Validation of Instrumental Activities of Daily Living-Elderly scale to screen individuals with Mild Cognitive Impairment

Maharunnisa, P.

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ALL INDIA INSTITUTE OF SPEECH AND HEARING

MANASAGANGOTHRI, MYSURU – 570006

May, 2017

CERTIFICATE

This is to certify that this dissertation entitled **"Validation of Instrumental Activities of Daily Living-Elderly scale to screen individuals with Mild Cognitive Impairment"** is a bonafide work submitted in part fulfillment for degree of Master of Science (Speech-Language Pathology) of the student Registration Number: 15SLP017. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru
May, 2017

Prof. S.R. Savithri
Director
All India Institute of Speech and Hearing
Manasagangothri, Mysore-570006

CERTIFICATE

This is to certify that this dissertation entitled **"Validation of Instrumental Activities of Daily Living-Elderly scale to screen individuals with Mild Cognitive Impairment"** has been prepared under my supervision and guidance. It is also being certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru
May, 2017

Guide
Dr. T. Jayakumar
Reader in Speech Sciences
Dept of Speech-Language Sciences
All India Institute of Speech and Hearing
Manasagangothri, Mysore-570006

DECLARATION

This is to certify that this dissertation entitled ***"Validation of Instrumental Activities of Daily Living-Elderly scale to screen individuals with Mild Cognitive Impairment"*** is the result of my own study under the guidance of Dr. T. Jayakumar, Reader in Speech Sciences, Department of Speech-Language Sciences, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru **Registration No.: 15SLP017**

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Chapter I

INTRODUCTION

Aging is a process of growing older at cellular, organ and whole body level throughout the life span (Medawar, 1995). It is characterized by decline in sensory functions and physiological functions of many organs and its system. During the aging process the biological, psychological and social structure of an individual will exhibit a progressive change. According to the literature, there are apparent linear decline in the physiological functions in men between 30-90 years of age. The rate of decline in these functions will change depending upon the age and organs. As you get older, the time (speed) taken by the brain to process an information will also increases and there will be a decline in vision, olfaction, audition, touch and taste. The effectiveness of immune system gradually regresses. As you get older, the only positive sign is that your capability to appreciate, infer information increases with age. During normal aging period associated memory changes are observed, during this stage the processing and retrieval of information slows down along with decreased flexibility in thinking and paying attention to challenging tasks. They also experience more trouble recalling recent than past events. There are also other factors associated with age related memory changes, such as vision and hearing loss, medical complications , poor nutrition and diet, lack of exercise , social isolation , Depression, anxiety and fatigue.

During the normal aging process, subtle cognitive deficits are observed in elderly population. This cognitive changes can affect their day to day functional activities. This

condition which is characterized by a transitional period between expected decline of normal aging and the more serious decline of dementia is called as Mild Cognitive impairment (MCI) .Persons with MCI exhibits decline in instrumental activities of daily living (IADL) with preserved basic activities of daily living (Brown, Devanand, Liu & Caccappolo 2011). MCI are of two types, they are amnestic and non-amnestic. Amnestic variety exhibits clinically crucial memory deficits but does not meet conditions for dementia. Non-amnestic variety exhibits subtle decline in function that affects attention, use of language and visuospatial skills. Recent studies on amnestic variety have shown that, 90% of such cases develops clinical signs of Alzheimer's disease (AD) whereas non amnestic variety appears to be forerunners of dementia not associated to Alzheimer's disease such as froto-temporal lobar or Lewy body dementia.

It is very important to recognize the normal cognitive variations because, these can disturb an elder adult's day to day function as well as this will help us to distinguish normal from disease states. MCI has a greater risk of developing into Alzheimer disease (Chertkow, Massoud, Nasreddine, Belleville, Joanette, Bocti & Bergman, 2008) and these population will have memory impairment beyond that estimated for age and education yet are not demented (Gauthier et al., 2006). These individuals with MCI are becoming the motivation for many prediction studies and early intervention trials.

Individuals with MCI will have concern about their forgetfulness; either from a patient, family or caregiver and they are characterized by lower cognitive performance than

would be expected for age/education for domains such as memory (specifically new learning), Executive function, attention, language, visual spatial skills. Individuals with MCI will have frequent word finding difficulty. They have a lack of recent memory for important and needs prompting or need for use of other cue. Because of their forgetfulness they will misplace the objects frequently and will have difficulty in tracing and locating them within home environment and frequently repeats the same story about a particular time of life. Whereas in normal aging the client will be more concerned about his forgetfulness than is family members and they are characterized by occasional word finding difficulty. In normal aging recent memory for important events is lacking on occasion, occasionally misplaces objects but is able to retrace steps and locate them within home environment and Loves to reminisce about one particular time of life.

According to literature aging is one of the risk factor to develop MCI, during this period there is a higher chances of physical, psychological, and emotional changes that can increase MCI risk (Partridge & Barton, 1996). Recent genetics study on MCI highlights that, researchers have found levels of B-amyloid plaques to be greater in those individuals with MCI and AD , Tau and B-amyloid plaques found in CSF are indicators for predicting conversion from MCI to dementia (Lo et al., 2011). Research has shown that, individuals with lesser years of formal education and less intellectually engaged activities are more likely to develop MCI, literature on brain imaging studies shows an increased blood flow and metabolism in the areas of brain doing the heavy cognitive task. Education and

intellectual engagement are thought to foster more and denser connections between brain cells. Metabolic health conditions such as hypertension, diabetes, and obesity, smoking and high cholesterol can trigger the risk of developing MCI (Anderson et al., 2008). These conditions can increase the risk of both a major stroke and small lesions in the white matter that can affect cognition. Psychological status of an individual plays an important role, people with depression are more likely to develop MCI, this is because depression can make the people vulnerable to cognitive decline and is a common response to early cognitive changes and it is the symptom of the brain changes that occur with MCI (particularly damage to the hippocampus, which is important for memory and is very sensitive to stressors).

Extensive survey of literature shows that in the past decade, few longitudinal studies have systematically looked at the longitudinal course of MCI and the neuropsychological predictors of MCI from that of cognitively unimpaired elder subjects. Review of literature indicates that Montreal Cognitive Assessment Tool (MoCA) is a very good tool to identify individuals with MCI. The MoCA was introduced by Nasreddine et al., (2005) as a brief screening tool for MCI in English language and has become a widespread screening tool for identifying cognitive impairment. It is a brief tool and can be administered within 10 min. MoCA has greater sensitivity and specificity for MCI and has good test-retest reliability, content validity and internal consistency (Nasreddine et al., 2005).

MoCA has been studied in patients with different conditions like MCI, Alzheimer's disease (AD), Vascular Cognitive Impairment, PD, Huntington's disease, Epilepsy, Traumatic brain injury, Frontotemporal dementia, Multiple sclerosis and Tumours of brain and found to be a useful screening tool in all these conditions.

Need for the study

There is an increased need for the early detection of MCI because people with this condition are at increased risk for developing Alzheimer's disease or other types of dementia compared with similarly aged individuals in the general population (Chertkow et al., 2008).

Prevalence of MCI was found to be 10-20% in population based studies of those 65 years or older, as per the study conducted by Mayo clinic on aging, it was found that subjects with 70-89 years of age has 11.1% of chances to develop amnestic MCI and 4.9% of non-amnestic MCI.

It has been reported in earlier studies that the incidence of dementia in general population was 1-2 % per year, in community based studies the incidence was found to be 5-10%. Factors such as aging, intellectual engagement, genetics, depression, and metabolic health has high risk of developing MCI. MoCA is one test used to detect MCI, However the client performance is required for that and using that test for large scale screening may not be practical. Hence, subtle cognitive deficits can be detected through the use of instrumental activities of daily living for elderly (IADL-E). This is a valuable tool for screening patients with early-stage disease, both to assess the level of disease and to

determine the patient's ability to care for him- or herself. Time requirement and the client involvement also less. There are no much studies done on Indian population to screen MCI using IADL.

Aim of the study

The present study aims to validate the IADL-E for individuals with mild cognitive impairment in Indian population

Objective of the study

- To estimate the IADL-E score for normal elderly individuals and individuals with MCI.
- Correlation of MoCA scores with IADL-E score in normal elderly individuals and individuals with MCI.

Chapter II

REVIEW OF LITERATURE

Aging process can result in three possible cognitive outcomes which includes, normal age related cognitive decline which is referred as normal and healthy aging, and age associated memory impairment and dementia. Cognitive impairment is when a person has difficulty in memorizing, learning new concepts, attending towards a particular stimulus or activities, or making decision in their daily living activities. One area which is most likely affected is attention which is the ability to take in information and retain it. They will have a serious deficit in problem solving and executive functioning. Memory deficit and difficulty recalling will increase as the disease progress and they will also exhibit visual spatial processing difficulties, which is the difficulty in recognizing visual patterns; language; verbal fluency and psychomotor speed, the ability to quickly process written and oral information is also affected. These impairment ranges based on the difficulty they are facing, it can range from mild to severe.

There are various diseases that can result in cognitive decline in an aged individuals, such as lack of vitamin B12, depression, folic acid, long term alcohol abuse, stress related diseases, diabetes, cardiovascular diseases and multimorbidity factors. Neurodegenerative diseases can also result in cognitive impairment such as Parkinson disease, Alzheimer disease, Frontotemporal dementia and multiple sclerosis (Costafreda et al., 2011). A significant acceleration of cognitive decline appears several years before a diagnosis of dementia (Thorvaldsson et al., 2011). Age is considered to be the major risk

factor for the cognitive impairment, other risk factors include family history, brain injury, heart disease, family education level, chronic conditions such as Parkinson's disease and diabetes.

