© Journal of the Indian Academy of Applied Psychology
January 2010, Vol.36, No.1, 123-131.

Cognitive Functions and Psychological States among Clinical and Non-clinical Subjects

Latha, and R.P.Jaya Priya
University of Madras, Chennai

Cognitive quality of life is an important factor for adjustment and well being. Researchers have demonstrated the vulnerability for cognitive dysfunction and impairment in different clinical samples. Rehabilitation of the patients must include cognitive domain as an important quality of life. This becomes more important in conditions like Coronary artery disease, Diabetes, which have become a economic and social burden in addition to psychological burden in urban India. Screening these patients for their cognitive status is of primary importance. Using a case control design 57 cardiac patients, 59 diabetic patients and 50 normal subjects were assessed for self -reported cognitive states and cognitive performance. In addition, these groups were also assessed for anxiety and mood states. Statistical analysis of the data revealed significant difference between the groups and also the role of psychological states in influencing the cognitive performance. Implication of the results for training and rehabilitation are discussed.

Keywords: Cognitive quality, Adjustment, Well being

Cognitive quality of life is one of the indicators of successful rehabilitation in clinical patients. The cognitive functions and impairment among clinical groups are of much researched area to understand the impact of disease on mind, daily activities and also search for ways to enhance overall quality of life. The cognitive impairment is attributed not only to the presence of disease, but also due to the management procedures associated with disease conditions. For example drugs, surgical procedures morbidity status, restriction on diet etc. Cognitive functions among patients with specific neurological, psychiatric and medical conditions are studied to understand performance status, possible modality of treatment and rehabilitation. Screening patients for cognitive functional status is well documented in Seizure Disorders (Saigeetha, 2006), Coronary artery disease, (Machann,1997, Benton ,1992,) Cancer (Christina, 2003), Diabetes (Wessels , Poumer, Gelhoedb & Snel, 2007) and specific cases of major organ failure. Research by Petrucci, Karen and Carter (1981) states that a broad pattern of cognitive impairment in mental processing with with verbal and visual memory functions was observed with in the advanced heart failure group.

There is a bidirectional association between cognitive functions and moods. Emotional states can influence performance on cognitive tasks or impaired functional status is also associated with mood fluctuations. Due to the interrelated aspects of these functions, the patients experience more stress and there by quality of life deteriorates. Cognitive functions are essential for daily activity, mobility, functional status and social activity which are important domains of quality of life. Impaired cognitive functions interfere with

self care, communication, subjective well being, personal and inter- personal relationships, thoughts, ability to live independently, life events and global emotional functions. It also interferes with other life activities like sleeping patterns, eating, alertness and emotional regulations .Thus among the clinical groups, cognitive quality of life plays a major role in determining global quality of life by facilitating return to normal life, which in turn is related to work life adjustments. These cognitive functions are multidimensional and influence the way individual adapt to demanding situations. In clinical patients to a large extent they determine their adjustment to day to day activities, adherence and compliance with treatment and also for the management of the disease.

Major line of research has focused on evaluating and screening cognitive performance of clinical patients at different stages of disease process . Researchers have tried to look into cognitive decline or impairment as a part of disease and also as a consequence of treatment for the disease.Ageing, age related degenerative disorder and specific metabolic disturbances are implicated in failure of selected cognitive processes.

Brands and Kessels (2005) carried out a meta analysis covering 33 studies and concluded that Type - I Diabetic group demonstrated significantly lowered performance on varied cognitive tasks and the authors concluded that impairment to be associated strongly with the micro vascular complications of disease rather than other clinical indices. Study by Gregg and Brown (1999)speculate the cause for cognitive decline to be chronic hyperglycemia and the production of advanced glycated end products that may damage vascular tissue and endothelial function, DNA and mitochondria in the brain and the increase of free radicals, inflammatory responses and amyloid deposition, which showed 60-100 percent greater risk for cognitive decline among people with diabetes. They concluded that medications can affect cognitive ability, physical functioning and depression through drug or drug-disease interactions and the use of medications especially those with sedating effects is a risk for cognitive impairment.

