on the table with a pen (not a pencil). Say. Draw a... If the patient fails to draw a complete figure,say, **Is this as complete as you can make it?** If the patient does not respond or does not appear to understand, turn to page 59 in the Stimulus Book and present the picture to the patient for 10 seconds. Remove the picture and repeat the item.		
Optional: If the patient still does not respond or does not appear to understand, present the picture and leave it for the patient to copy.		
Time Limit: 30 seconds per item		
Scoring: Score the point value that best reflects the patient's drawing. Deduct I point if patient needs to see the visual stimulus. Deduct 2 points if the patient draws by copying.		
வினாக்கள்	**மதிப்பிடுவதற்கான குறிப்பு**	**மதிப்பெண்**
1 . ஒரு வட்டம் வரையவும்.	2 மதிப்பெண்கள் = மூடிய வட்டம் 1 மதிப்பெண் =வளைந்த பகுதி 0 மதிப்பெண் = தவறான படம் அல்லது பதில் இல்லை	
2. ஒரு கனசதுரம் வரையவும்.	5 மதிப்பெண்கள் = உருவமும் வடிவமும் இருந்தால். பொருத்தமற்ற கோணம் இருந்தால் 1 மதிப்பெண் கழிக்கவும். 1 மதிப்பெண் = ஒன்பது கோடுகளும் வரையப்பட்டிருந்தால். 0 மதிப்பெண் = தவறான படம் அல்லது பதில் இல்லை	
3. ஒரு சதுரம் வரையவும்.	2 மதிப்பெண்கள் = மூடிய சதுரம் 1 மதிப்பெண் = நான்கு கோடுகள் 0 மதிப்பெண் = தவறான படம் அல்லது பதில் இல்லை	
4.ஒரு கடிகாரம் வரையவும். கடிகார முட்களை " பதினொன்று பத்துக்கு வைக்கவும்' (தேவைப்பட்டால் முட்களை 11.10க்கு வைக்க பயிற்சிக்குட்படுவோருக்குநி னைவூட்டவும்.)	துல்லியமான கடிகார முட்களுக்கு மதிப்பெண் வழங்காதீர்கள். 5 மதிப்பெண்கள் = சரியான படம், எண்கள் மற்றும் அமைப்பு. மணிமுள் சிறியதாக இருத்தல். 4 புள்ளிகள் = எண்கள் அல்லது அமைப்பு கிட்டதட்ட சரியாக இருத்தல். 3 மதிப்பெண்கள் = எண்களிலும் முட்களிலும் பல தவறுகள் இருந்தால். 2 மதிப்பெண்கள்= பல எண்கள் இல்லாமலும், தவறானதாகவும் அல்லது தவறான இடத்தில் வரைதல். 1 மதிப்பெண் = வட்டம் மட்டும் படம் மோசம். 0 மதிப்பெண் = புரிந்துகொள்ளவியலாத அல்லது பதில் இல்லாத.	
5.ஒரு மரம் வரையவும்.	3 மதிப்பெண்கள் = தரம்	

	2 மதிப்பெண்கள் = சமச்சீருள்ளவை 1 மதிப்பெண் =சமச்சீறற்றவை 0 மதிப்பெண் = தவறான படம் அல்லது பதில் இல்லை என்றால்.	
6.ஒரு வீடு வரையவும்.	5 மதிப்பெண்கள் = முழுமையான உருவ அமைப்பு. உருவமைப்பு இல்லாமைக்கு 1 மதிப்பெண் கழிக்கவும். விடப்பட்ட விவரங்களுக்கு 1 மதிப்பெண் கழிக்கவும். 2 மதிப்பெண்கள் = தோராயமான படத்திற்கு. 0 மதிப்பெண் = தவறான படம் அல்லது பதில் இல்லாமை.	
7.ஒரு மனிதரை வரையவும்.	5 மதிப்பெண்கள் = முழுமை மற்றும் சமச்சீருள்ளவை. படத்தின் விடுபட்டுள்ள ஒவ்வொரு பாகத்திற்கும் 1 மதிப்பெண் கழிக்கவும். (எ.கா., கை,கால், தலை, முண்டம்). 1மதிப்பெண் =தோராயம் 0 மதிப்பெண் = தவறான மற்றும் பதில் இல்லாமை.	
8.இந்தக் கோட்டில் நடுப்பகுதியை/மையப்பகுதியை குறிக்கவும். (கீழே உள்ள கோட்டினை காண்பிக்கவும்.)	3 மதிப்பெண்கள் = மையப்பகுதியின் 5மிமீ க்குள் இருந்தால் ஒவ்வொரு 5மிமீ வேறுபாட்டிற்கும் ½ மதிப்பெண் குறைக்கவும். 0 மதிப்பெண் = பதில் இல்லாமை.	
	Drawing Score *(Max-30)*	