Age associated memory impairment is seen even in healthy individuals between the age range of 65 and 91 and they are characterized by a significant slowing of psychomotor speed than younger individuals as well as evidenced by slowing of the electrical activity of the brain measured by EEG (Salthouse,1985). These individuals will have preserved occupational and social functioning. Conditions such as depression and dementia should be ruled out.

Mild cognitive impairment is a condition wherein an individual lies in between the boundary of normal aging and dementia and these individuals will demonstrate impairments usually only in one domain (eg, memory) who do not meet criteria for clinical diagnosis of dementia with preserved occupational and social functioning. Research findings specifies that the cognitive deficits in MCI are not restricted to episodic memory deficits with several studies supporting the semantic memory deficit, especially for the knowledge of people (Ahmed et al., 2008).Some of the commonly used cognitive screening tools includes- Mini-Mental State Examination (MMSE), Short Test of Mental Status (STMS), Montreal Cognitive Assessment (MoCA), Saint Louis University Mental Status Examination (SLUMS), Brief Cognitive Assessment Tool (BCAT) & BCAT-SF**.**

A study was done by Farias, Mungas, Reed, Harvey, & DeCarli, 2009) in clinic-vs community-based cohorts to identify the progression of mild cognitive impairment to dementia. The aim of the study was to identify whether the conversion rate to dementia from mild cognitive impairment varied according to the source of recruitment. Prospective study at a single center was carried out to examine the rate and predictors of conversion. In this study 46% of participants were enrolled from a clinical setting and 54% from community outreach. They followed 111 individuals with MCI longitudinally for 2.4 years. Results reveals that 28 individuals progressed into dementia, with the clinical sample at a conversion rate of 13%, whereas the community sample with the annual conversion rate of 3%. The author concluded that the clinical sample showed conversion rates higher than that of community based samples because of the baseline functional impairment which attributed for the differences in rate of conversion across the two cohorts as measured by Clinical Dementia Rating Scale. Hence these results supplement to the emerging literature to suggest that the significant predictor of progression to dementia is the baseline functional impairment and its degree and may support to elucidate discrepancies in findings between epidemiological and clinic-based studies.

Dementia is a chronic and progressive condition which causes disturbance in intellectual abilities and result in behavioral and personality changes. Dementia is a syndrome rather than a diagnosis. Dementia are of different types, most common types includes –Alzheimer's dementia, vascular dementia and mixed dementia. Other forms includes Lewy body dementia and Frontotemporal dementia.

In early stages these individuals will exhibit deficits in attention and concentration and memory impairment. They will have semantic memory deficit which is exhibited as word finding difficulty which is caused due to impairment in memory stores (Hodges & Patterson, 1995). Remote, autobiographical memory gradually deteriorates over time (Greene, Patterson, Xuereb, & Hodges, 1996). Expressive speech is fluent, with no articulation, phonological, or syntactic difficulties, but semantic memory impairments begin to surface as intermittent and subtle problems. They begin to have complications with word finding, expressing and comprehensing abstract language, and following complex conversation. Reading comprehension, writing, and pragmatic skills remain preserved. Dementia may be caused by the following conditions such as Metabolic conditions (e.g., thyroid disease, liver disease, and diabetes), Neoplasms, Toxins (e.g., alcohol and heavy metals), Infections (e.g., meningitis, neurosyphilis and HIV), Autoimmune disorders (e.g., multiple sclerosis and lupus), Nutritional disorders (e.g., deficiencies in thiamine, folate, and vitamin B), Pharmaceutical drug effects (e.g., drug interactions), Normal – pressure hydrocephalus.

The correlation between cognitive function, capacity to carryout activities of daily living and perceived health related quality of living in the community of Linköping was carried out by Johansson, Marcusson, & Wressle, (2012). The study consisted of 373 subjects with age of 85 years. The study was done as a part of the Elderly in Linköping Screening Assessment 85 (ELSA 85). The test findings revealed that individuals with MCI

performed poorly on activities of daily living and they had lower health related quality of living.

Koskas, Henry, Feugeas, Poissonnet, Peyneau & Drunat, (2014) who examined the diagnostic ability of the Lawton Instrumental Activities Daily Living (IADLs) scale and the Activities Daily Living (ADLs) scale as a sensitive tool to early Alzheimer's disease (AD) in community-dwelling elderly people. He found that, the sensitivity of ADL scale or IADL-4 item or the MMSE was low (52%-57%). The most effective early detection of AD used both the IADLs-4 item and the MOCA with a threshold score of 20. Besides age and memory scores, the main correlates of IADLs scale or ADLs scale were executive, neuropsychiatric, vascular, and extrapyramidal scores.

Johansson, Kvitting, Wressle, & Marcusson, (2014) evaluated the diagnostic accuracy and clinical utility of a cognitive screening instrument named Cognistat for identifying individuals with cognitive impairment in a primary care population. The author concluded that Cognistat has a very good sensitivity and specificity of 0.85 and 0.79 with relatively good diagnostic accuracy when compared to MMSE which had sensitivity of 0.59 and specificity of 0.91. Johansson et al., (2014) did a study which aimed to develop an instrument named the Cognitive Impairment in Daily Life (CID) to measure self-perceived or caregiver reported ability to perform activities of daily living in individuals with cognitive impairment and dementia. It was found that the CID has good content validity.

Johansson, Marcusson, & Wressle (2015) conducted a study to explore the experiences of cognitive impairment, its impact on everyday life activities and the necessity for support in individuals with mild cognitive impairment or mild dementia and their relatives. Interviews for the study was carried out on 13 subjects which consisted of five with MCI and eight with mild dementia and their relatives. The findings was that individuals with MCI and dementia faced cognitive decline that could be onerous and consequence was the altered activity patterns. In summary, these results supports the previous findings in the field of MCI which opines that even at the very early stage of cognitive dysfunctions it has an effect on standard of living and decreases perceived quality of life. Hence it is very important to look at the activities of daily living during assessment to improve the intervention.

Following are the some of the studies which compared Moca with other tools to evaluate its sensitivity and specificity when compared to other tools in predicting MCI.

The MMSE (Folstein, & McHugh 1975) is a commonly administered tool for cognitive screening in individuals with Dementia. MMSE is being used in different parts of the world and has greater sensitivity in predicting dementia but it is less sensitive for the prediction of MCI and early cognitive dysfunction seen in Parkinson's disease (PD). Research studies indicates that MMSE shows a ceiling effect in patients and normal controls. Recent studies on individuals with PD presented that, almost half of patients with normal MMSE score have a cognitive dysfunction when tested with MoCA.

A hospital based cross-sectional study was done by Radhamani (2005) with the objective of cross-cultural adaptation of MoCA scale into Malayalam and to evaluate the validity and reliability of MoCA-Malayalam for cognitive assessment in individuals with PD. They administered MoCA on 70 patients with PD and 60 controls matched for age and education. They assessed the metric properties and the comparison of performance score was done between the validated Malayalam version of MMSE and Addenbrooke's Cognitive Examination (ACE). They reported that MMSE-M has a very good internal consistency and test-retest reliability, similar to the original version of MoCA and its score was correlating well with the MMSE and ACE score. They concluded that MoCA-M is a very good tool for early predictive screening and management for cognitive decline. MoCA-M scores differed significantly between individuals with PD and normal volunteers, paralleling the observation in a more elaborate and established cognitive testing instrument- the Malayalam version of ACE.

A validation study of MoCA was done by Nasreddine, Phillips, Bédirian, Charbonneau, Whitehead & Chertkow (2005) in French language. He administered MoCA and MMSE on 94individuals with MCI, 93 individuals with mild AD and on 90 controls. He measured the sensitivity and specificity of both tools for identification of MCI and mild AD. The author reported that, using a cut-off score 26, the MMSE had a sensitivity of 18 % to detect MCI, whereas the MoCA had 90% sensitivity. In the mild AD group, MoCA detected 100%, whereas MMSE had 78% sensitivity. Both MMSE and MoCA has outstanding specificity (100% and 87%, respectively).

A comparative study between MMSE and MoCA was done by Aggarwal & Kean (2010). A longitudinal study was done to associate the efficacy of the MMSE and MoCA in a rehabilitation setting of inpatient. They administered both the tool on 50 patients with an average age of 71.7 years. They obtained a mean test score of 26.5 and 22.2 for MMSE and MoCA respectively. They obtained the Pearson's correlation coefficient between the scores and it was found to be 0.695 ($p < 0.003$). They reported that performance of MMSE was poor, hence cannot be used as a screening instrument for MCI. Around 25 patients scored less than 25 on MoCA which is an indicative of MCI, whereas in MMSE they scored within normal range of 24 or more. Hence MoCA should be used as a cognitive screening tool compared to MMSE.

Most of these neuropsychological studies are done in western population and there are no much Indian studies which states the use of IADL in predicting the risk of developing MCI among elderly population. These are the some of the studies which states that individuals with MCI perform poorly on IADL when compared to healthy elderly individuals.

An Assessment tool for older people was introduced by Lawton and Brody in 1969 for the evaluation of self-maintenance and Instrumental activities of daily living. Study consisted of 265 participants with the age range of 60 & above, they found that, IADL is a best tool to predict the early decline of physical and cognitive functions in elderly

population and the validity of the scale was also tested by determining their correlation with various standardized intellectual and cognitive tests.

A survey based study was done by Barberger-Gateau, Commenges, Gagnon, Letenneur, Sauvel & Dartigues, (1992**)** to study the functional and cerebral aging. The study consisted of 2792 subjects aged 65 and over. Results revealed that Four IADL items are associated with cognitive decline irrespective of age, gender, and schooling: ability to handle phone, use of means of transportation, responsibility for taking medicines, and managing finances. The four IADL score could be integrated into the screening procedure for dementia in elderly community dwellers.