Looking in to the causal mechanism for cognitive failure, research evidence have identified factors like anesthesia, treatment procedures, stress of hospitalization, nature of medication and lifestyle regulation etc, are implicated in the lowered cognitive functions. It was found that significantly more medically than surgically treated coronary patients were found to be have more cognitive deficits. Todaro, Fennel and Samuel (1987) investigated the cognitive effects of coronary artery disease and open heart surgery, and suggested that longer duration of hypoxic states secondary to chronic heart disease and longer duration on the cardiopulmonary bypass pump were associated with greater cognitive delay and they experience cognitive deficits. Dorman, Rummans and Gerald (2007) suggested that factors other than cardiopulmonary bypass may be responsible for cognitive decline, such as anesthesia and generalized inflammatory response that is associated with major surgical procedures. A study by Bergh and Jonsson (2007) looked at the cognitive decline associated with surgical procedures. And they found that cognitive decline was found in 53 percent of patients at the time of discharge, i.e. at 6 weeks. The rate was assessed at 36 percent at 6 months . However, five years after the surgery the rate of cognitive decline was 42 percent. The authors states that older age, a low level of education, a higher preoperative scores for cognitive function are the significant predictor for the presence

of cognitive decline at discharge after CABG. Josepch and Perring (2008) suggested the genetic basis for certain functional difference ,in which they found that the specific genes involved were, those for C-reactive protein (which plays an important role in the body's initial response to injury) and P- selectin (which helps to recruit circulating white blood cells to the sites of an injury). Patients with the variation of C- reactive protein gene were 20.6 percent less likely too suffer mental decline and the patients with the P-selectin variant had a 15.2 percent risk reduction. The risk of cognitive decline for those with both gene variants was only 17 percent compared to 43 percent for patients who had neither variant. Deary and Strachan (2004) found that the presence of gene (Apo lipoprotein E4) may also increase the likelihood of decline after bypass surgery.

In looking at factors involved in maintaining cognitive and emotional health in adults as they age George, Hammon and Kon (2008) with an extensive investigation has concluded that controlling cardiovascular risk factors such as reducing blood pressure, reducing weight, reducing cholesterol, treating diabetes and not smoking is important for maintaining brain health in aging. They also found protective factors most consistently reported for cognitive health included higher education level, higher socio economic status, emotional support, better initial performance on cognitive tests, better lung capacity, more physical exercise, moderate alcohol use and use of vitamin supplements. Psychosocial factors, such as social disengagement and depressed mood are associated with poorer cognitive and emotional health in late life and increased mental activity throughout life, such as learning new thing may reduce the impact on cognitive function. Studies with medical patients by Cervilla and Prince (2000) also highlight depression and stress vulnerability are also associated with low level of cognitive performance.

Jonna, Andrexej and Tomarn (2002) states that heart surgery is a factor triggering of specific emotional and physiological response of a patient. In spite of positive somatic effects of surgery, depression and anxiety can persist or appear for the first time time after the surgery worsening the patient's psychosocial functioning and quality of life. Thus, the dysfunction or predicting impairment is attributed to complex set of disease process and the process of its management.

The complexity of the of the issue enhances, when we take in to consideration of multiple factors that influence cognitive processes. Age, gender status, educational educational level, life style habits, food habits, mental status, personality traits all have a role to play in influencing the cognitive process. Colditz, Simin and Liu (2002) demonstrated pronounced cognitive decline in very old age can be due to co – morbidity of diabetes and hypertension. Gregg and Kristine (1999) found that woman who had diabetes for more than 15 years had a 57 percent to 114 percent greater risk of major cognitive decline than woman with out diabetes. Researchers have used both experimental lab oriented cognitive tasks and clinical neurological tests to evaluate the cognitive functions .Cognitive processes are multidimensional and thus a single set of measure is not sufficient to explain the impairment or deficits. Researchers advocate the usage of objective performance test and self – reported measures of cognitive failure and disturbances as important assessment tools ,Wallace (2004); Matthews ,Neil and James (2003). The role of cognitive quality of life is not only significant for clinical population, its role among workers in organized sector is also well researched.. Even among healthy population within an organizational set up ,

the cognitive functional inefficiency of employees is associated with low quality of work performance, safety and accidents, Wallace and Vodonvich (2003); Linden, Keijsers and Eling (2005).