B. Block Design

Materials: Stimulus Book, four blocks, stopwatch or clock with a second hand

Demonstration and Trial Item

***Directions*:** Place the four blocks on the table in front of the patient. Say, Look at these blocks. They are all alike. On some sides they are all red, on some all-white, and on some, half red and half white. Turn to page 65 in the Stimulus Book. Say, I am going to put the blocks together to make them look like this picture. Watch me first. Slowly arrange the blocks to match the design In the Stimulus Book. Then mix up the blocks. Say, now look at the picture and make one just like it with the blocks. If the patient falls to replicate the picture in 90 seconds, mix up the blocks and have him or her try again.

Test Items

Directions: Present the test Items even if the patient fails to correctly replicate the Demonstration Item. Turn to page 65 in the Stimulus Book and say, Put the blocks together to make them look like this picture. Allow the patient at least 2 minutes before presenting the next item. Mix up the blocks after each item.

Repetition: None. Allow the patient only one attempt per item

Scoring: Circle the point value that best reflects the patient's drawing.

3 points = Correct design within 60 seconds
2 points = Correct design with extra time (up to two minutes)
1 point = Four blocks put together, but design is incorrect
0 points = Four blocks not put together or no response

Item	*Score*
1.	
2.	
3.	

Block Design Score *(Max-9)*	

C. Calculation							
Materials: Stimulus Book							
Directions: Turn to page 69 in the Stimulus Book. Point to the equation and say, I would like you to add. What is 5 + 4? The patient may respond orally or by pointing to the correct answer on the stimulus page. Present the rest of the items.							
Scoring: Circle the patient's response. Correct responses appear in bold type.							
Item	**Response**					**Score**	
I would like you to add. What is 5+4?							
1). 5+4	**a. 9**	b. 20	c. 1	d. 8	e. NR	2	0
2). 6+2	a. 4	b. 12	**c. 8**	d. 3	e. NR	2	0
3). 4+3	a. 6	b. 12	**c. 7**	d. 4	e. NR	2	0
I would like you to subtract. What is 6-2?							
4). 6-2	a. 8	**b. 4**	c. 12	d. 3	e. NR	2	0
5). 9-7	a. 16	**b. 2**	c. 5	d. 63	e. NR	2	0
6). 8-3	**a. 5**	b. 3	c. 24	d. 11	e. NR	2	0
I would like you to multiply. What is 4x2?							
7). 4x2	a.7	b. 2	**c.8**	d.6	e. NR	2	0
8). 5x3	a.6	b.2	c.8	**d.15**	e. NR	2	0
9). 6x7	a.2	b.11	**c.42**	d.25	e. NR	2	0
I would like you to divide. What is 8/4?							
10). 8+4	a. 12	**b. 2**	c. 32	d. 4	e. NR	2	0
11). 64+8	a. 13	b. 56	**c. 8**	d. 72	e. NR	2	0
12). 18+3	a. .4	b. 21	c. 15	**d.6**	e. NR	2	0
Calculation Score *(Max-24)*							