Fillenbaum, Chandra, Ganguli, Pandav, Gilby, Seaberg & Nath, (1999) developed an activities of daily living scale to screen illiterate rural older population with dementia in India which is brief, reliable and valid with norms suitable for evaluating the dementia in uneducated rural elderly people in India. For the development of the scale documentation of pertinent items, pre-testing of items and modification of administrative measures and scoring was carried out in 30 group of subjects aged 55 and older. Results revealed that the original number of 35 items including instrumental and personal care, mobility was condensed to an 11 item unidimensional scale with internal consistency, test retest reliability of 0.82. The illiterate subjects, women, older subjects and individuals with impaired cognitive functions performed poorly in activities of daily living scale.

A prospective study was done by Sauvaget, Yamada, Fujiwara, Sasaki & Mimori, (2002) to determine the role of cognition for the functional decline of performing basic and instrumental activities of daily living. The study included 1358 subjects aged 61 years and older. It was a community based study and the participants were followed up for 4 years. The results revealed that Dementia is an central contributing factor for functional status. Decline in ADL is more significant than decline in IADL, signifying that elements other than cognition, such as motivation or perceptual, sensory and motor abilities, may be important in IADL performance.

Mathuranath, George, Cherian, Mathew, & Sarma, (2005) did a study on educationally and socio-culturally heterogeneous population, to develop and validate the IADL-E scale for Dementia which can be used in combination with other cognitive screening test to screen individuals with dementia. In this study 240 subjects, 135 without and 105 with Dementia were administered with 11 IADL items. Each eleven item was evaluated for its applicability, degree of disability and contributing impairment (cognitive and / or physical). From this a composite index of cognitive (CDI) or physical (PDI) disability was derived. They concluded, IADL-E has a good internal consistency and highly correlated with the diagnosis of MMSE, Clinical DSM IV and Clinical dementia rating (CDR).All the items in the test has very good inter-rater and test-retest reliability.

Peres, Chrysostome, Fabrigoule, Orgogozo, Dartigues & Barberger-Gateau, (2006) did a cross-sectional and longitudinal analysis with the objective to identify the

restriction in IADL in MCI and to evaluate the effect of IADL restriction on the progression to dementia and on MCI reversibility. The study sample consisted of 1,517 participants, who were followed up for 8 and 10 years. A total of 285 participants were classified as having MCI with no dementia but a cognitive decline at baseline based on neuropsychological assessment and IADL. They found that 15.2% with MCI with more IADL restriction developed dementia within 2 years. The restriction in IADL depressed the chance of reversibility to normal, detected in 10.7% of the restricted MCI and 34.7% of the non-restricted MCI.

A prospective cohort study was done by Pérès, Helmer, Amieva, Orgogozo, Rouch & Barberger (2008) which was designed in 1988 to study cerebral and functional aging. The objective of the study was to identify the subtle changes in IADL over the 10 years preceding the clinical diagnosis of dementia. The sample consisted of 104 cases of dementia at the 10 year follow-up and 882 subjects free of dementia at the same visit. The results revealed that future cases of dementia had restriction in performing IADL to a greater extent 10 years before the clinical diagnosis of dementia and there was a rapid functional decline in these individuals. Hence the author concluded that early restriction in IADL can be viewed as a screening tool for the patients who are at risk of developing dementia.

Wadley, Okonkwo, Crowe, & Ross-Meadows, (2008) did a cross-sectional and comparison group study on fifty subjects with MCI and 59 controls with the objective to

identify the nature of functional difficulties in MCI that can be used to augment clinical assessment and management of MCI. They compared the speed and accuracy among normal and MCI in performing standardized timed IADL measures that assesses the five functional domains frequently met in everyday life such as taking medication, shopping, financial abilities, using telephone, preparing food. They found that across Timed IADL domains, Subjects with MCI performed comparable with normal in terms of accuracy, but they took considerably longer time to carry out the functional activities in all domains. They concluded that slower speed of task performance is an important component in early prediction of functional change in MCI.

A study was done by Ahn, Kim, Chung, Kang & Kim, (2009) to identify whether the individuals with MCI show deficits in Seoul-IADL (S-IADL) as related to normal subjects and to detect the most frequently affected functional domain in IADL. S-IADL and Seoul-Activities of Daily Living(S-ADL was administered to caregivers of 66 individuals with MCI and 61 controls. The total S-IADL score was found to be considerably greater for patients with MCI with the mean score of 4.47 & SD of 2.06 than in the controls with the mean score of 1.44 and SD of 1.65 ($p<0.001$). The performance was found to be significantly worse for individuals with MCI on IADL for the following items, such as the use of telephone, taking medication, preparation of meals, keeping appointments ($p<0.05$). The S-IADL scale was able to differentiate well between individuals with MCI and controls. The authors concluded that IADL requires the proper

integration and function of memory and frontal/executive functioning which are predominantly impaired in MCI.

Kim, Lee, Cheong, Eom, Oh & Hong, (2009) examined 255 cases with MCI and 311 cognitively normal individuals in the age range of 60-94 years old. Different cognitive examination tools were assessed on subjects, and each MCI patients was categorized into one of four subtypes. These subjects were administered with Barthel ADL and Seoul-IADL (S-IADL) for ADL measures. They found that there was a significant difference between the performance score of individuals with normal cognition and MCI in terms of total S-IADL scores. They concluded that MCI subjects scored differently in specific IADL items and these items can definitely help in the prediction of MCI subtypes, especially amnestic MCI-multiple domains.

A study was done by Binegar, Hynan, Lacritz, Weiner & Cullum, (2009) to identify if a direct measure of instrumental activities of daily living (IADL) scale designed for use with dementia patients can identify the differences between neurotypical individuals and individuals with mild cognitive impairment (MCI).In this study they collected cross sectional and longitudinal IADL scale data from MCI and neurotypical individuals who visited Alzheimer's Disease Center for follow-up. Findings supports that the performance of individuals with MCI were significantly poorer than that of neurotypical individuals on IADL scale and scored significantly poorer too. Hence the author concluded that MCI can be detected through the direct IADL measure for dementia and it was able to identify the small differences between MCI and NC.

A cohort study was done by Marshall, Rentz, Frey, Locascio, Johnson & Sperling (2011) with an objective to determine how IADL and executive functions are related to each other across the entire sample which consisted of population such as normal older controls, MCI and patients with AD by considering factors such as demographic, cognitive and behavioral. In this study 228 normal's, 387 individuals with MCI and 178 Alzheimer's disease patients were participated. The author used multiple regression model to determine the relationship between executive function and IADL. Results indicated that all the subjects in the study exhibited a significant relationship between executive dysfunction and IADL impairment. Hence the author concluded that the impairment in IADL is primarily caused by the executive dysfunction and it is the key factor for the impairment. Even after considering the degree of memory deficit across the continuum of cognitive impairment and dementia, this relationship was apparent.

Sacco, Joumier, Nelly, Arnaud, Derreumaux, Lee & Renaud, (2012) did a study with the objective to demonstrate the use of video monitoring system to acquire a quantifiable assessment of IADLs in Alzheimer's disease and in MCI. The aim of the study was to develop a daily activity scenario (DAS) score using Information and Communication Technology (ICT) that can detect the functional impairment in AD and MCI when compared to normal. A total 64 individuals over 65 years participated in the study with the study group consisted of 16 AD, 10 NC and 19 MCI. Each subject was instructed to carry-out a set of activities of daily living in a 'smart home" setting which is equipped with 2 video cameras and to use objects which is related to the activities of daily

living which is provided in that setting. The daily activity scenario (DAS) scores were then measured based on the quantitative and qualitative parameters obtained from video recordings. Hence this study supports the use of ICT's to assess the functional impairment in AD and MCI. This tool will be helpful for the early detection of MCI in elderly population by determining early cognitive deficits.

A community based study was done by Giebel, Sutcliffe, Stolt, Karlsson, Renom-Guiteras, Soto, & Challis, (2014). to determine the effect on quality of life due to decline in basic activities of daily living across different stages of cognitive decline in dementia. The participants completed the measures on cognitive functioning and quality of living which was reported by caregivers. The results revealed that ADL performance declined differently for each activity. Specifically, the performance of individuals with mild to severe dementia on bathing and dressing declined to a greater extent when compared to toileting, transfer and feeding which stayed comparatively unaffected throughout. It give the impression that continence was not reduced by the stage of dementia with similar levels of impairment. Basic ADL performance impacted quality of Living (QoL) to different degrees across dementia stages and countries.

Chapter III

METHOD

3.1 Participants

Fifty one individuals participated in the study. Among those, 31 participants were cognitively neurotypical, 10 with mild cognitive impairment and 10 patients had dementia. All the participants belonged to the age range of ≥55 years. All were native speakers of Kannada, with a formal education of greater than five years.

The cognitively neurotypical individual was selected based on the following inclusion criteria:

- Participants should be neurologically, cognitively and functionally intact.
- Free of memory and cognitive disorders;
- Preserved basic and instrumental activities of daily living.
- No history of seizures, psychiatric illness and alcohol/drug history.

The participants was diagnosed with MCI according to the following criteria:

- With an average MoCA score of 19.0-25.2.
- A decline in cognitive skill which is reported by self and/or care taker.
- Preserved basic activities of daily living such as-bathing, brushing etc.
- Subjects who do not meet criteria for dementia based on neurological report and MoCA scores.

Exclusion Criteria for Mild Cognitive Impairment

- Subjects with any significant neurological or psychological impairment were excluded from the study.
- Subjects with the history of convulsions, Road traffic accidents, head trauma, chronic alcoholism and drug abuse were excluded.