Apart from the evaluative studies there have been interventions to enhance cognitive quality of life. The role of physical activity, types of mental engagement engagement, involvement in challenging tasks, nutritional status, hobbies and interests, self efficacy beliefs and positive attitudes are outlined as protective factors that prevent decline, Woolinsky (2006). Sherry and Sharon (2008) have demonstrated that cognitive training on every day function related to memory ,reasoning ,speed of processing could improve the activity of daily living in the trained group compared to the control group. This study spanning over a period of 5 years could demonstrate the effect of cognitive training. Thomas and Caren (2008) reported that physical activity to be beneficial for mental function in type II diabetes.

In India, the burden of coronary diseses and diabetics is increasing at an alarming rate more specifically in middle age persons who are in productive period of life. The burden is more felt in relation to health cost and production lost. The main stream of the medical management focuses on disease management and life style changes in terms of nutritional counselling,emotional and stress management. Cognitive evaluation and functions are hardly studied and intervened in the care of diseases. Even though the evidence is strong to the fact that cognitive quality of life is affected due to disease and its process, there is a lack of knowledge about the process of cognitive impairment or dysfunction level in clinical group. Studies are warranted to understand the cognitive functional level of the clinical patients and embark on a management strategy to address them.

In this background , the present study focuses to evaluate the cognitive functions and psychological states, among clinical population and healthy subjects using a case control design.

Method

Sample:

The sample for the study constituted of cardiac patients (N =57) and Diabetic patients (N=59) and the control sample included healthy subjects (N = 50). The three samples were matched for age, gender, educational level and socio economic status. Only literates in the age range of 40 to 60 years were included. Exclusion criteria for clinical group was presence of co-morbid conditions like psychiatric disturbances cancer, arthritis, asthma and COPD. The healthy control were free from major illness and were not on any long term medications. The sample consisted of 35 females and 131males. All the individuals were graduates,11 were unemployed and 155 were employed . Five individuals remain unmarried and 161 were married. Among the 166 individuals 25 were vegetarians and 141 were non-vegetarians.15 were regular smokers ,16 were occasional smokers and 135 were non-smokers. Typically the age as a risk for cardiac and diabetic conditions is reinforced in this emerging data .The mean age of normal population, diabetic and cardiac sample was 48.26, 49.89 and 52.50 respectively, [F(2) =12.56;P>.01] .

Tools:

Cognitive failure questionnaire (Craig Wallace, 1999): This 25 item self-report inventory is a measure of every day task failures that individuals are normally capable of completing.. It consists of four dimension, namely distractibility, memory Lapses, blunders and memory for names It inquires about minor mistakes and slips over the past 6 months. The subjects responded to items using a 5 point Likert point scale (i.e, 0-

never, 4-always) and the score ranged from 0 to 100. The factorial validity of the questionnaire and its reliability is well established by the authors.

Digit symbol substitution test: This is one of the subtest of Wechsler adult intelligence scale, 3rd edition (1997). A series of number each of which is paired with its own corresponding hieroglyphic like symbols. Using a key, the subject is to write the symbols corresponding to the which measures processing speed. The time limit for the test is 90 seconds (2^{nd} edition) This test assesses incidental learning and a digit symbol copying process,which is a measure of perceptual and grapho motor speed..The reliability co efficient ranges from 0.70 to 0.90 across different age groups indicating a high reliability of the test.

Digit span: It is another subtest of Wechsler adult intelligence scale,3^{rd} edition (1997). This test consists of a series of orally presented number sequences that the subject repeats verbatim for digit forward and in reverse order for digit backward. This subtest is an important measure of memory. The reliability coefficient for this subtest ranged from 0.79 to0.85 across age groups and it is highly valid.

Stroop test -NIMHANS Version (1999): It is a measure of cognitive flexibility This test measures the Response inhibition,when a "conflict" task is involved, the subject has to curb their natural and automatic response. Thus, it measures the ability to inhibit one response and spontaneous suppress the another. Stroop consists of the color namely, 'Blue','Green','Red','Yellow" are printed in capital letters on a paper. The color of the print occasionally correspond with the color designated by the word. The words are printed in 16 rows and 11 columns.The subject was asked to read the stimuli and the time taken to read all the stimuli are noted d own Then the subjects is asked to name the color which the word is printed. Time taken to name all the colors is note down. Scoring is done by means of getting stroop effect score. The reading time and the naming time were converted in to seconds.The reading time are subtracted from the naming time to get stroop effect score.