D. Raven's Coloured Progressive Matrices (RCPM)		
Materials: Raven's Coloured Progressive Matrices (RCPM) Stimulus Book, stopwatch		
Directions: Open the RCPM Stimulus Book to Set A, Item Al. Point to the pattern and then the six pieces below It and say, Point to the piece that Is missing, or say, Look at this pattern. A piece is missing. It Is one of these. Point to the piece that goes there. Present the remaining items.		
Scoring: Record the number corresponding to the patient's response or NR if the patient does not respond. Correct responses appear in bold type below. Score I point for each correct response and 0 points for each incorrect or no response.		
Time Bonus: if all three item sets are completed in 5 minutes or less, add I point to the patient's score.		
Set A	**Set B**	**Set C**

Item	Response	Score		Item	Response	Score		Item	Response	Score	
A1	____4	1	0	A_b1	____4	1	0	B1.	____2	1	0
A2	____5	1	0	A_b2	____5	1	0	B2.	____6	1	0
A3	____1	1	0	A_b3	____1	1	0	B3.	____1	1	0
A4	____2	1	0	A_b4	____6	1	0	B4.	____2	1	0
A5	____6	1	0	A_b5	____2	1	0	B5.	____1	1	0
A6	____3	1	0	A_b6	____1	1	0	B.6	____3	1	0
A7	____6	1	0	A_b7	____3	1	0	B7.	____5	1	0
A8	____2	1	0	A_b8	____4	1	0	B8.	____6	1	0
A9	____1	1	0	A_b9	____6	1	0	B9.	____4	1	0
A10	____3	1	0	A_b10	____3	1	0	B10.	____3	1	0
A11	____4	1	0	A_b11.	____5	1	0	B11.	____4	1	0
A12	____5	1	0	A_b12	____2	1	0	B12.	____5	1	0
Set A Sub total (Max 12)				**Set A_b Sub total (Max 12)**				**Set B Sub total (Max 12)**			
Finish Time ____											
Finish Time- Start Time= Total Time ____ Minutes											
Time Bonus: Completed in 5 minutes or less? Yes= 1 No= 0											
Raven's Colored Progressive Matrices (RCPM) Score (A+ A_b + B = Time Bonus) = _____(Max 34)											

Supplemental Writing and Reading

A. Writing Irregular Words to Dictation

Materials: Unlined paper, pen

Directions: Say, **Write the following words**. Dictate each word to the patient.

Repetition*:* Repeat each item once if the patient requests or does not respond.

Discontinue Rule: If the patient does not respond to five consecutive items, discontinue the task and do not administer Writing Non-Words to Dictation. Write DC next to the items you do not administer and score as 0 points.

வினாக்கள்	மதிப்பெண்	
1.ஆற்றோரம்	1	0
2. ஈடற்ற	1	0
3. ஓய்வூதியம்	1	0
4. உடலுழைப்பு	1	0
5. இலாபம்	1	0

6. வகையீட்டுச்செயலி	1	0
7. அய்யப்பன்	1	0
8. ஓருயிர்	1	0
9. இஃது	1	0
10. கடனீந்தோர்	1	0
Writing Irregular Words to Dictation Score *(Max-10)*		

B. Writing Non-Words to Dictation		
Materials: Unlined paper, pen		
Directions: Say, The next words are nonsense words. Writs exactly what you hear. Dictate each word to the patient.		
Repetition: Repeat each item one time if the patient requests or does not respond.		
Discontinue Rule: If the patient does not respond to five consecutive words, discontinue the task. Write "DC" next to the Items you do not administer and score as 0 points.		
வினாக்கள்	மதிப்பெண்	
1. கசடதபற	1	0
2. ரவனம்	1	0
3. கசவை	1	0
4. சஹாபி	1	0
5. மச்சை	1	0
6. களக்கடு	1	0
7. ஆடிங்கம்	1	0
8. ஜாலம்	1	0
9. விவகாசம்	1	0
10. பொலிக்கட்டு	1	0
Writing Non-Words to Dictation Score *(Max-10)*		