Subjects for the study were selected from different old age homes in Mysore locality and through screening in shops, parks and home. Three patients with dementia was selected based on the medical diagnosis by a neurologist who visited AIISH for speech and language evaluation. Other 7 patients with dementia was selected from different old age homes, who were medically diagnosed by a neurologist. Individuals with MCI and dementia were obtained from following old age homes- Sri Chayamatha Vruddhapya, Ananthalaya, Pejawara Sridhama, Sri Vasavi Shanthidhama and Little sisters Of The Poor Home for the aged. All the inmates who fell under the mean age of 72.5 were screened using MoCA and administered IADL on them, CLAP was administered to those individuals who fell under the criteria for MCI.

- A total of 70 individuals with the mean age of 72.5 were screened in these old age homes (Among them, 10 scored less than 26, which indicated MCI.

  Further evaluations were done to assess their cognitive skills using CLAP and inorder to estimate their functional dependence IADL was administered).

Seven individuals with dementia were obtained from these old age home with the medical diagnosis by a neurologist and MoCA and IADL were administered to all the seven individuals. 15 out of 70 was not enrolled in the study since they were falling under the exclusionary criteria.

- Three dementia patients were obtained from AIISH, who visited the institute for the therapy. MoCA and IADL-E was administered on them.
- Consent letter was read to all the participants before they were enrolled as subject and the study was done with the consent of all the subjects. Normal elderly subjects were obtained from Mysore locality, through screening at temples, parks, shops and home.
- The consent letter was signed by all of them.

3.2 Procedure

For the present study MoCA (Montreal Cognitive Assessment Tool), was administered to all the fifty individuals. This test was validated across many language population (Radhamani, 2005) and it is a very sensitive tool for identifying individuals with MCI. The MoCA assesses cognitive domains like attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation.

- The short-term memory recall task includes two learning trials which includes five nouns and delayed recall after around 5 minutes. A maximum of 5 scores can be obtained in this.
- Visuospatial abilities are evaluated using a clock-drawing task and copying of cube. A maximum of 4 score can be obtained from this.
- Executive functions and its multiple aspects are evaluated using an alternation task, phonemic fluency task and verbal abstraction task. A score of 1 is given for the correct response in all these tasks.
- Short term memory, attention and concentration are assessed using a sustained attention task and a serial subtraction task. A maximum 5 can be obtained in this task
- Assessment of language is carried out using confrontation naming task, repetition of two syntactically complex sentences. A maximum of 5 is obtained in this.
- Orientation to place and time was evaluated asking questions and 6 point would be given for all 6 correct responses.
- Maximum score obtained can be 30, less than 26 indicates abnormality and scores greater than 26 are considered normal.

Assessment of Instrumental Activities of Daily Living-Elderly

IADL was administered to all the three population including- cognitively neurotypical individuals, individuals with MCI and dementia. The Instrumental Activities of Daily Living for Elderly was used to assess the memory and complex reasoning skills, which are reported to be impaired in MCI. This tool was administered to caregiver/ subject itself by speech language pathologist. This tool was developed by Lawton and Brody in 1970 and it was adapted on Indian population by Mathuranath (2005) and was tested on Malayalam speaking population. This tool consisted of 11 items, which is rated for its applicability (Whether it's applicable or not), the degree of disability; that is whether the client is able to do the task by himself competently or not (a score of 0 is given if competent), a score of 2 for unable to perform. Finally the tool was rated for the underlying impairment like cognitive, physical or both which was considered to be responsible for the disability. If both types of disability affects the performance to varying degrees on an item, then the examiner gave different disability scores for the different impairments on that item. A cognitive Disability Index (CDI) and Physical Disability Index were derived. IADL-CDI was obtained by taking the sum of cognitive disability score (CDS) divided by the product of the maximum possible "disability" on an item (i.e. 2) and the number of items reported applicable (NAI). A similar formula was used to obtain IADL-PDI. The number of applicable (NAI) items should be 6 or more in order to obtain these indices.

For individuals with mild cognitive impairment, Cognitive Linguistic Assessment Protocol (CLAP) was administered, which consisted of domains such as attention perception and discrimination, memory, problem solving and organization. This tool was used for the purpose of in-depth analysis of cognitive linguist aspect in individuals with MCI.

3.3 Statistical analysis

The raw scores for each individuals were tabulated and appropriate statistical analysis were performed using SPSS (version 21.0). Following this the mean and standard deviations were computed across each test items (which had a maximum score of greater than 3) and across three groups of subjects. Since the SD obtained for each task was wider, the non-parametric test Kruskel-Wallis was administered to see the significant difference across groups. Further Mann-Whitney U test was administered to see the pair wise group significant difference.

Chapter IV

RESULTS AND DISCUSSION

The primary aim of the study was to validate the IADL-E for individuals with mild cognitive impairment in Indian population. Present study estimate the IADL-E score for normal elderly individuals and individuals with MCI and correlation of MoCA scores with IADL-E score in normal elderly individuals and individuals with MCI. Total of 51 individuals were recruited for the study. Among those, 31 participants were cognitively neurotypical, 10 with mild cognitive impairment and 10 patients had dementia. For the present study IADL-E and MoCA was administered to all the subjects to identify and to rule out the presence of cognitive impairment. For individuals with mild cognitive impairment, Cognitive Linguistic Assessment Protocol (CLAP) was administered. Qualitative and quantitative analysis were carried out using Statistical Package for Social Sciences (SPSS) software version 21. Since the SD obtained for each task was wider, the non-parametric test Kruskel-Wallis was administered to see the significant difference across groups. Further Mann-Whitney U test was administered to see the pair wise group significant difference. Within group comparison was done for all 3 groups using Spearman's correlation test.

Table 1

IADL-E scores for Normals, MCI and Dementia participant across all the 11 questions

IADL Questions	Normal(n=31)				MCI(n=10)				Dementia(n=10)			
	0	1	2	NA	0	1	2	NA	0	1	2	NA
Q1	31	0	0	0	2	8	0	0	0	4	6	0
Q2	31	0	0	0	3	7	0	0	0	0	10	0
Q3	16	2	0	13	4	4	0	2	0	1	2	7
Q4	29	1	0	1	5	5	0	0	0	7	3	0
Q5	31	0	0	0	0	6	4	0	0	0	10	0
Q6	30	0	0	1	0	6	4	0	0	0	10	0
Q7	31	0	0	0	4	6	0	0	0	4	6	0
Q8	31	0	0	0	6	4	0	0	0	4	6	0
Q9	31	0	0	0	5	5	0	0	0	5	5	0
Q10	20	0	0	11	2	2	0	6	0	7	3	0
Q11	31	0	0	0	3	7	0	0	0	2	8	0

NA – Not applicable, Q1=question 1 in IADL-E

From table 1, it was observed that Q1, Q2, Q5, Q6, are the sensitive questions in differentiating three groups using IADl-E. The scoring of normals were mostly ‘0’ and MCI had scored intermediate and dementia had high scoring.

IADL scoring for MCI reveals that these individuals shows a gradual decline in Q1 (Ability to use telephone), majority of them (8/10) scored 1 in this. Which indicates that they can use telephone but needs helps from others for dialing. Similarly Q1 is found to be as a sensitive question for individual with dementia too, wherein all of them showed a marked decline in this area. All the normals scored 0 in this task.

Similar trend was seen in Q2, where the performance of normals were superior to that of MCI and dementia. Where 7/10 individuals with MCI scored 1(ie, they can shop

independently only for small purchases and not all), whereas individuals with dementia scored very poor in this activity.

From table 1, it can also be observed that Q5 (Travel), Q6 (managing finance), also showed a remarkable performance of normals when compared MCI and dementia. Both the MCI and dementia group showed a similar trend in these activities. Dementia group performed below par than MCI group by scoring 2 in these 2 questions.

The results of the present study revealed that there was a decline in activities such as, ability to use telephone, shopping, travel and managing finance. These difficulties are due to decline of higher order cognitive abilities. As reported by Perneczky (2006) in individuals with MCI activities which requires the involvement of memory and complex reasoning skills were majorly impaired in these population. Hence we can say that the inability to use telephone in MCI could be due to impaired working memory and poor recall abilities. The poor recall ability and working memory with respect to aging can be interpreted based on either the morphological changes associated with aging which include a decline in total brain volume, cortical thinning and gyral atrophy (Raz et al., 1997) or to decline in the core cognitive functions like speed of information processing (Salthouse, 1996) lack of inhibition, or due to poor working memory capacity (Craik, Morris & Gick, 1990). The present study also suggests that they have difficulty with shopping (shops independently only for small purchases) and managing finance. It is due to impaired attention, executive dysfunction. This disability reflects their cognitive impairment such as, difficulty recalling required items, writing or retrieving the words to generate a list.

They also face difficulty in searching for their required item and making payment. The ability to shop can also be affected due to physical impairment also (such as, difficulty in walking to market, climbing stairs, pushing a cart down the aisles, carrying the groceries to home). Hence the difficulty shopping in individuals with MCI could be due to either the cognitive disability or the physical disability or the combination of both.

The present study findings also suggests that they have difficulty travelling independently (they can travel independently only to selected or well-practiced destinations). The difficulty with travelling could be attributed to the attention, executive function and Visuo-spatial dysfunction. Executive functions are important to manage yourself using available resources and to achieve the goal. These findings on executive dysfunction and Visuo-spatial difficulties are further supported by several research findings. A study done by Traykov et al (2007) reported that individuals with MCI scored lower in Free and Cued Selective Reminding Test, Stroop test and Modified Card Sorting Test. This findings indicate that these individuals have difficulty with episodic memory, response inhibition, switching and cognitive flexibility which are the different important aspects of executive functions. Furthermore, the visuospatial skills are impaired in individuals with MCI and this is supported by the findings of Perrochon et al (2014), he reported that MCI individuals have spatial navigation and Visuo-spatial short term disturbances.