Spielberger's State Trait Anxiety Inventory for Adults, Form Y (1983): This measures, State and Trait anxiety. State anxiety is the measure of anxiety in situations, statements indicating how they feel right now and trait anxiety in which statements indicating how they generally feel. The scale consists of 20 items in each. The subjects responded to statements from 1-Almost never to 4- almost always. The anxiety statements are directly scored, items which indicate absence of anxiety are reverse scored. Scoring separately for State Anxiety and Trait anxiety scales vary from a minimum of 20 to maximum of 80.The alpha co-efficients is 0.93 for state anxiety scale and 0.91 for trait anxiety scale. Test and retest reliability is very high for trait anxiety scale and moderate for state anxiety scale. The scale has very high factorial and construct validity

Brad burn Affect Balance scale (1969): This is a 11 item scale measures the moods of the individual of the past 10 day, indicate how they 'feel at different times' .It consist of consists of 11 items of which 5 items measure positive mood, 5 items measure negative mood and 1 item measures neutral mood. The moods can be measures in three dimensions namely, Positive mood Negative mood and Neutral mood .The subjects responded to statements from 0-often to 3-never.

Procedure:

The consenting subjects were individually interviewed and assessed on subjective and objective measures. A detailed personal data was obtained directly from the patients, significantly from others and also from medical records. The personal data sheet

was completed by the second investigator. After collecting the personal data, they completed the Self- report cognitive failure inventory (Craig Wallace,1999), State Trait Anxiety Scale (Speilberger, Gorsuch, Lushene, Vagg, and Jacobs,1983) and Mood Checklist (Bradburn, 1969). Then the subjects were assesses on cognitive performance tasks. This included a timed task (2minutes) of Digit symbol substitution (WAIS,1997), Digit span test (WAIS,1997) and Stroop test (NIMHANS Version,1999). All these tests were a administered by the second researcher. The case sample data was collected from two hospital s and the control data was obtained from general population. The data was subjected to one way ANOVA, and Regression analysis.

Results

Group 1- Normal Group 2- Diabetic patients, Group 3- Cardiac patients. The one way analysis of variance indicates significant differences between the groups on all the measures of cognitive functions and psychological states.The clinical groups specifically the cardiac patients have found to report higher level of distractibility, memory lapses, and blunders than the other groups [F(2) = 401.35;P>.01]. This is further supported by lower scores for the cardiac group on all objective cognitive tasks indicating lower concentration, [F(2) = 143.91;P>.01] graphomotor speed [F(2) =131.38;P>.01] and also higher stroop effect [F(2) =152.57;P>.01] . The diabetic patients are also found to have mild cognitive problems. The clinical groups also demonstrate a significantly higher emotional states characterized by anxiety both in trait[F(2) =159.75;P>.01]and in state levels [F(2) =178.62;P>.01] and negative moods [F(2) =324.52 P>.01]. In order to understand the predictive relation ship between the psychological states and cognitive scores a regression analysis was carried out with psychological factors as independents and cognitive failure and performance as dependents.

Table 1: Mean, SD and Significant differences between groups on Study variables

Variables	Groups	Mean	S.D.
Cognitive	1	1.12	.89
Failure	2	8.54	3.45
	3	23.31	6.10
Trait Anxiety	1	32.00	5.72
	2	33.62	6.00
	3	48.03	3.59
State Anxiety	1	27.10	6.09
	2	29.66	5.84
	3	45.68	4.86
Positive Moods	1	13.26	1.90
	2	10.38	1.51
	3	6.56	1.78
Negative Moods	1	5.76	1.13
	2	5.64	.96
	3	12.06	2.0
Graphomotor	1	87.68	20.0
Speed	2	66.33	5.70
	3	50.44	5.00
Digit forward	1	6.22	.73
	2	5.33	.66
	3	4.03	.63
Digit backward	1	5.20	.63
	2	4.36	.66
	3	3.43	.70
Stroop effect	1	114.78	35.26
	2	128.84	27.58
	3	218.56	38.42