C. Reading Irregular Words		
Materials: Stimulus Book		
Directions: Turn to page 81,82 In the Stimulus Book. Say, Read these words aloud. Present the rest of the items.		
Discontinue Rule: If the patient does not respond to five consecutive items, discontinue the task. Write "DC" next to the items you do not administer and score as 0 points.		
வினாக்கள்	மதிப்பெண்	
1. ஆற்றோரம்	1	0
2. ஈடற்ற	1	0
3. ஓய்வூதியம்	1	0
4. உடலுழைப்பு	1	0
5. இலாபம்	1	0
6. வகையீட்டுச்செயலி	1	0
7. அய்யப்பன்	1	0

8. ஓருயிர்	1	0
9. இஃது	1	0
10. கடனீந்தோர்	1	0
Reading Irregular Words Score *(Max-10)*		

D. Reading Non- Words		
Materials: Stimulus Book		
Directions: Turn to page 83,84 in the Stimulus Book. Say, the next words are nonsense words. Read them aloud.		
Scoring: Allow for reasonable variations in the pronunciation of non-words		
Discontinue Rule: if the patient does not respond to five consecutive items, discontinue the task. Write "DC next to the items you do not administer and score as 0 points.		
வினாக்கள்	மதிப்பெண்	
1. கசடதபற	1	0
2. ரவனம்	1	0
3. கசவை	1	0
4. சஹாபி	1	0
5. மச்சை	1	0
6. களக்கடு	1	0
7. ஆடிங்கம்	1	0
8. ஜாலம்	1	0
9. விவகாசம்	1	0
10. பொலிக்கட்டு	1	0
Reading Non-Words Score *(Max-10)*		

Score Summary Worksheet- Record Form 2

Reading	**Patient's Score**	
A. Comprehension of Sentences	_____/40	
B. Reading Commands	_____/20	
C. Written Word-Object Choice Matching	_____/6	
D. Written Word-Picture Choice matching	_____/6	
E. Picture-Written Word Choice Matching	_____/6	
F. Spoken Word-Written Word Choice Matching	_____/4	
G. Letter Discrimination	_____/6	
H. Spelled Word Recognition	_____/6	
I. Spelling	_____/6	
Reading Total	_____/ 100	
Divided by 5	_____/20	**Reading Score** (Use to calculate LQ)
Divided by 10	_____/10	**Reading Score** (Use to calculate CQ)
Writing		
A. Writing Upon Request	_____/6	
B. Writing Output	_____/34	
C. Writing Dictation	_____/10	
D. Writing Dictated Words	_____/10	
E. Alphabet and Numbers	_____/22.5	
F. Dictated letters and Numbers	_____/7.5	
G. Copying a Sentence	_____/10	
Writing Total	_____/100	

Divided by 5	_____/20	**Writing Score** (Use to calculate LQ)
Divided by 10	_____/10	**Writing Score** (Use to calculate CQ)

LANGUAGE QUOTIENT (LQ)	
_____/20	**Spontaneous Speech Score** (Record Form Part 1)
_____/ 20	**Auditory Verbal Comprehension Score for LQ and CQ** (Record Form Part 1)
_____/10	**Repetition Score** (Record Form Part 1)
_____/10	**Naming and Word Finding Score** (Record Form Part 1)
_____/ 20	**Reading Score** for LQ
_____/ 20	**Writing Score** for LQ
_____/100	**Language Quotient (LQ)**

Prorated Reading Total

Directions: If the patient's Combined Score on Reading tasks A and B is greater than or equal to (>/=) 50, and tasks C-1 are not administered, calculate the patient's Reading Total using this formula: 100-2 (60- patient's Combined Score).

Prorated Writing Total

Directions: If the patient's Combined Score on Writing tasks A-C is greater than or equal to (>/=) 40, and tasks D-G are not administered, calculate the patient's Writing Total by multiplying the Combined Score by 2.