Table 2

Mean (M), Standard Deviation (SD) and Median values (MD) for Normal, MCI and Dementia for IADL-E.

GROUP	COGNITIVE DISABILITY SCORE(CDS)			COGNITIVE DISABILITY INDEX(CDI)			TOTAL IADL-E SCORES		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
NORMAL (N=31)	0.19	0.47	0.00	0.95	2.40	0.00	0.95	2.37	0.00
MCI (N=10)	8.50	2.56	9.50	41.95	12.20	45.00	46.45	19.15	45.0
DEMENTIA(N=10)	17.20	1.03	17.0	87.65	5.12	89.00	87.65	5.12	89.0

Mean, standard deviation and median values across normals, MCI, and dementia for cognitive disability score (CDS), cognitive disability index (CDI) and total IADL-E scores were obtained using descriptive statistics. There was a wide difference in mean values present between Normals, MCI and Dementia in CDS and CDI scores of IADL-E.

The performance of 3 groups across activities in IADL-E are depicted in table 2. On comparing the mean scores across groups, it was seen that normal group performed better for CDS and CDI. However dementia group performed poorer than normal and MCI group in CDS and CDI. This findings could be due to impairment in cognitive functions such as abstract reasoning, spatial orientation, working memory, organization, problem solving and executive functions. These changes could be attributed to the white matter decrease. Many studies have linked aging with decrease in the brain's white matter and it's made up of myelin. Myelin helps to improve communication between brain cells (Yankner, Lu, & Loerch, 2008). Research shows that changes in white matter are linked with changes in speed of cognitive processing. Cognitive processing includes memory, attention, action,

problem solving and decision making abilities (Yankner, Lu, & Loerch, 2008). It is also observed that individuals with MCI experiences cognitive decline at an early stage, and this is reflected in their difficulty performing more complex IADL with high cognitive demands such as managing finance or shopping. These complex IADl activities requires more cognitive resources when compared to simple IADl such as preparing meals. Hence these complex IADL's are more vulnerable to early cognitive changes than activities which requires low cognitive demands or resources such as preparing meals and maintaining personal hygiene. Hence we can say that, the poor performance of MCI group on IADL-E and poor cognitive disability score and index when compared to normals could be due to the above reason.

The above results closely parallel those reported by Peres et al. 2006; luck et al. 2011, who did a longitudinal study on MCI and found that IADL restrictions may predict cognitive decline. The present study confirms that highly cognitive demanding activities poses more difficulty for individuals with MCI and IADL can be used to predict MCI. This could be a useful guideline which will help the clinicians to refine MCI criteria. This tool is more likely to find more obvious difference between dementia and neurotypical individuals. A qualitative study done by De Vriendt et al., (2012) supports the findings of the present study that more complex activities of daily living are affected in MCI and that this functional decline interacts with adaptation and coping mechanisms which can lead to activity disruption and insufficiency in functioning.

Figure 1:

CDS, CDI and total IADL-E score across three groups

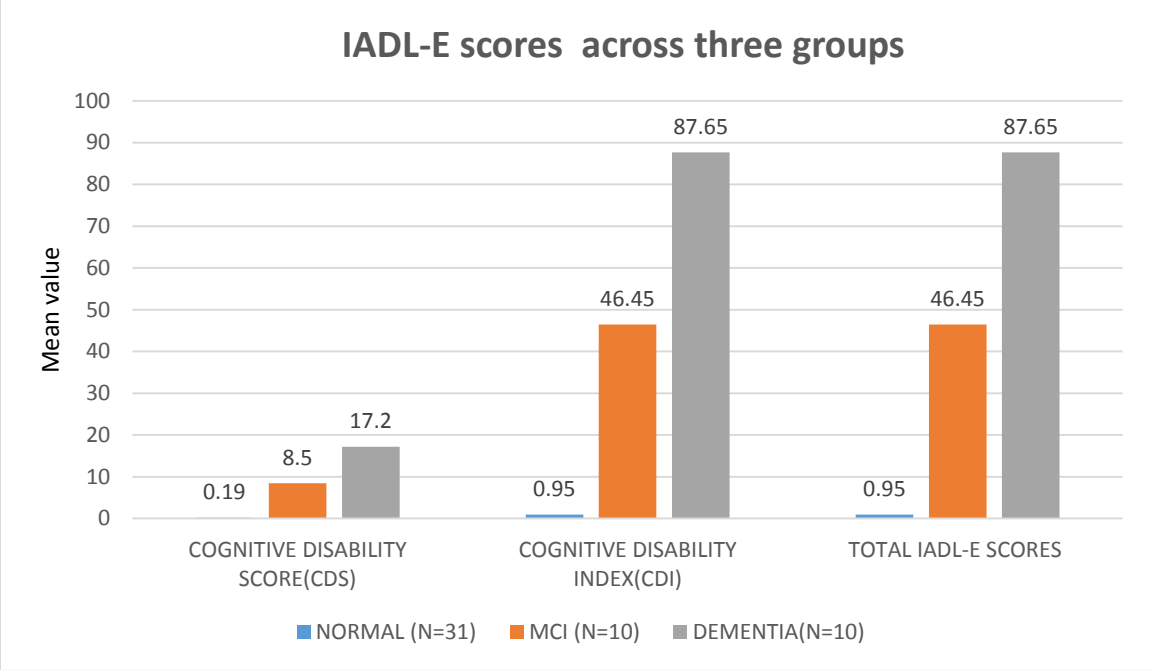

Table 3

MoCA subtest score for Normals, MCI and Dementia participant

MoCA SUBTEST	Scoring	Normal (n=31)	MCI (n=10)	Dementia(n=10)
ALTERNATING TRIAL MAKING TASK	0	2	10	10
	1	29	0	0
DRAWING 3D CUBE	0	6	6	10
	1	25	4	0
CLOCK DRAWING TASK	0	0	2	7
	1	0	0	2
	2	2	2	1
	3	29	6	0
NAMING TASK	0	0	0	0
	1	1	0	1
	2	8	5	6
	3	22	5	3
FORWARD DIGIT TASK	0	0	1	6
	1	31	9	4
BACKWARD DIGIT TASK	0	0	0	4
	1	31	10	6
PHONEMIC ATTENTION TASK	0	0	0	10
	1	31	10	0
SENTENCE REPETATION TASK	0	3	1	6
	1	16	6	4
	2	12	3	0
PHONEMIC FLUENCY TASK	0	5	10	10
	1	26	0	0
ABSTRACTION TASK	1	0	2	5
	2	31	8	5
DELAYED RECALL TASK	0	0	3	9
	1	0	3	1
	2	3	2	0
	3	8	2	0
	4	10	0	0
	5	10	0	0
ORIENTATION TASK	1	0	2	2
	2	0	1	1
	3	0	2	2
	4	0	0	0
	5	5	3	3
	6	26	2	2

The subtest in MoCA which has scoring of more than three was subjected for the descriptive statistics.

Table 4

Mean (M), Standard Deviation (SD) and Median values (MD) for Normal, MCI and Dementia across MoCA tasks.

GROUP	CLOCK DRAWING TASK			NAMING TASK			SUBSTRACTION TASK		
	M	SD	MD	M	SD	MD	M	SD	MD
NORMAL (N=31)	2.94	0.25	3.0	2.68	0.54	3.0	2.77	0.67	3.0
MCI (N=10)	2.20	1.23	3.0	2.50	0.52	2.50	2.10	1.20	2.50
DEMENTIA (N=10)	0.40	0.70	.00	2.20	0.63	2.0	1.10	1.20	1.0

Table 5

Mean (M), Standard Deviation (SD) and Median values (MD) for Normal, MCI and Dementia across tasks in MoCA.

GROUP	DELAYED RECALL			ORIENTATION			TOTAL MoCA SCORE		
	M	SD	MD	M	SD	MD	M	SD	MD
NORMAL (N=31)	3.87	0.99	4.0	5.97	0.18	6.0	27.06	1.41	27.00
MCI (N=10)	1.30	1.16	1.0	5.40	1.27	6.0	19.80	1.31	19.00
DEMENTIA (N=10)	0.10	0.32	0.0	3.70	1.94	4.0	9.60	3.34	9.50

The table 3 shows the MoCA subtest scoring for normals, MCI and dementia participant. It is evident that the following tasks in MoCA is very sensitive in differentiating 3 groups, they are; Alternating trail making task, Phonemic fluency task, Delayed recall and orientation task. Both the MCI and dementia group scored 0 in trail making task.

Normal group performed better than MCI and dementia group in phonemic fluency task. Both the MCI and dementia group scored 0 in this task indicating language deficits in these two groups. In delayed recall and orientation task none of the participants from MCI and dementia were able to score 5 and 6. Hence these two tasks are very helpful in differentiating these two groups from normals. The analysis of results shows that the alternating trail making task is impaired which indicates a decline in Visuo-spatial and executive functions in these individuals as trail making test taps these two functions. Difficulty in phonemic fluency task could be due to degradation of semantic networks which indicates that neuropathological changes may extend beyond the early changes in hippocampal regions. This observations are supported by the findings of Katherine et al (2008) who that both semantic and phonemic fluency were impaired in individuals with MCI. These are attributed to the poor semantic storage and slower retrieval process. To carry out a verbal or phonemic fluency task, the executive function plays a major role by adding executive components such as switching and shifting. The present study findings revealed that individuals with MCI exhibits a decline in delayed recall abilities. According to Raz et al., (1997), the prominent changes due to aging are seen in pre-frontal cortex (PFC) an area often attributed to the process of recall attempt (Tulving, 1983). It can be implied that decline in recall abilities with aging can be due to this atrophy in the PFC. As stated by Craik (1983) older adults are weaker in these self-initiated processes and hence have difficulty in recall. Another support is derived from kynette et al., (1990) study which indicated that with aging the recitation rate slows down. So it can be assumed that older

adults in particular will have difficulty to rehearse more items in the short time span because of their slow recitation rate and hence show poor recall abilities. Individuals with MCI performs good with the immediate recall tasks, since there is a minimal interference and hence superior recall (Burton, Niles & Wildman, 1981). The present findings also supports the presence of impaired orientation skills. Which could be due to poor episodic memory and executive dysfunctions.