Group 1- Normal Group 2- Diabetic patients, Group 3- Cardiac patients

The results indicate that state anxiety and negative moods are significant predictors of self reported cognitive failures (84 %) and the positive mood states is likely to lowerr the failures on day to day cognitive tasks. Performance on stroop test was significantly predicted by negative moods (.25) and generalized anxiety states (.16). Nearly 65% of variance was determined by these two variables. This result substantiates an

impeding effect of psychological states on cognitive task completion. When the performance on objective cognitive tasks was analyzed the results points to the positive mood states associated with higher performance. The state or situational anxiety (-.49) is found to lower the grapho motor speed which is measured in digit substitution task. Along with this positive mood contributed significantly to better performance in digit substitution test. Thus mental alertness and calmness is essential to perform these activities and the disease affects both the emotional and cognitive wellbeing. None of the demographic factors particularly age contributed to the self-reported cognitive failure and performance in cognitive task. All the demographic factors which included gender,age,clinical status got excluded as significant predictors.

Table 2: Summary of regression analysis with significant predictors and their beta values.

variables	R square	F value	Constant	Predictors with beta co.efficients
Cognitive failure	0.84	154.35	1.84	State Anxiety (.36) Positive mood (.26) Negative Mood (.30)
Stroop effect	0.65	38.69	51.69	Trait anxiety (.16) Negative Mood (.25)
Grapho motor Speed	0.60	30.46	73.97	State Anxiety (-.49) Positive mood (.32)
Digit Forward	0.68	43.78	6.59	Positive Mood (.13)
Digit Backward	0.54	23.38	3.71	Positive mood (.25)

Discussion

Health is a multidimensional holistic state of wellbeing. The clinical status with its impact on the lifestyle and the psychological wellbeing also impair the cognitive functions which have essential role to play in daily activities. Research evidence has looked into the areas of cognitive impairments in varied clinical population and also try to understand the reasons and mechanisms underlying such processes. The findings of the present study supports the evidence for self -reported cognitive failures and lower performance on objective tasks in clinical patients. These tasks are sample of cognitive processes which underlie many of our daily activities which which requires alertness, concentration, processing speed and also ability to attend to relevant stimuli. The comparison between clinical and non-clinical group shows a relatively poorer cognitive status in cardiac and diabetic patients. The findings of this study support the evidence of cognitive impairment among coronary and diabetic patient by Petrucci, Karen and Carter (1981) and Brands and Kessels (2005).Ageing, clinical status and medication are likely factors which can compromise these functions. But in this study they did not emerge as significant predictors. The study also highlights the psychological mood states and emotional level predicting lower performance. The findings of this study on anxiety and negative mood states in cardiac patients support the research evidence of Jonna, Andrexej and Tomarn (2002).

These findings have implication for psychological management of patients and their rehabilitation. Screening the clinical patients for cognitive status is essential to

decide on the therapy regimen and also for health education.Distraction, forgetting, lack of alertness can impair the work efficiency in work, life adjustment and also interpersonal relation ship. Enhancing the psychological status and simultaneously providing specific cognitive oriented functional skills is important. Physical activity, Exercise, Nutrition, Positive mood states and Stress reduction oriented interventions must be examined as a strategy of improving multidimensional health quality of life among cardiac and diabetic population.

Conclusion

Cardiac and Diabetic patients report significantly more cognitive failure and perform poorly on specific cognitive task. These clinical patients experience anxiety and negative moods significantly more than the normal subjects. The negative psychological status of the clinical patients significantly predict the subjective and objective cognitive performance.

References

Benton, D. (1992). Cholesterol levels in Mental Processing. *Psychosomatic Medicine*, *57*, 50-53.

Bergh & Jonsson.(2007). Elderly experience long term Cognitive decline after surgery. *The Journal of American Medical Association*, *124,* 189-212.

Brad Burn Norman. (1969).*Two dimensions of Psychological well being :Positive and Negative Affect*,Chicago,Adline Publishing Company.

Brands, A.,& Kessels, R.P. (2005). The effect of Type I diabetes on Cognitive Performance. *Diabetes Care, 28,*726-735.

Cervilla ,J. A.& Prince, M. (2000). Does Depression predict cognitive outcome 9 to 12 years later?. *Psychological Medicine, 30,* 1017-1023.

Christina, A. & Kenneth, R (2003).Multifaceted end points in brain tumour clinical trails. *Journal of Neuro Oncology*,*5*,89-95.

Colditz, L., Simin Liu, & Bent, N. (2002). Diabetes mellitus, Hypertension and the Rate of cognitive ageing. *Diabetes Care* , *56,* 211-216.

Craig Wallace. (2004). Confirmatory factors analysis of the cognitive failure questionnaire-evidence for dimensionality and construct validity. *Personality and Individual Difference*, *37*, 307-327.

Deary, I.J. & Strachan, M.W. (2004). Is type II diabetes associated with increased risk of cognitive decline. *Diabetes Care*, *23*, 438-448.

Dorman, D., Rummans, M.D.& Gerald,T.G. (2007). Off pump surgery appears to have no benefit on cognitive or cardiac out comes after 5 years. *The Journal of American Medical Association*, *65,* 714-722.

George ,H., Hammon, J. W.& Kon, N.D.(2008). Risk factors and solutions for the development of neurobehavioral changes after coronary artery bypass grafting. *Annals of Thoracic Surgery*, *63,*1613-1618.

Gregg, E. & Brown, W. (1999). Is diabetes associated with cognitive impairment and cognitive decline among older women. *Archives of Internal Medicine,160,* 141-145.

Gregg, E.,& Kristine Yaffe.(1999). Diabetes associated with cognitive impairment and Cognitive decline. *Archives of Internal Medicine, 160,* 174-180.

Jonna, R.,Andrexej, K.& Tomarn, U. (2002). Depression and anxiety in Coronary artery bypass grafting patients. *Diabetes Care*, *20*, 585-590.

Josepch, S.,& Perring, X . (2008). Inflammatory genes linked to cognitive decline after heart Surgery.*The Journal of American Journal of Cardiology, 265,* 1104-1110.

Linden, D.V, Keijsers, P.J & Eling,P (2005).Work stress and attentional difficulties- An initial Study on burnout and cognitive failures. *Work and Stress*, *19,* 23-36.

Machann, B. (1997).Psychology in coronary care, The British Journal of Medical Psychology, *24,*359-370.

Mathews,B.,Neil, S. &James, B. (2003).The enhancing recovery in Coronary Artery Disease - Randomized trial. *Journal of American Medical Association*, *289,* 3106-3116.

Petrucci, R., Karen, C.& Carter, A. (1981).Cognitive Dysfunction in Advanced

Heart failure and Prospective Cardiac Assist Device. *Annals of Thoracic Surgery*, *81*, 1738-1744.

Saigeetha (2006). Cognitive functions of children with seizure disorder and normal children.*Unpublished Ph.D Thesis,* University of Madras, Chennai.

Sherry,L.Willis, & Sharon.(2006). Long term effect of Cognitive Training on every day functional outcomes in older adults. *Journal of American Medical Association, 296,* 2805-2814.

Speilberger, D.C., Gorsuch, R.I., Lushene, R.Vagg, & Jacobs, G.A.(1983).*State Trait Anxiety Inventory (STAI) Manual*, California, Mindgarden.

Thomas, R. & Karen, E. Peters. (2008). Physical activity and cognitive Functioning: Translating research to practice within a public health approach *Diabetes Care*, *31,* 233-235.

Todaro, C., Fennell, A. & Samuel, J. (1987).Use of heart pump during bypass surgery implicated in Cognitive decline. *The Issue of Neurology*, *87*, 532-542.

Wallace, J.C & Vodonvich, S.J. (2003). Work place safety performance: conscientiousness, cognitive failure and their interaction, *Journal of Occupational Health Psychology, 8,* 316-327.

Wechsler, (1997). *WAIS, Administration and scoring Manual*. San Antonio, Psychological Corporation, Harcourt Brace and company.

Wessels , A.M., Poumer, F., Gelhoed, P.H, & Snel, M. (2007). Evidence for cognitive failure in Type-I,II Diabetes-a cross sectional study , *Diabetes Medicine, 234,* 567-79.

Woolinsky, D., Frederick, W.,David, M & Richard Jones (2006). The active cognitive training trail and health related quality of life . *Journal of Gerontology Series, 61,* 1324-1329.

Received: January 17, 2009
Revision received: March 16, 2009
Accepted: November 26, 2009

Latha, PhD, Research Scientist-B, Department of Psychology, University of Madras, Chennai - 600 005.

R.P. Jaya Priya, Department of Psychology, University of Madras, Chennai-600 005.