Cognitive Linguistic Assessment Protocol (CLAP) was administered only for MCI individuals to investigate the cognitive-linguistic abilities in detail.

Table 6

Mean (M), Standard Deviation (SD) and Median values (MD) for MCI subjects across different CLAP tasks

CATEGORY	**MCI(N=10)**			**Mean normative scores (Age Range-60-65 years)**
	M	**SD**	**MD**	**Mean**
VISUAL	24.60	5.19	26.50	27.66
AUDITORY	25.80	2.74	25.0	27.99
TOTAL	50.40	7.23	50.50	55.99
EPISODIC MEMORY	12.0	2.71	11.50	8.83
SEMANTIC MEMORY	34.10	3.07	33.50	37.50
TOTAL	46.10	5.24	45.0	52.49
PROBLEM SOLVING	38.80	7.19	41	56.17
ORGANIZATION	29.90	15.19	35.50	35.83
GLOBAL TOTAL	**165.20**	**26.63**	**164.50**	**302.46**

From the above table 6, it is evident that, individuals with MCI had difficulty performing problem solving task and these degradation in performance is linear with respect to age and triggered in case of pathological condition. Similarly, as age progresses organization skills will be impaired which will result in word finding difficulty. From the above table it is clear that individuals with MCI performed poorly on organization task, this could be due to the difficulty in taxonomic organization in elderly individuals which expected to decline over age and this findings are supported by several other studies. As reported by Denny and Denny (1974), the ability to perceive and use taxonomic relations decreases and this decline would be functional before 75 years of age and is also related to the neurophysiological modifications in brain as seen in dementia and MCI.

Since the SD of the sub-task is high in table 2, the non-parametric test Kruskal-Wallis test is administered to see the significant difference across groups.

Comparison of IADL-E across groups

Table 7

Chi square value and significance value across three group of participants for activities in IADL-E

CATEGORY	N=51	
	Chi-Square value	Sig
CDS	43.906	0.000*
CDI	43.854	0.000*
Total IADL-E	**43.755**	0.000*

*p <0.05

From the above table 7, it is evident that there is a significant difference across 3 groups for CDS and CDI of IADL-E, hence Mann-Whitney U test was administered to see the pair wise group significant difference for CDI and CDS scores.

Table 8

Z value and significance value for Normals & MCI, MCI & Dementia and Normals & Dementia across activities in IADL-E

CATEGORY	Normals & MCI		MCI & Dementia		Normals and Dementia	
	Z-value	p value	Z-value	p value	Z-value	p value
CDS	-5.452	0.000*	-3.811	0.000*	-5.458	0.000*
CDI	-5.457	0.000*	-3.791	0.000*	-5.453	0.000*
Total	**-5.452**	**0.000***	**-3.718**	**0.000***	**-5.453**	**0.000***

*p <0.05

From the above table 8, it is evident that there's a significant difference between normal and MCI group for CDS and CDI values for IADL-E with p value<0.05 and similar trend is observed between normals and dementia group.

Normals and MCI shows greater difference in mean value which is represented by Z score (/z/=5.4), similar trend is seen in normals and dementia. However MCI and dementia showed a lesser mean difference which is represented by /Z=3.81/ and this could be due to the rapid progression of MCI to dementia. From table 8, we can infer that the cognitive difference between MCI and dementia in terms of their performance in IADL-E is less compared to MCI and normal. This indicates that, there are greater chances for MCI group to fall under dementia with little amount of cognitive decline. From table 8, we can infer the possible reason for higher /Z/ score between normals and MCI, this could be due to different stages of cognitive decline in MCI. Not all elderly individuals' progress into

MCI and it takes a considerable amount of cognitive decline to reach a criteria for MCI. Similarly the greater /Z/ value in normals and dementia indicates that there is a widespread lesion in dementia so it takes a longer time for the transition from normal aging to pathological aging and is not an immediate process.

It is reported that, there are two types of MCI group, Amnestic MCI and Non amnestic MCI. A study done by Luck et al. 2011 reported that, greater restrictions in highly cognitive demanding IADL predicted amnestic MCI (aMCI) but not non amnestic MCI (nMCI). Therefore individuals with aMCI have a higher risk of progressing into dementia earlier than nMCI.

A study done by Reppermund et al. 2011 reported that, IADL with highly cognitive demanding tasks requires the intact functioning of cognitive domains such as memory, attention/processing speed, executive function, language and visuospatial ability, in contrast IADL with low cognitive demand were only associated with attention/processing speed and to a lesser extent with executive function but not with memory. Hence we can say that the poor performance in MCI in IADL-E is due to the impairment in executive function, memory, attention/processing speed, language and visuospatial ability.

Table 9

Chi square and significance value across all three population for tasks in MoCA

CATEGORY	N=51	
	Chi-Square	p value
CLOCK DRAWING TASK	33.997	0.000*
NAMING	5.537	0.063
SUBTRACTION	20.812	0.000*
DELAYED RECALL	34.712	0.000*
ORIENTATION	25.698	0.000*
TOTAL	**39.029**	**0.000***

*p <0.05

All three groups were compared across each domains in MoCA. Clock drawing test, subtraction, delayed recall and orientation showed significant difference with p value <0.05. Significant difference was not present only for naming, with a p-value of .063. Since other domains exhibited significant difference, further Mann-Whitney U test was administered to see the pair wise group significant difference.

Table 10

Z value and significance value for Normals & MCI, MCI & Dementia and Normals & Dementia across MoCA tasks

CATEGORY	Normals & MCI		MCI & Dementia		Normals & dementia	
	Z-value	p value	Z-value	p value	Z-value	p value
CLOCK DRAWING TASK	-2.670	0.008*	-2.901	0.000*	-5.839	0.000*
SUBTRACTION	-2.392	0.017*	-1.884	0.060	-4.554	0.000*
DELAYED RECALL	-4.288	0.000*	-2.746	0.000*	-4.820	0.000*
ORIENTATION	-2.478	0.013*	-2.280	0.023*	-5.097	0.000*
TOTAL	**-4.825**	0.000*	**-3.841**	0.000*	**-4.818**	0.000*

*p <0.05

All domains showed significant difference between MCI and normal, MCI and dementia, normals and dementia with p value<0.05. Normals and MCI showed greater difference in mean value which is represented by Z score (/z/=4.8), similar trend is observed between normals and dementia with /z/=4.8. Whereas MCI and dementia showed a lesser mean difference which is represented by /z=3.8/. Hence we can say that, there is a lesser cognitive difference between MCI and dementia in terms of their performance in MoCA. Both these group exhibited a similar trend in cognitive decline for the domains such as executive functions, Visuo-spatial skills, language and attention with greater impairment in dementia compared to MCI. This is due to widespread brain lesion in dementia whereas MCI is the transitional state between normal ageing and dementia.

IADL-E also showed a trend such as greater difference between normals and MCI, normals and dementia but less difference between MCI and dementia. The similar trend

was also observed in MoCA, where MoCA also showed a greater difference between normals and MCI, normals and dementia but less difference between MCI and dementia. Which indirectly tells that both the tests are in consensus with each other.

For the purpose of validating IADL-E, MoCA was correlated with IADL-E for MCI, normals and dementia also IADL-E was correlated with CLAP separately for MCI.

Within group comparison was done for all 3 groups using Spearman's correlation test.

Within group comparison for MoCA and IADL-E, IADL-E and CLAP

Table 11

Correlation between MoCA and IADL-E for all three group

All three groups	Correlation coefficient (r)
MoCA V/S IADL-E	-0.886**

**p<0.01

Table 12

Correlation between MoCA and IADL-E for MCI group

Groups	MoCA V/S IADL-E Correlation coefficient (r)
Normal	-0.350*
MCI	-0.357
Dementia	-0.506

*p<0.05

From the above table 11, we can observe that, the total correlation between MoCA and IADL-E is very good (p<0.01) across all three groups together. The above results closely parallel those reported by Koskas et al (2014) who examined the diagnostic ability of the

Lawton Instrumental Activities Daily Living (IADLs) scale and the Activities Daily Living (ADLs) scale as a sensitive tool to early Alzheimer's disease (AD) in community-dwelling elderly people. He found that, the sensitivity of ADL scale or IADL-4 item or the MMSE was low (52%-57%). The most effective early detection of AD used both the IADLs-4 item and the MOCA with a threshold score of 20. Besides age and memory scores, the main correlates of IADLs scale or ADLs scale were executive, neuropsychiatric, vascular, and extrapyramidal scores.

Peres et al., (2006), did a cross-sectional and longitudinal analysis with the objective to identify the restriction in IADL in MCI and to evaluate the effect of IADL restriction on the progression to dementia and on MCI reversibility. They found that 15.2% with MCI with more IADL restriction developed dementia within 2 years. The restriction in IADL depressed the chance of reversibility to normal, detected in 10.7% of the restricted MCI and 34.7% of the non-restricted MCI.

From the above table 12, it is observed that there is a negative correlation between MoCA and IADL-E scores for MCI, normals and dementia group and this difference is not significant except for normals. The reason for this less correlation between MoCA and IADL-E in MCI and dementia could be possibly because of less number of subjects, one extreme value (out layer) and also due to the difference between MoCA and IADL-E task performance. MoCA is a performance test whereas IADL-E is a subjective test. Hence in IADl-E, there are higher chances of incorrect responses from the subjects due to their overestimation of their

capability. For most of the subjects IADL-E was administered on to subjects without much information from the caregiver because of their unavailability. There can be incongruity between the disability reported by MCI subjects (who tend to overestimate) and caregiver (who tend to underestimate) their problem. Therefor it is important to verify the responses given by the subjects by rechecking with the caregiver. Whereas MoCA is truly a performance test which is not influenced by the external factors. Some of the items in IADL-E is not applicable for either the genders. For example, preparing meals is highly applicable for females, similarly shaving beard is applicable only to males. But excluding both would unduly hamper the assessment of highly applicable and important instrumental activities of women and men, respectively. On the contrary, retaining both would allow them to balance each other with respect to gender.

Table 13

Correlation between IADL-E and CLAP for MCI group

MCI	Correlation coefficient (r)
IADL-E v/s CLAP	0.122

From the above table 13, it is observed that there is a positive correlation between IADl and CLAP for MCI. Which signifies that, poor performance in IADL-E is positively correlated with the poor performance in CLAP. Episodic and semantic memory has very good correlation(r=0.508) with the IADl-E.

Table 14

Normative table for IADL-E

Reference value for IADl-E Scores		
Groups	**Mean (SD)**	**Range(M± 2SD)**
Normals	0.95 (2.37)	0-5.69
MCI	46.45 (19.15)	8.15-84.75
Dementia	87.65 (5.12)	77.41-97.89 or above

In IADL-E, the normal will have a score between 0-6, MCI individual score starts from 8 till 84 whereas dementia starts from 77 and can go till 97 and above.

Chapter V

SUMMARY AND CONCLUSION

Cognition refers to a set of mental activities that are involved in processing of: memory, language, learning and speech. Learning about different cognitive processes helps us to understand how we acquire, store, retrieve and utilize knowledge (Matlin, 1983). During normal aging period associated memory changes are observed, during this stage the processing and retrieval of information slows down along with decreased flexibility in thinking and paying attention to challenging tasks. They also experience more trouble recalling recent than past events. During the normal aging process, subtle cognitive deficits are observed in elderly population. This cognitive changes can affect their day to day functional activities. This condition which is characterized by a transitional period between expected decline of normal aging and the more serious decline of dementia is called as Mild Cognitive impairment (MCI). Persons with MCI exhibits decline in instrumental activities of daily living (IADL) with preserved basic activities of daily living (Brown, Devanand, Liu & Caccappolo 2011).

The aim of the study was to validate the IADL-E for individuals with mild cognitive impairment in Indian population and to estimate the IADL-E score for normal elderly individuals and individuals with MCI and correlation of MoCA scores with IADL-E score in normal elderly individuals and individuals with MCI. The cognitively neurotypical individuals were selected based on the following inclusion criteria such as the participants should be neurologically, cognitively and functionally intact, Free of memory and cognitive disorders and Preserved basic and instrumental activities of daily living.

MCI participants were diagnosed according to the following criteria: With an average MoCA score of 19.0-25.2. A decline in cognitive skill which is reported by self and/ or care taker. Preserved basic activities of daily living such as-bathing, brushing etc. and Subjects who do not meet criteria for dementia based on neurological report and MoCA scores.

Total of 51 individuals were recruited for the study. Among those, 31 participants were cognitively neurotypical, 10 with mild cognitive impairment and 10 patients with dementia. All the participants belonged to the age range of ≥55 years. All were native speakers of Kannada, with a formal education of greater than five years. For the present study IADL-E and MoCA was administered to all the subjects to identify and to rule out the presence of cognitive impairment. For individuals with mild cognitive impairment, Cognitive Linguistic Assessment Protocol (CLAP) was administered.

Findings of the present study revealed that individuals with MCI had greater difficulty performing complex instrumental activities of daily living which required greater cognitive demands. Four questions in IADL-E was found to be very sensitive in differentiating three groups, they are Q1 (ability to use telephone), Q2 (shopping), Q5 (travel), Q6 (Managing finance). IADL with highly cognitive demanding tasks requires the intact functioning of cognitive domains such as memory, attention/processing speed, executive function, language and visuospatial ability, in contrast IADL with low cognitive demand were only associated with attention/processing speed and to a lesser extent with executive function but not with memory. Hence we can say that the poor performance for

individuals with MCI in IADL-E for Q1, Q2, Q5 and Q6 could be due to the impairment in executive function, memory, attention/processing speed, language and visuospatial ability. This could be a useful guideline which will help the clinicians to refine MCI criteria.

Findings of MoCA revealed that, Alternating trail making task, Phonemic fluency task, Delayed recall and orientation task are sensitive in differentiating three groups. The analysis of results shows that the alternating trail making task is impaired in MCI which indicates a decline in Visuo-spatial and executive functions in these individuals as trail making test taps these two functions. Poor performance on orientation skills could be due to poor episodic memory and executive dysfunctions.

Cognitive Linguistic Assessment Protocol (CLAP) was administered only for MCI individuals. Findings of CLAP for MCI group was compared with mean scores obtained for neurotypical individuals in the age range of 60-65 years. Results indicated that, MCI performed poorly on organization task and problem solving task. This could be due to the difficulty in taxonomic organization and executive dysfunction in elderly individuals which expected to decline over age and this findings are supported by several other studies.

Results of Mann-Whitney U test revealed significant difference between normal and MCI group for cognitive disability score (CDS) and cognitive disability index (CDI) values for IADL-E with p value<0.05 and similar trend was observed between normals and dementia group too. MCI and dementia showed a lesser mean difference which is represented by /Z=3.81/ which implies that the cognitive difference between MCI and

dementia in terms of their performance in IADL-E is less compared to MCI and normal hence there are greater chances for MCI group to fall under dementia with little amount of cognitive decline.

Within and across group comparison was done for MoCA and IADl-E, within group comparison was done for IADL and CLAP for MCI group using Spearman's correlation test. The total correlation between MoCA and IADL-E is good across all three groups with $p<0.001$. However there was a negative correlation($r=0.886$) between MoCA and IADL-E scores for MCI, normals and dementia group and this difference is not significant except for normals. This poor correlation could be certainly due to the difference between MoCA and IADL-E task performance. MoCA is a performance test whereas IADL-E is a subjective test. Hence in IADl-E, there are higher chances of incorrect responses from the subjects due to overestimation of their capability. There can be incongruity between the disability reported by MCI subjects (who tend to overestimate) and caregiver (who tend to underestimate). Therefor it is important to verify the responses given by the subjects by rechecking with the caregiver. Whereas MoCA is truly a performance test which is not influenced by any external factors. Some of the items in IADL-E is not applicable for either the genders. For example, preparing meals is highly applicable for females, similarly shaving beard is applicable only to males. But excluding both would unduly hamper the assessment of highly applicable and important instrumental activities of women and men, respectively. On the contrary, retaining both would allow them to balance each other with respect to gender. Potential limitations of the study include the relatively small sample size

obtained and the predominance of relatively highly educated participants within the sample. In IADL-E, the normal will have a score between 0-6, MCI individual score starts from 8 till 84 whereas dementia starts from 77 and can go till 97 and above.

Implications of the study:

The current study enables us to understand age related cognitive changes with specific reference to IADL. The results of the study reveals an impairment in complex IADL performance in individuals with MCI, hence this needs to be kept in mind while screening /evaluating MCI population.

Limitations of the study:

- Potential limitations of the study include the relatively small sample size obtained and the predominance of relatively highly educated participants within the sample.
- The incongruity between the disability reported by MCI subjects and caregiver on IADL-E. Therefore IADL-E information should be obtained from both of them.

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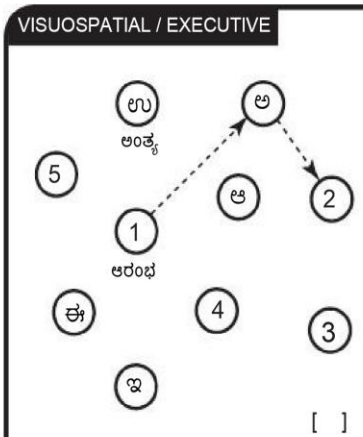
APPENDIX I

MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.1 Kannada Version

NAME:
Education: Date of birth:
Sex: DATE:

VISUOSPATIAL / EXECUTIVE — POINTS



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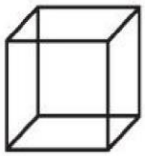

ಕ್ಯೂಬ್ ನಕಲು ಮಾಡಿ

ಗಡಿಯಾರ ಚಿತ್ರಿಸಿ (ಹನ್ನೊಂದು ಗಂಟೆ ಹತ್ತು ನಿಮಿಷ) (3 Points)

[ ] Contour [ ] Numbers [ ] Hands

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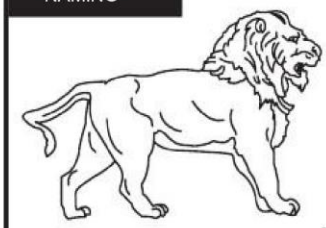
NAMING



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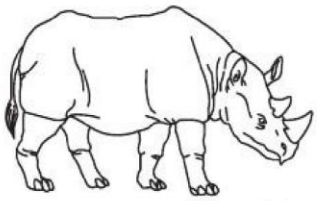

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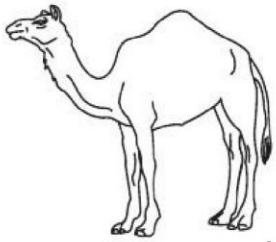

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MEMORY ಪದಗಳನ್ನು ಓದಿ. ಪ್ರಯೋಗಾರ್ಥಿ ಪದಗಳನ್ನ ಪುನರಾವರ್ತಿಸಬೇಕು. ಎಲ್ಲ ಪದಗಳನ್ನು ಹೇಳಿದರು ಕೂಡ ಎರಡನೇ ಬಾರಿ ಪದಗಳನ್ನು ಹೇಳಿ.5 ನಿಮಿಷ ಬಿಟ್ಟು ಮತ್ತೆ ಕೇಳಿ.

	ಕಣ್ಣು	ಸೀರೆ	ದೇವಸ್ಥಾನ	ಗುಲಾಬಿ	ನೀಲೀ
1 ಪ್ರಯೋಗ					
2 ಪ್ರಯೋಗ					

No points

ATTENTION ಪಟ್ಟಿಯಲ್ಲಿರುವ ಸಂಖ್ಯೆಗಳನ್ನು ಓದ (1 Digit/sec) — ವ್ಯಕ್ತಿಯೂ ಸಂಖ್ಯೆಗಳನ್ನು ನೆನಪಿಸಿಕೊಂಡು ಮುಂದಕ್ಕೆ ಹೇಳಬೇಕು [ ] 2 1 8 5 4; ವ್ಯಕ್ತಿಯೂ ಸಂಖ್ಯೆಗಳನ್ನು ಉಲ್ಟಾ ಕ್ರಮದಲ್ಲಿ ಹೇಳಬೇಕು [ ] 7 4 2 — __/2

ಪಟ್ಟಿಯಲ್ಲಿರುವ ಅಕ್ಷರಗಳನ್ನು ಓದಿ. ವ್ಯಕ್ತಿಯೂ ಅ ಅಕ್ಷರ ಬಂದಾಗ ತನ್ನ ಕೈ ತಟ್ಟಬೇಕು. No points if ≥ 2 errors
[ ] ಫ, ಬ, ಅ, ಸ, ಮ, ನ, ಅ,ಅ, ಜ, ಕ ಲ, ಬ, ಅ, ಫ, ಅ, ಕ, ಡ, ಈ, ಅ,ಅ,ಅ,ಅ,ಜ,ಅ ಮ.ಜ.ಫ.ಅ.ಅ.ಅ.ಬ — __/1

100 ರಿಂದ ಶುರು ಮಾಡಿ 7ನ್ನು ಕಳಿಕೊಂಡು ಹೋಗಿ. [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65
4 or 5 correct subtractions: **3pts**, 2 or 3correct: **2pts**, 1 correct: **1 pt**, 0 correct: **0 pt** — __/3

LANGUAGE ಪುನರಾವರ್ತಿಸಿ: ನನಗೆ ಗೊತ್ತು ಈ ದಿನ ನನಗೆ ಸಹಾಯ ಮಾಡವವನು ರಾಮು ಮಾತ್ರ [ ]
ಕೋಣೆಯಲ್ಲಿ ನಾಯಿ ಬಂದರೆ ಬೆಕ್ಕು ಯಾವಾಗಲೂ ಮಂಚದ ಕೆಳಗೆ ಬಚ್ಚಿಟ್ಟುಕೊಳ್ಳುತ್ತದೆ [ ] — __/2

ಪ ಅಕ್ಷರದಿಂದ ಶುರುವಾಗುವ ಪದಗಳನ್ನು ಹೇಳಬೇಕು. ಎಷ್ಟು ಪದಗಳು ಸಾಧ್ಯೋ ಅಷ್ಟು ಹೇಳಬೇಕು [ ] _____ (N ≥ 11 words) — __/1

ABSTRACTION ನಡುವಿನ ಸಮಾನತೆ ಉದಾಹರಣೆ: ಬಾಳೆಹಣ್ಣು - ಕಿತ್ತಳೆಹಣ್ಣು = ಹಣ್ಣು [ ] ಟ್ರೈನ್ ಸೈಕಲ್ [ ] ಪ್ರಶ್ನೆ- ಸ್ಕೇಲ್ ಕೈಗಡಿಯಾರ — __/2

DELAYED RECALL

	ಸುಳಿವು ಇಲ್ಲದೆ	ಕಣ್ಣು [ ]	ಸೀರೆ [ ]	ದೇವಸ್ಥಾನ [ ]	ಗುಲಾಬಿ [ ]	ನೀಲೀ [ ]	Points for UNCUED recall only
Optional	Category Cue						
	Multiple Choice Cue						

__/5

ORIENTATION [ ]ದಿನಾಂಕ [ ] ತಿಂಗಳು [ ] ವರ್ಷ [ ] ದಿನ [ ] ಸ್ಥಳ [ ] ಊರು — __/6

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Normal ≥ 26 / 30

TOTAL __/30

Add 1 point if ≤ 12 yr edu

Administered by: _____

APPENDIX-II

SCALE FOR THE INSTRUMENTAL ACTIVITIES OF DAILY LIVING IN THE ELDERLY (IADL-EDR)

Name:_____ Testing Date:_____
DOB (Age):_____ Gender:_____
Urban/Rural:_____ Education (yrs.):_____
Informant:_____ Relationship:_____

INSTRUCTIONS: Read aloud to the subject each of the 11 items and the response that follow. Ask them to circle "Yes" if they considers it as applicable to them (or their patient) and circle "No ", if otherwise. If they circle "Yes", ask them to choose from one of the three responses that follow, the one they consider most applicable to them (or their patient). If they choose the second or third response for any of the items, ask them to circle the score against that response under the column "CD if they consider that disability to be resulting from cognitive impairment or circle the score under "PD", if it considered to be resulting from physical impairment. If they think that both the impairments are contributory, then ask them to circle the scores in both the columns. If they think that both the impairments are contributory, but to different extents, then they may circle the appropriate score in each of the column (e.g., circle 1 for CD and 2 for PD). If the subject chooses the second or third response for any activity, ensure that they (or their patient) were capable of doing the activity at some point of time in the past. An item may be rated as not applicable if that task was not done by the subject any time in the past for either want of necessity (e.g., banking is done by the husband) or opportunity (e.g., is an atheist, does not pray). If a task was being done by the subject in the past but is not done now because other members of the family do it, then it must not be rated as "not applicable ". In such a case, it should be clarified if the subject is now competent to do it on his/her own, and rated accordingly.

		Applicable		CD	PD
1.	Ability to use telephone	No	Yes		
	0. Operates telephone on own initiative (looks up and dials numbers etc.)			0	0
	1. Answers phone but asks help for dialling			1	1
	2. Unable to use telephone			2	2
2.	Shopping	No	Yes		
	0. Takes care of all shopping needs independently			0	0
	1. Shops independently only for small purchases			1	1
	2. Unable to shop.			2	2

3.	Meal preparation	No	Yes		
	0. Plans, prepares and serves adequate and well cooked meals independently			0	0
	1. Prepares inadequate meals or can only heat and serve prepared meal			1	1
	2. Unable to either prepare or serve meals.			2	2
4.	Housekeeping	No	Yes		
	0. Maintains house alone or with occasional assistance (e.g., heavy workdomestic help)			0	0
	1. Performs light daily tasks such as dishwashing, bed-making etc.			1	1
	2. Unable to do housekeeping			2	2
5.	Travel	No	Yes		
	0. Travels independently (public or private transport)			0	0
	1. Travels independently only to selected or well-practiced destinations			1	1
	2. Needs to be accompanied for travel purposes on public transport			2	2
6.	Manage finance	No	Yes		
	0. Independently manages personal finance (pay bills, banking, lending or borrowing, budget)			0	0
	1. Manages only day-to-day purchases, but unable to handle large sums of money			1	1
	2. Unable to handle any finance			2	2
7.	Social activity/ interactions	No	Yes		
	0. Spontaneously interacts unassisted and normally with both strangers as well as acquaintances			0	0
	1. Spontaneously interacts unassisted and normally with *close* family members and friends only			1	1
	2. No spontaneous interactions			2	2
8.	Personal care	No	Yes		
	0. Takes proper and complete personal care (face-washing, brushing, toilet, bathing, grooming, dressing)			0	0
	1. Independent for simple activities (face-washing, brushing) only or needs reminders for personal care			1	1
	2. Shows no interest in personal care			2	2

9.	Entertainment and information	No	Yes		
	0. Does at least one of the activity (reading, watching TV, listening to radio,			0	0
	1. Performs the activity but often needs help in comprehending it			1	1
	2. Unable to perform the activity or comprehend it			2	2
10.	Shaving (beard or moustache)	No	Yes		
	0. Fully independent			0	0
	1. Can soap but needs help with the razor			1	1
	2. Unable to shave on his own			2	2
11.	Prayer activity	No	Yes		
	0. Able to participate in all prayer related activities (verbal and ritual)			0	0
	1. Needs prompting or correction with verbal or ritual related elements of 1 1 prayer			1	1
	2. Unable to participate in prayer activities			2	2

Number of Applicable Items (NAI) = ☐

Total Cognitive Disability Score (CDS) = ☐

Total Physical Disability Score (PDS) = ☐

Calculating the Cognitive Disability Index (CDI) and the Physical Disability Index (PDI):

Add up and enter in the space provided above, the number of applicable questions (NAI), and the circled scores in the columns CD (CDS) and PD (PDS).

The CDI or PDI can be calculated provided the NAI is 6 or more. Use the following formula to calculate the CDI and/or PDI. Alternatively, read it from the table overleaf.

CDI = CDS / 2 x NAI.

PDI = PDS / 2 x NAI.